ENVIRONMENTAL RISK FACTOR IDENTIFICATION AND ASSESSMENT OF HEALTH OUTCOMES ON SELECTED SUBJECTS IN AND AROUND THE VICINITY OF PETROL STATIONS IN ILORIN, KWARA STATE, NIGERIA

Abosede Hadizat LAWAL

Director of Studies
Professor George KARANI

Second Supervisor
Professor Daniel THOMAS

Thesis submitted to Cardiff Metropolitan University
in partial fulfilment for the degree of
Doctor of Philosophy
Cardiff School of Sport and Health Sciences

June 2022

DEDICATION

"To GOD ALMIGHTY the giver of life and my loving mother who believed in my dreams with her endless effort in making it a realisation"

ABSTRACT

In Nigeria, the number of retail petrol stations keeps increasing due to the lucrative petroleum market as a major fuel and economic capital source in the country. Therefore, assessing how the retail petrol station contributes to the health and environmental risks within the country is vital in ensuring the safety and well-being of Nigeria's population. Retail petrol stations are a major source of employment in Nigeria. These retail petrol stations sell petroleum products to customers, such as petrol, diesel, kerosene, and cooking gas. The study aimed to assess and identify health outcomes and explore the perception and awareness of health hazards related to retail petrol stations in Ilorin, Kwara State and those employed in the sector.

A sequential explanatory strategy mixed-methods approach was adopted in conducting this study. The research was carried out in two stages, i.e., the pilot and the main study phase. A quantitative survey and checklist were used to obtain information on the characteristics of Ilorin retail petrol stations and the sociodemographic characteristics of selected subjects employed at the retail petrol stations. Thirty-six operating retail petrol station was chosen for the pilot study. The thirty-six retail petrol stations in the pilot study were also used for the main study phase. Information and sociodemographic factors and quality of life were collected from 96 retail petrol station employees and a comparison group of 200 people within a university setting as representative of the general population. Quality of life information was collected using the SF-36 questionnaire. In the qualitative stage of the main phase study, in-depth interviews and focus groups were conducted to explore the perception and awareness of health and environmental risks associated with retail petrol stations. The interview was conducted with a retail petrol station manager and a public health officer. Three focus groups were conducted among six retail petrol station owners, seven retail petrol station attendants and 20 environmental health officers.

The study results show poor occupational health and safety management practices among the selected retail petrol stations and poor awareness and knowledge of health risks related to RPS among RPS owners. Potential factors responsible for the no statistically significant difference between the retail petrol station employees and the general population's quality of life in this study were also identified. The public and environmental health officers were aware of the health and environmental risks associated with RPSs. This study emphasises the need for policy amendment, increased awareness of environmental & health improvement, and collaborative partnership between stakeholders in tackling retail petrol stations related issues.

ACKNOWLEDGMENTS

ABBREVIATIONS

ABR	-	Art-Based Research
AIDS	-	Acquired Immune Deficiency Syndrome
API	-	American Petroleum Institute
ATSDR	-	Agency for Toxic Substances and Disease Registry
BP	-	Bodily Pain
BTEXs	-	Benzene, Toluene, Ethyl-Benzene, and Xylenes
CBPR	-	Community-Based Participatory Research
CDC	-	Centre for Disease Control and Prevention
CGQOL	-	Caregiver Quality of Life
CPI	-	Centre for Public Impact
DEFRA	-	Department for Environment, Food and Rural Affairs Development
DPR	-	Department of Petroleum Resources
E&P	-	Exploration and Production
ECHA	-	European Chemical Agency
EHO	-	Environmental Health Officer
EP	-	Environmental Pollution
EPA	-	Environmental Protection Agency
EW	-	Emotional Well-Being
FAO	-	Food and Agricultural Organisation
FG	-	Focus Group
FMCGs	-	Fast Moving Consumable Groups
GBD	-	Global Burden of Disease
GH	-	General Health
GPS	-	Global Positioning System
HBM	-	Health Belief Model
HEI	-	Health Effects Institute
HIV	-	Human Immunodeficiency Virus
HND	-	Higher National Diploma
HRQoL	-	Health-Related Quality of Life
IDSL	-	Integrated Data Services Limited

IEA	-	International Energy Agency
ILO	-	International Labour Organisation
IO	-	Indigenous Operator
IOC	-	International Oil Company
IPM	-	Independent Petroleum Marketer
IPMAN	-	Independent Petroleum Marketer Association
JV	-	Joint Venture
KWASU	-	Kwara State University
LFN	-	Laws of the Federation of Nigeria
LNG	-	Liquefied Natural Gas
MCS	-	Mental Component Summary
MDGs	-	Millennium Development Goals
MF	-	Marginal Field
MOMAN	-	Major Oil Marketer Association of Nigeria
MOS	-	Medial Outcomes Study
MPM	-	Major Petroleum Marketer
MSMEs	-	Micro Small and Medium Enterprises
NAPIMS	-	National Petroleum Investment Management Services
NCBI	-	National Centre for Biotechnology Information
NEED	-	National Energy Education Development
NGC	-	Nigerian Gas Company
NHP	-	Nottingham Health Profile
NIOSH	-	National Institute for Occupational Safety and Health
NNPC	-	Nigerian National Petroleum Corporation
NPDC	-	Nigerian Petroleum Development Company
OECD	-	Organisation for Economic Co-operation and
OHS	-	Occupational Health and Safety
		on Millennium Development Goals
OPEC	-	Organisation of the Petroleum Exporting Countries
		Organisation
OSSAP-MDGs	-	Office of the Senior Special Assistant to the President –
		Millennium Development Goals
PCS	-	Physical Component Summary
PF	-	Physical Functioning

PGWB	-	Psychological General Well-being Index
PHE	-	Public Health England
PM	-	Particulate Matter
PPE	-	Personal Protective Equipment
PPMC	-	Petroleum Products Marketing Company
PPPRA	-	Petroleum Products Pricing Regulatory Authority
PSC	-	Production Sharing Contract
PWC	-	PricewaterhouseCoopers
QoL	-	Quality of Life
QOL-DA	-	Quality of Life Scale for Drug Addicts
RCN	-	Royal College of Nursing
REW	-	Role of Emotional Well-Being
RPF	-	Role of Physical Functioning
RPS	-	Retail Petrol Station
RPSA	-	Retail Petrol Station Attendant
RPSE	-	Retail Petrol Station Employee
SC	-	Service Contract
SCM	-	Stages of Change Model
SCT	-	Social Cognitive Theory
SDGs	-	Sustainable Development Goals
SEM	-	Socio-Ecological Model
SF	-	Social Functioning
SF-12	-	Short-Form 12
SF-36	-	Short Form-36
SF-6D	-	Short-Form 6 dimensions
SF-8	-	Short-Form 8
SMEs	-	Small and Medium Enterprises
SQLS	-	Schizophrenia Quality of Life Scale
SR	-	Sole Risk
SSA	-	Sub-Saharan Africa
TPB	-	Theory of Planned Behaviour
TRA	-	Theory of Reasoned Action
TTM	-	Transtheoretical Model
U.S EIA	-	U. S Energy Information Administration

UKPIA	-	UK Petroleum Industry Association
UN	-	United Nation
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environment Programme
UNESCO	-	United Nations Educational Scientific and Cultural
UNFPA	-	United Nations Population Fund Agency
UNICEF	-	United Nations Children's Fund
UP	-	University Population
USAID	-	United States Agency for International Development
VOCs	-	Volatile Organic Compounds
VT	-	Vitality
WHO	-	World Health Organisation
WHOQOL	-	WHO Quality of Life
WWAP	-	World Water Assessment Programme

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The work environment is defined as an environmental condition in which an individual performs their tasks, i.e., work environment relates to everything around an employee during their work, whether physical or non-physical, that can affect the health and duty of the employee directly or indirectly (Pulungan, 2020; Sugiyanta *et al.,* 2021; Yusof, 2021). According to Nidaul Izzah *et al.* (2019) and Afandi and Ardiana (2021), the work environment can be categorised into a physical and non-physical work environment. The physical work environment is the conditions of the environment such as noise, temperature, air, lightning, workspace, layout, odour, colour, etc., around employees (Setyaningrum, Pawar and Pujiono, 2021; Simbolon and Oktafien, 2021). The non-physical work environment comprises all conditions related to relationships at work (relationship with work colleagues, relationships of superior with subordinates, and relationship of subordinates with superiors (Juliandra and Purba; Setyaningrum, Pawar and Pujiono, 2021). Both the physical and non-physical work environment influences the well-being, welfare, health, and productivity of employees either positively or negatively (Aisyah, Deswindi, and Indrajaya, 2020; Nuramalina and Cahyadi, 2021). Employers are shouldered with the responsibility of providing an appropriate and conducive working environment for their employees (Pulungan, 2020).

Employees of an organisation are an important human resource that aids the achievement of an organisation's goal (Hulls *et al.,* 2020). According to Pitchforth *et al. (*2020); Colenberg, Jylhä, and Arkesteijn (2021), the health and well-being of an employee are influenced by factors of the physical work environment such as office design, air quality, ergonomics, lighting, and noise. According to the World Health Organisation, the health of an individual is defined as the "state of complete physical, mental and social well-being and not just the absence of disease or illness" (Fallon and Karlawish, 2019). Despite the lack of a consensual definition of well-being, Huppert and So (2013), cited in Marsh *et al*. (2020), defined well-being as positive mental health. The well-being of an individual could be evaluated subjectively (a person's evaluation of the quality of their own life) and by objective criteria such as leisure time or the level of income (Sutton, 2020). Generally, the work environment is important to employees' work-life balance because it is symbolically considered a second home for the employee

(Saleem, Shenbei, and Hanif, 2020). Work-life balance is a term that reflects the balance of an employee's work, personal life, and family commitments (Sanchez-Hernandez et al., 2019). The balance between employee work, personal life, and family commitments does not refer to equality but rather the desired balance of the stated aspects at a point in an individual's life and career (Adkins and Premeaux, 2019).

Furthermore, the work or job characteristics of an employee within the work environment, such as skill variety, task identity, task significance, autonomy, and feedback, also influences the attitudinal and psychological conditions of the employee (Steyn and Vawda, 2014; Johari and Yahya, 2016; Senen et al., 2020; Matsuo, 2021; Yagil and Oren, 2021). The job characteristics, work environment, and employee motivation influence the employee's quality of work-life (Akar, 2018; Leitão et al., 2019; Nair and Subash, 2019; Younis et al., 2020; Leitão et al., 2021; Mulyana, 2021). An employee's quality of work-life is defined as an aspect of their overall quality of life affected by work. The components that affect employees' work-life quality include health hazards, working time and conditions, job security, payment mode for salary, etc. (Muindi and K'Obonyo, 2015; Klein et al., 2019). The quality of life of an individual can be defined as the quality of the physical and social environment in which individuals fulfil their personal needs and want (Power, 2020; Brown, 2021). The quality of life of an employee comprises lots of life aspects such as subjective well-being and health, the balance between personal life and work, etc., which depends on the culture of the organisation they work (Eurfond, 2017).

Due to the significant effect of the work environment on the employee's quality of work-life and work-life balance, the work environment is considered an important setting for health promotion due to its access to a large population of employees (Magnavita, 2018; Brogan et al., 2020; Pham et al., 2020). Workplace health promotion is defined as a collaborative effort by employees, employers, and the entire society towards improving the health and well-being of individuals at work and targets factors related to motivating, safe, and enjoyable workplace (Ejlertsson et al., 2018; Verra et al., 2019; Gorgenyi-Hegyes et al., 2021). The social welfare, economic, physical, and mental health of employees can be promoted in an organisation by health behaviour change, workplace health promotion, and environmental protection measures (Hsu et al., 2021). Workplace health protection is defined as the collaborative activities that protect employees from occupational illness and injury, ranging from basic safety training to the use of protective equipment and job organisation that improves workplace safety (Pescud et al., 2015). It is vital to promote and protect the well-being and health of employees because

it helps to produce a healthy workforce within any organisation, which in turn increases productivity and performance of the organisation (Hymel *et al.,* 2011; Day and Nielsen, 2017; Sorensen *et al.,* 2018; Fehér and Reich, 2020; Gorgenyi-Hegyes *et al.,* 2021).

This research highlights and discusses industries, especially the petroleum industry, as a potential source of environmental pollution that exposes the employees in the industry to risk factors that affect their health and well-being. Focusing on petroleum industrial-related environmental pollution and its health effects on employees in this industrial sector does not imply that other industrial sources of environmental pollution are less detrimental to human health or less of public health concern. Environmental pollution is a growing public health issue (Ajibade *et al.,* 2021). Environmental pollution is defined as the introduction of harmful substances into the environment (combination of microorganisms and living organisms known as the biotic components and the atmosphere, hydrosphere, and lithosphere, known as the abiotic components) (Manisalidis *et al.,* 2020). Environmental pollution (E.P.) and its associated detrimental effects on human health are considered a severe problem, making environmental pollution a global public health concern and an increasing area for research studies (Attademo *et al.,* 2017; Ajibade *et al.,* 2021). The effects of environmental pollution are not limited to human health but affect sustainable social and economic development (Dong *et al*., 2020). The industrial sectors are closely related to environmental pollution (Zhu and Xia, 2019; Hao *et al.,* 2020). Various environmental pollutants such as particulate matter, heavy metals, volatile organic compounds, ozone, sulphur dioxides, carbon monoxide, polycyclic aromatic hydrocarbons, and nitrogen dioxide are emitted from the complex industrial activities (El Bab and Jauregui, 2015; Eom *et al*., 2018; Kim *et al.,* 2020; Sbai *et al*., 2021; Wang *et al.,* 2021).

As part of the industrial sector, the petroleum industry is one of the significant sources of environmental pollution due to the wide consumption and use of petroleum products and their derivatives (Nigri *et al*., 2020). Several toxic substances harmful to human health and the environment are released from petroleum industry activities. The activities of the petroleum industry that causes the release of toxic compounds into the environment include crude oil production, oil refinery, petrochemical products, transportation, distribution, and storage of petroleum products (Raza *et al.,* 2019; Bodo and Gimah, 2020; Varjani *et al.,* 2020; Chenhao and Yupeng, 2021). Benzene, Toluene, Ethylbenzene, and Xylene, commonly known as BTEX, Volatile Organic Compounds (VOC), and Polycyclic Aromatic Hydrocarbons (PAHs), are common environmental pollutants released from petroleum activities into the environment

(Varjani *et al.,* 2018; Treviño-Reséndez *et al.,* 2021; Virdi *et al.,* 2021). Environmental pollutants from activities of the industrial sector like the petroleum industry enter the human body through ingestion, inhalation, or skin absorption causing detrimental effects such as cancer, acute bronchitis, asthma, leukaemia, chronic obstructive pulmonary diseases, neurological effects, eye and skin diseases (Alsbou and Omari, 2020; Lu *et al.,* 2020; Yousefian *et al.,* 2020; Aminiyan *et al.,* 2021; Dobaradaran *et al.,* 2021; Wang *et al.,* 2021; Wu *et al.,* 2021). According to research, employees working in petroleum industries are exposed to a significant level of various environmental pollutants such as BTEX, VOC, PAHs emitted from the industries which are harmful to human health (Al-Harbi *et al.,* 2020; Darwish *et al.,* 2020; Moridzadeh *et al.,* 2020; Mihajlović *et al.,* 2021; Qafisheh *et al.,* 2021).

1.2   Study Overview and Rationale

In Nigeria, the participation of independent marketers in the downstream sector of the petroleum industry has been enormous, especially in the marketing and sale of petroleum products, due to the increasing demands for petroleum products in Nigeria (Okonkwo *et al.,* 2014; Akankali and Elenwo, 2015). Thus, there has been an increasing number of retail petrol stations (registered facilities for the storage and sale of petroleum products such as gasoline, liquefied petroleum gas and dual-purpose kerosene to consumers) by independent marketers established for easy accessibility to consumers in different states across the country (Ambituuni *et al.,* 2014; Oloko-oba *et al.,* 2016; Abdullahi and Adedayo 2017; Odipe *et al.,* 2018). The RPSs in Nigeria are owned by both the government (the Nigerian National Petroleum Corporation (NNPC) and the private sector, including both the foreign and indigenous sectors. And they are regulated and monitored by the Petroleum Products Pricing Regulatory Authority (PPPRA), the Department of Petroleum Resources (DPR) and other government agents (Ehinomen and Adeleke, 2012). The indigenous sectors are made up of private independent petroleum marketers. There has been an increasing number of independent marketers since the scheme was introduced to the petroleum industry in 1978 (Ehinomen and Adeleke, 2012). The independent marketers owned about 19,000 out of 25,000 registered retail petrol stations in Nigeria (Udo, 2017).

The increasing number of RPSs has been a source of employment for many graduating youths, thereby reducing the unemployment rate and showing the beneficial factor of small and medium enterprises in Nigeria. According to the National Bureau of Statistics, 55.4 % of

Nigeria's youth population within the age group of 15-34years are unemployed or underemployed (National Bureau of Statistics, 2019). A large number of people are employed in the retail petrol station in various roles such as attendants, managers, drivers, and supervisors.

Although the retail petrol station in Nigeria plays a vital role in reducing youth unemployment, however, retail petrol station employees such as attendants are exposed to various work hazards (chemical, biological, physical, ergonomics and safety hazards) in their workplace (Hilpert *et al.,* 2015; Moro *et al.,* 2015; Tiu and Dubey, 2017; Zoleikha *et al.,* 2017; Iyanda, 2018; Johnson and Umoren, 2018; Moghadam *et al.,* 2020). As briefly highlighted in the introduction, the environment in which an individual carries out their tack or job plays an important role in the general well-being and quality of life. Employees who help with sales and refuelling vehicles with petrol & diesel (leaded and unleaded) and other petroleum products daily to the customer at retail petrol stations in developing countries are commonly called attendants/ petrol attendants (Moolla *et al.,* 2015). Retail petrol station attendant (RPSA) is exposed to health hazards through skin contact and inhalation of different toxic chemicals from the gasoline, which has been associated with both mild (headaches, dizziness, throat irritation, vomiting, confusion, breathing difficulties, and nausea). And serious health problems (blood cancer, neurological damage, impotence, hypertension, and anaemia) (Abou-ElWafa *et al.,* 2015; Monney *et al.,* 2015; Awasthi, 2016; Alsbou and Omari, 2020; Lu *et al.,* 2020; Yousefian *et al.,* 2020; Aminiyan *et al.,* 2021; Dobaradaran *et al.,* 2021; Wang *et al.,* 2021; Wu *et al.,* 2021). Vapours released during gasoline loading, refuelling, and combustion from moving vehicles are sources of volatile organic compounds, especially BTEX. BTEX is the group of VOCs hazardous for non-occupational or occupational exposure when inhaled (Al-Harbi *et al.,* 2020).

Baghani *et al.* (2019) reported elevated BTEXs concentration around RPSs. Oil and gas industry employees are exposed to high levels of BTEX (Moridzadeh *et al.,* 2020). Retail petrol station employees are exposed to and affected by the combination of air pollutants and solvents present in their work environment. VOC (volatile organic compounds) causes severe damage to the health of workers due to its classification as an associated human intoxication hazard (Al-Harbi *et al.,* 2020). Exposure to BTEX has been recognised as a serious health problem for various occupations. It is associated with different human health problems such as kidney and liver failure, memory loss, headaches, insomnia, cardiac damage, respiratory diseases, and neurological damage (de Deus Honório *et al.,* 2020; Temam *et al.,* 2020). Retail petrol station employees are occupationally exposed to BTEX, a risk factor associated with miscarriage in

female RPSA, and chromosomal abnormalities are found in RPS employees exposed to BTEXs (Silvestre *et al.,* 2020). Retail petrol station employees are also exposed to physical risk factors such as exposure to extreme temperature, noise pollution from generators and vehicles, and biological risk factors like fungi, bacteria, viruses, etc., from various interactions with people. The psychological risk factors exposed to retail petrol station employees include violence, repetitive movement patterns, etc. The physical, biological, chemical, and psychological risk factors could create or increase occupational accidents and diseases that could endanger the life and health of RPS employees (Cezar-Vaz *et al.,* 2012).

In addition, the factors that influence people's quality of life are not only limited to work-related risks and exposures (e.g., job stress) but also include lifestyle factors and demographic factors such as gender, age, marital status, education attainment and sleep pattern or duration (Rabanipour *et al.,* 2019). The working population are a key element of a nation's economy, and employees are key assets to organisations' success; therefore, it is important to ensure the health and well-being of the entire population to promote good quality of life. Hence, it is necessary to assess and evaluate the quality of life as an important health indicator among the workforce in various organisations. This study focuses particularly on employees in retail petrol stations in Nigeria.

The federal republic of Nigeria is a western African country sharing boundaries with Benin in the West, Niger in the Northwest, Chad in the Northeast, and Cameroon in the East (Anyanwu and Okoye, 2017). At the south-eastern edge of the West African region lies Nigeria between 4°N, 3°E, and 14°N, 15°E. Nigeria's area size is 923,768 square Kilometres with a total of 853 kilometres of coastline near the Gulf of Guinea (Library of Congress, 2008). Nigeria gained its independence in 1960 (Sohn, 2020). The five major topographical regions in Nigeria are the low coastal zone on the Gulf of Guinea; mountainous areas beside the eastern border, including the country's highest point, the Chappal Wadi (2419 meters); a stepped plateau that extends to the northern border with more than 1,200 meters in sea level; hills and plateaus to the north of the coastal zone; and Niger - Benue River Valley (Library of Congress, 2008). Nigeria is a populous country known for its religious, ethnic, and cultural diversity (World Bank Group, 2019). Abuja is the capital of Nigeria, and it is located in the Northcentral zone of the country (Lifongo *et al*., 2014). Figure 1.1A shows the outline of the map of Africa on the World Map. Figure 1.1B shows the outline of Nigeria's map on Africa's map. Figure 1.1C shows the Nigeria map with the location of its 36 states. Nigeria operates on a federal system of government (Antom, 2021). Constitutionally a federal government system requires a country to be divided

between a governing authority and constituent geopolitical units (Obidimma and Obidimma, 2015; Emmanuel and Olaniran, 2020). Therefore, Nigeria is divided into thirty-six states with a federal capital territory, according to the Federal Republic of Nigeria's 1999 constitution (Obidimma and Obidimma, 2015; Antom, 2021). Lagos, the former capital of Nigeria, is ranked the largest city in Sub-Saharan Africa and the most populous city in Nigeria, with about 9 million people (Okolie *et al.*, 2017; Varrella, 2020b). The climate in Nigeria varies from arid in the Northern region to tropical in most other areas of the country (United States Agency for International Development (USAID), 2012). Furthermore, the country's climate is characterised by dry (Harmattan) and rainy (wet) seasons (Sufiyan *et al.,* 2020). The rainy season is caused by the air mass from the South Atlantic Ocean (Tropical Maritime Air Mass), while the dry season is caused by the dust-laden air mass origination from the Sahara Desert (Tropical Continental Air Mass) (Eludoyin and Adelekan, 2013).

Figure 1.1A. World map (Worldatlas, 2021); Figure 1.1B. Map of Africa (Fakunle, 2013); Figure 1.1C. Map of Nigeria (Nigeria High commission, 2021)

1.2.1   Nigeria Population and Workforce

Nigeria is one of the nine most populated countries globally, with an estimated population of about 206 million people in the year 2020 (World Bank Group, 2019; Varrella, *2020a*). Fifty per cent of Nigeria's population is aged under 19 years, and a small percentage (2.7%) of people are aged 60 years and above (United Nations Population Fund (UNFPA), 2020; Varrella, *2021)*. Across the world, Nigeria has one of the youngest populations and is ranked 18th with the lowest median age in the whole of the world and Africa (Varrella, *2021).* In 2019, 49.3% of Nigeria's population were female, while 50.7% were male (World Group, 2019a; World Group, 2019b). Nigeria comprises about 374 ethnic groups speaking about 250 languages (Okolie et al., 2017). According to the World Bank data, the country's total labour force in

2020 was 62,242,745 (World Bank Group, 2021). Nigeria's labour force comprises people aged 15 to 64 years who are employed and unemployed but actively looking for jobs. The country's labour participation rate among this age group was 53.4 percent in 2020 (Plecher, 2020; Trading Economics, 2021). According to the Nigeria National Bureau of Statistics (2021), Nigeria had unemployment, underemployment, and youth unemployment rate of 33.3%, 22.8%, and 42.5%, respectively, in 2020.

1.2.2   Nigeria Resources

Nigeria is abundantly blessed with natural resources, including limestone, coal, zinc, lead, iron ore, tin, niobium, arable land, crude oil, and natural gas. The country's economy is highly dependent on crude oil. Presently, about 86 per cent of all Nigeria's export revenue is made from petroleum export (Ogunleye, 2008; Organisation of the Petroleum Exporting Countries (OPEC), 2021). In Nigeria, over 40 different solid mineral resources exist in an estimated number of 450 locations, but most of these resources are present in tiny amounts or with no commercial prospects (Olade, 2019). In addition, the discovery of crude oil and over-dependence on petrol revenue in Nigeria led to the negligence and continuous rapid decline of the solid mineral industry in the past decades. But the mining industry has been experiencing a constant revival with growing expectations (Merem *et al.,* 2017).

1.2.3   Petroleum Industry in Nigeria

Production of crude oil in Nigeria commenced at about 5000 barrels per day (BPD) in 1958, two years after its discovery in commercial quantity by Shell Petroleum in 1956 (Adewusi,1998; Aigbedion and Iyayi, 2007). The status of Nigeria as a crude oil-producing nation was confirmed following crude oil discovery in Bonu and Afam after the initial discovery in Oloibiri in the Niger delta (Aigbedion and Iyayi, 2007). The discovery and production of crude oil in Nigeria led to an influx of multinational exploration and production companies such as Texaco, Agrip, Chevron, formerly known as Gulf, Mobile, and Elf, formerly known as Safrap, in the early sixties. They were later joined by other companies such as Great Basins, Japan petroleum, Occidental, Ashland, Phillips and Deminex (Adewusi,1998). Therefore, the oil industry in Nigeria became the backbone of the country's economy, producing an estimated 2.5 million barrels of crude oil per day. The state of Nigeria was given

ownership and control of oil and gas natural resources according to the amended petroleum act in 1969 (Fajana, 2005).

In addition, Nigeria became a member of OPEC (Organisation of the Petroleum Exporting Countries) in 1971 (U.S Energy Information Administration (U.S EIA), 2016). Furthermore, because of the high quality of the crude oil produced due to its low sulphur contents, the petroleum industry in Nigeria invites a lot of investment annually (Ogri, 2001). Developed countries also desired Nigeria's crude oil because it is easier to refine into jet fuel or petrol than other crude oil. In addition, varieties of sweet and light crude oil grades like the Escravos Beach and Bonny light were produced in Nigeria (Wapner, 2017). According to Fajana (2005), Nigeria had a proven and possible reserve of about 24 billion and 80 billion barrels, respectively; the country was recognised as the sixth-largest producer of crude oil in the world. In 2015, Nigeria was identified as the fourth largest exporter of liquefied natural gas (LNG) globally and Africa's largest crude oil producer, according to the U.S Energy Information Administration (U.S EIA) report on Nigeria country analysis (U.S EIA, 2016). While in 2018, Nigeria was ranked the fifth largest exporter of LNG in the world and the second-largest proved crude oil reserve in Africa at the end of 2019, with approximate 37.0 billion barrels of crude oil (US EIA, 2020). Nigeria produced approximately 2.0 million barrels per day in 2019 but signed an agreement as an OPEC member to reduce its production to 1.41 million barrels per day in 2020; this agreement ends in April of 2022 (US EIA, 2020).

The petroleum industry in Nigeria is classified into the upstream and downstream sectors (Aigbedion and Iyayi, 2007). The upstream sector deals with crude oil exploration and production activities, while the downstream sector deals with refining, distributing, and marketing petroleum products to end-users (Godfrey and Oritsematosan, 2015). Exploration of oil and gas resources in the upstream sector by oil companies in Nigeria occurs both offshore and onshore (Oti and Mbu-Ogar, 2018). Figure 1.2 shows the institutional regulatory structure of the upstream, downstream, and service provider monitoring and regulation in Nigeria by the Department of Petroleum resource that regulates the operation of the oil and gas industry in Nigeria. In the upstream operation monitoring and regulation, the DPR regulates the Nigerian National Petroleum Corporation, which oversees the operation of Integrated Data Services Limited (IDSL), Joint Venture (J.V.), Nigerian Petroleum Development Company (NPDC), and Production Sharing Contract (PSC). The DPR regulates and monitors the International Oil Company's (IOC) Joint Venture (J.V.), Production Sharing Contract (PSC), and Service Contract (S.C.). Also, the DPR monitor and regulate the operation of Indigenous Operators

(I.O.), Sole Risk (S.R.), Production Sharing Contract (PSC), and Marginal Field (M.F.). The Department of Petroleum Resources regulates the operation of the Nigerian National Petroleum Corporation, which comprises the Refineries, Nigerian Gas Company (NGC), and Petroleum Products Marketing Company (PPMC). In the downstream operation monitoring and regulation, the DPR also regulates the operation of Major and Independent Marketers. The DPR regulates the special, major, and special categories under service provider monitoring and regulation (DPR, 2017).
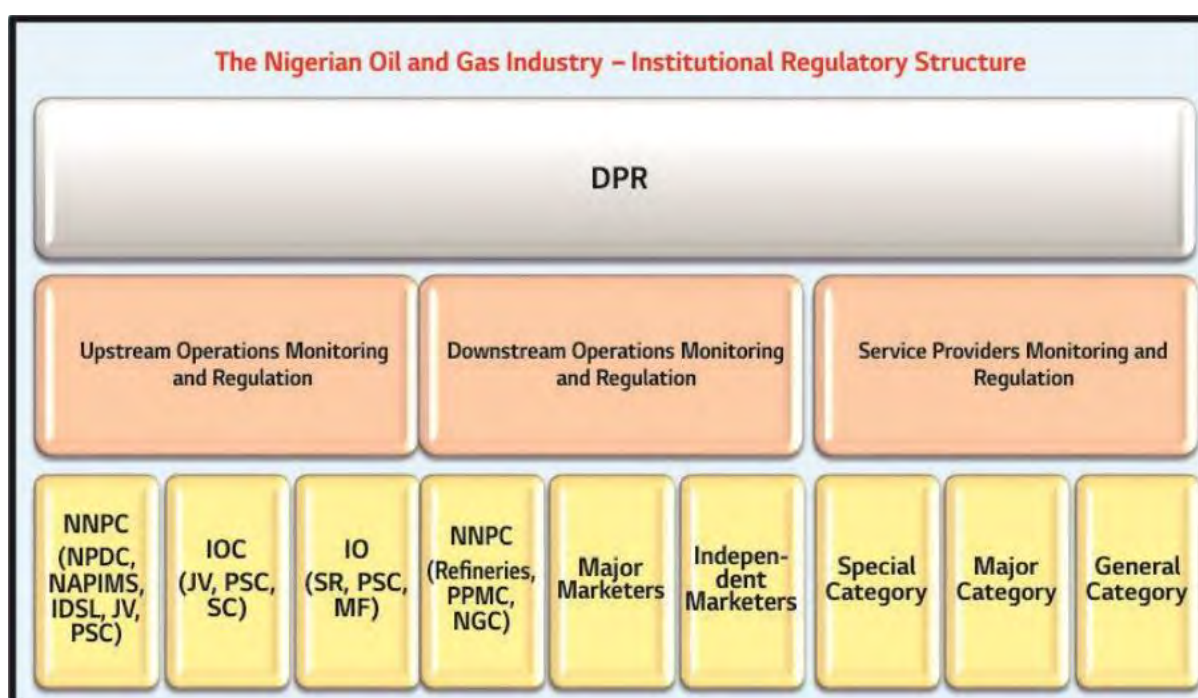
Figure 1.2. Nigerian oil and gas regulatory agency structure (DPR, 2017)

1.2.4   Retail Petrol Station (RPS) as a Small and Medium Enterprises in Nigeria

There is little accommodation for small and medium enterprises (SMEs) in Nigeria's oil and gas industry (Aigboduwa and Oisamoje, 2013). However, the retail petrol stations in the downstream sector of the oil and gas industry are categorised as small and medium enterprises based on the number of employees, which is less than 300, according to Nigeria's definition of SMEs in Oyedokun and Micah (2019). The indigenous sector of the petrol industry in Nigeria is made up of independent petroleum marketers. There has been an increasing number of these independent marketers since the scheme was introduced to the petroleum industry in 1978 (Ehinomen and Adeleke, 2012). The National Policy defines small and Medium Enterprises

(SMEs) or Micro Small and Medium Enterprises (MSMEs) as businesses with less than 250 employees and less than five hundred million Naira turnover per annum (Osunde, 2016; Bank of Industry, Nigeria, 2018). The SME sector is known for performing a vital role in the world's economy (Kot, 2018). By ensuring diversification and growth of industrial production and achieving the main development goals, the SMEs can act as a driving force for industrial and economic development. In addition, SMEs make up a large proportion of business in almost all countries globally, and it creates the majority of jobs and outputs in the private sector (Yunusa and Paul, 2018). Despite the presence of various natural resources in Nigeria, the country is still confronted with challenges of high youth unemployment, recession, and deteriorating oil revenues, among others. These challenges have highlighted the critical need for expansion and revitalisation of the country's economy hence the need for SMEs, which is considered a vital tool for expansion and revitalisation of a country's economy (Emmanuel, 2017).

Across the world, a continuous popular phrase in the history of economic development is small and medium enterprise. Therefore, both developing and developed countries have active engagement in achieving realistic, practical methods to improve SMEs' activities and processes (Oyedokun and Micah, 2019). SMEs are defined in terms of workers as an enterprise with not more than 300 and not less than ten employees and an enterprise that employs less than 300 people and operates with less than 200 million Naira worth of assets (Oyedokun and Micah, 2019). Different definitions have also been given to SMEs in Nigeria at other times. SMEs is defined differently in various sectors across different part of the world. Still, quantitative measures such as the annual sales turnover, number of employees, asset value, and investment expenditure of an enterprise are referenced in the various definition of SME. In addition, the different definition of SMEs has common characteristics that SMEs are limited in some specific capacity which varies from academic fields, time interval, professions, countries and so on (Muriithi, 2017; Ayo-Balogun and Ogunsanwo, 2020).

A small and medium enterprise is the most common sector of Nigeria that has been in existence for a long time, and it constitutes a larger percentage of registered companies in Nigeria (Yunusa and Paul, 2018). SMEs in Nigeria have generally contributed to employment, improvement of people's social welfare, enhancement of human development, and poverty alleviation (Agwu, 2018; Yunusa and Paul, 2018). Despite the contribution of the SMEs sector in Nigeria, this sector is confronted by various financial and non-financial challenges (Osotimehin *et al.,* 2012). The central element for SMEs' growth strategy in Nigeria should

be made up of the implementation of strategic management practices, according to Adeyemi *et al.* (2017) cited in Agwu (2018).

In Nigeria, SMEs are known to employ and utilise more workforce than large enterprises, and they are recognised as a development platform for indigenous entrepreneurship (Agwu, 2018). According to Muriithi (2017) and Orogbu *et al.* (2017), SMEs accounts for 95% of the manufacturing sector and 70% of the industrial job in Nigeria. The role of SMEs in rural and urban development in Nigeria cannot be underestimated hence the development of various policies that encourage the growth of SMEs in the country (Obi, 2015). Small and medium enterprise in Nigeria is considered drivers of the economy because of their contribution to the growth and performance in agriculture, manufacturing, and other business sectors (Abeh, 2017). Rural-urban migration is also reduced within Nigeria due to the easy process of setting up SMEs with minimal managerial skills and capital (Abeh, 2017).

SMEs are reported as an important sector that has significantly contributed to different sectors of the Nigerian economy, and SMEs are responsible for 70% of the labour force employed in the country (Gumel, 2017; Kowo *et al.,* 2019; Muhammad and Rana, 2020). SMEs in Nigeria account for 96% of the country's businesses and contribute an estimated 48% of Nigeria's national gross domestic product (GDP) (PwC, 2021). The functions of SMEs in the smooth operation of any country's economy are essential because it ensures accurate and adequate delivery of goods during and after public emergencies. Furthermore, SMEs play a crucial part in local employment, social inclusion, and innovation in rural areas (Aladejebi, 2020).

In addition, due to the result in the increasing rate of unemployment in Nigeria, there has been a growing interest and promotion of the role of entrepreneurs in economic growth and job creation in society. Over the years, the importance of small and medium enterprises has been seen in Nigeria's economic development (Akinyemi *et al.,* 2018). Oyelola *et al.* (2013) and Asogwa & Dim (2016) states that entrepreneurship has been of great benefit leading to the establishment of small and medium enterprises that provide various forms of employment opportunities to more than fifty per cent (50%) of the population. The slight reduction in Nigeria's unemployment has also been associated with the engagement of forty-five to sixty per cent of the urban labour force in small/medium businesses, including retail petrol stations.

Increasing RPSs has led to high market competition among owners leading to non-adherence to government guidelines in siting RPSs. The inability of the government to stop the encroachment of people in building shops and residential accommodation close to pre-existing

RPSs have led to the location of RPSs close to shops, banks, markets, hospitals, and residential buildings (Mshelia *et al.,* 2015; Odipe *et al.,* 2018; Paul, 2021). The siting location of petrol stations is determined by various factors such as accessibility, local government approval, and marketability (Abdullahi and Adedayo, 2017; Paul, 2021). Although the increasing number of RPSs has led to job creation, the competition among RPS owners has also led to violation and non-adherence to government guidelines for locating retail petrol stations that state:

- Retail petrol stations should be sited in convenient locations that do not cause nuisance and unacceptable risks to adjacent users.

- RPS should be sited in a very spacious land area of two plots or a minimum of 1200 square meters.

- To avoid the wastage of resources of any investment used in setting up RPS, proper feasibility studies should be thoroughly carried out.

- RPS should be easily accessible by vehicles without passing through local streets in high-density residential and /or commercial areas.

- RPS should be at a minimum of 30 meters and 7meter setback from any residential building.

- RPS should not be close to or around public assembly places such as churches, schools, hospitals, town halls, stadiums, mosques, offices, etc.

- RPS should be located at a minimum of 152 meters from any public assembly.

- RPS must be sited at least 400 meters away from any existing or approved RPS on the same side of the road.

- The RPS nearest pump should not be less than 15 meters to the edge of the road.

- The RPS drainage should not go into rivers or streams (DPR, 2018; Yunus, 2019; Adewuyi, 2020; Ulasi and Uwadiegwu, 2020).

1.2.5 Safety Practices in Retail Petrol Stations in Nigeria

Due to the high risks associated with petroleum operation, risk management is essential in preventing economic losses, environmental pollution, and accidents in the petroleum industry.

Therefore, the establishment and implementation of risk management procedures according to the characteristics of petroleum operations are significant (Tsiga and Tsiga, 2018). Both the upstream and downstream sectors of the petroleum industry pose risks to human health, safety, and the environment (Ambituuni *et al.,* 2014). Therefore, to prevent hazards that could affect the environment and human health, safety practices in RPSs by customers and service providers remain crucial (Afolabi, 2011).

In terms of safety standards, RPSs owned by major petroleum marketers (conglomerate) is better than RPSs owned by independent petroleum marketers (private). Lack of adequate staff training, accident, and fire safety equipment maintenance are observed among RPSs owned by independent petroleum marketers (Ahmed *et al.,* 2014). In general, retail petrol station attendants had good but limited knowledge of safety measures, according to the study carried out by Ahmed *et al.* (2014). In Ifeyinwa *et al.* (2016) study conducted among RPSA in Owerri, Nigeria, most retail petrol station attendants work without shift and do not use PPE at work. The findings of Okafoagu *et al.* (2017) show that a high percentage of RPS employees in the study were aware of workplace safety practices and the need for personal protective equipment. According to Johnson and Umoren's (2018) study in Uyo state Nigeria, poor awareness of any type of PPE and its usage, availability of first aid boxes, and hand hygiene practice were reported among the RPSAs, particularly those working in independent petroleum marketers owned stations. The reported finding in Moke (2019) study carried out in Delta state Nigeria shows that the RPSA in the survey used PPE and had a good level of adherence to safety practices, but the use of protective nose masks at work was poor among RPSAs through observation. Also, low PPE usage among RPSAs despite their good knowledge of one or more types of PPE was reported in Emokpae *et al*. (2020) study carried out among RPSA in Benin city, Nigeria. Chineke *et al. (*2016) study conducted among workers in RPSs in Imo state Nigeria reported that PPE is provided in the RPSs but in limited quantity, which may be the possible reason for poor usage of PPE among RPSE.

Safety practices and safety measures are essential in retail petrol stations because it helps in the knowledge of the harmful effect and dangers relating to petroleum products and assesses people's appropriate attitude and beliefs about associated health risk exposure (Okafoagu *et al.,* 2017). Educating and training retail petrol station attendants to provide adequate knowledge of hazards related to petroleum products and their work is vital in maintaining good standard safety practices at retail petrol stations (Emokpae *et al*., 2020). Uko *et al.* (2015) emphasise the need for an increase in the advocacy to encourage PPE use by RPSE at work and adopt control

measures to reduce exposure to petroleum products at the workplace. Hence the rationale and justification for evaluating the quality of life of employees in retail petrol stations, a sector of the oil and gas industry that contributes the most to Nigeria's economy.

1.2.6   Occupational Health and Safety Practises in Nigeria

Despite the availability of occupational health and safety policies in Nigeria, there is still an increase in Nigeria's work-related fatalities. In addition, the accurate figure for work-related fatalities is hard to come by in Nigeria due to the inaccuracy of data and the unavailability of occupational health and safety (OHS) databank (Abubakar, 2015). Occupational health and safety is described as a cross-disciplinary area that deals with the protection of health, safety, and wellbeing of engaged individuals in an employment or occupation (Khan *et al*., 2014). Occupational health and safety protect not only workers but also provide protection to employers, suppliers, family members, co-workers, and members of the public affected by a workplace environment (Idubor and Oisamoje, 2013). Also, OHS is considered an important issue legally, economically, and morally (Friend and Kohn, 2018). Enforcement and compliance with OHS law in Nigeria are poor despite being an industrialising economy (Idubor and Oisamoje, 2013). Nigeria's government passive and permissive attitude towards employers who do not adhere to health and safety laws even when their negligence leads to death is a major concern. In addition, the deterioration of millions of workers and their families'working and living conditions in Nigeria are associated with rampant corruption and greed and poor management in several sectors of the country (Ngwama, 2016). Some other contributing factors to occupational health and safety infringements in Nigeria, according to Idubor and Oisamoje (2013) and Adeyemo and Smallwood (2017), includes weak legal structures, lack of strict judicial references, bribery, low educational level of the workforce, unemployment, lack of corporate accountability and responsibility, lack of political will, weak national OHS standards, funding challenges, inadequate staff training, shortage of professional labour, undemocratic and repressive human rights record, and cultural dimension. In addition, Umokafor and Isaac (2015) reported that the regulatory activities of health and safety regulators in Nigeria are based on deterrence theory, thereby associating challenges to their operation to factors such as political influence, inadequate legislation, and logistic problems. The operation of occupational health and safety inspectors is highly influenced by politics, where sanctions on offending organisations are dismissed by the word quote "order from above". Therefore, the health and

safety inspectors try to avoid workplaces or organisations owned by politicians or influential people during inspection for c health and safety compliance (Boadu *et al.,* 2021).

Furthermore, the lack and inadequate/poor OHS practice and management in the different occupational groups in Nigeria, such as construction, agriculture, timber industry, petrol industry, etc., have been reported in several studies (Adeoye *et al.,* 2015; Diwe *et al.,* 2016; Adeyemo and Smallwood, 2017; Okoye, 2018; Idungafa and Charles, 2019; Johnson and Etokidem, 2019; Ekong *et al.,* 2020; Omolekan, 2021). Therefore, workers in various occupational sectors in Nigeria are subjected to different risks and hazards ranging from minor to fatal, leading to loss of vital body parts, causing disability, and even loss of lives (Adesola *et al.,* 2021). Although compliance with OHS laws and regulations is important to the improvement of OHS, organisational culture and enforcement are also identified as vital in improving occupational health and safety, according to Umeokafor *et al.* (2014).

1.2.7 Occupational Health and Safety Legislation in Nigeria

Nigeria, like other countries, has its laws relating to the health and safety of its workforce, and the major laws include the Factories Act, CAP F1, Laws of the Federation of Nigeria (LFN), 2004; Employee's Compensation Act, 2010; Nigerian Minerals and Mining Act, 2007; and Nigerian Nuclear Safety and Radiation Act, 1995 (International Labour Organisation (ILO), 2017). Other laws that give guidance to the application of OHS in Nigeria include Nigeria Basic Ionising Radiation Regulations, 2003; Nigerian Radiation Safety in Nuclear Regulations, 2006; Minerals Oils (Safety) Regulations, 1962; Petroleum (Drilling and Petroleum) Regulations, 1967; National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, 2007; Lagos State Safety Commission Law, 2011 (ILO, 2017). Furthermore, Nigeria also adopted the ILO recommendations and convention as a United Nations member (Idubor and Oisamoje, 2013).

The Factories Act development and transformation journey started as the British Factories Act of 1937, which was amended in 1948, followed by the Factories Ordinance in 1956, amended in 1958, Legal Notice No. 57 of 1961 (Factories Act, 1958), Factories Decree No. 16 of 1987, Factories Act, 1990, Chapter 126, Vol. VIII, LFN 1990 and finally, Factories Act, CAP F1, LFN 2004 (ILO, 2017). The Factories Act part II, III, IV, and V deal with workers' health, safety, and welfare. The act also deals with the investigation of accidents, offences, penalties, legal proceedings, and empowerment of inspectors in cases (Adeyemo and Smallwood 2017).

Employee's Compensation Act, 2010 makes provisions in terms of industrial accident for compensation for injuries of temporary nature, injuries leading to disability, and compensation to a dependant for the death of an employee. This law covers all employees working in civil or public service, private organisations, and the Nigerian police but excludes any employee working in the public sector outside Nigeria and not a Nigerian citizen and members of the armed forces, other than people working in a civilian capacity (Ngwama, 2016).

Nigerian Minerals and Mining Act, 2007 regulates and coordinates all mineral mining in Nigeria and assigns the ownership and control of all Nigeria mineral resources (Musa, 2020). This act also gives the property rights of all mineral resources gotten in Nigeria to the Nigeria Government on behalf of the people (Okoronkwo, 2017).

Nigerian Nuclear Safety and Radiation Act, 1995 is "*An act that establishes the Nigerian Nuclear Regulatory Authority whose functions shall include the control and regulation of the use of radioactive substances, material, equipment, emitting and generating ionising radiation*" (Food and Agriculture Organisation (FAO), 2021). The Nigerian Nuclear Regulatory Authority became operational in 2001 (Ejiogu, 2013).

1.2.8   Occupational Health and Safety Management at Enterprise Level in Nigeria

Both the small-medium enterprise and large cooperation in Nigeria adopt occupational health and safety management systems to preserve the health, safety, and wellbeing of their employees and comply with national and international statutory laws, regulations, and policies. Aviation, Marine, Oil and Gas, Construction, and the Fast Moving Consumable Groups (FMCGs) sectors of the Nigerian economy generally adopt the OHS management system. The majority of the large organisations, especially multinational companies, develop an in-house, industry-specific OHS management system. In contrast, most small-medium enterprise in Nigeria relies on the Factories ACT in the application and practice of OHS in their organisation (ILO, 2017).

1.2.9   Progress Towards Sustainable Development Goal in Nigeria

Nigeria embraced the Millennium Development Goals (MDGs) like other United Nations (U.N.) member countries. Still, it could not meet up with most of the MDGs target by the end of 2015, which was achieved by smaller countries in Africa such as Botswana, Cameroun, Ghana, and Kenya (Durokifa and Abdul-Wasi, 2016; Ukoette *et al.,* 2020). The Millennium

Development Goals comprises eight goals agreed by all U.N. member countries in 2000 to be achieved by 2015. World leaders were committed through the declaration to combat disease, poverty, illiteracy, discrimination against women, hunger, and environmental degradation (WHO, 2018; WHO, 2021; United Nations Development Programme (UNDP), 2021a). The eight MDG goals include:

1. Eradicate extreme poverty and hunger

2. Achieve universal primary education

3. Promote gender equality and empower women

4. Reduce child mortality

5. Improve maternal health

6. Combat HIV (Human Immunodeficiency Virus) and AIDS (Acquired Immune Deficiency Syndrome), malaria, and other diseases

7. Ensure environmental sustainability

8. Develop a global partnership for the development

Although, the MDGs were relatively successful in Sub-Saharan Africa (SSA). Several countries in Sub-Saharan Africa, including Nigeria, recorded progress and improved performance in achieving their MDGs (Durokifa and Abdul-Wasi, 2016). The best record of improvement in primary education was recorded in SSA, with a 20% increase in its education enrolment rate from 2000 to 2015 (U.N., 2015). Nigeria made considerable progress in the achievement of MDGs, especially in reducing maternal death and reducing the percentage of people living in absolute poverty by half. Also, in achieving gender equality in education, universal primary education enrolment, and reducing the spread of HIV and AIDS (Office of the Senior Special Assistant to the President on Millennium Development Goals (OSSAP-MDGs), 2015).

Concerning MDG 1, Nigeria missed the target, but there was a 66% reduction in hunger by 2012, which earned the country an international recognition by Food and Agricultural Organisation (FAO) in 2013 (OSSAP-MDGs, 2015). Progress in universal basic education was made, but the effective track of progress due to changes in reporting format and ineffective monitoring has been a significant problem in measuring Nigeria's progress in universal basic education towards the achievement of MDG 2 (Centre for Public Impact (CPI), 2017). Among

118 countries in UNESCO's Education for All, which accounts for adult literacy, gender quality, universal basic education, and quality of education, Nigeria was ranked 103 as of 2015. The enrolment rate for primary education level was reduced by 4%, but there was a 130% increase for secondary education from 2000 to 2013 (CPI, 2017). In pursuit of gender equality in Nigeria's basic education, there was a steady increase in the ratio of girls to boys, with a significant increase from 82% in 1991 to 94% in 2013 (Adeyeye and Ighorojeh, 2019). Also, the record shows that women's contributions to the total labour force in both the non-agricultural and agricultural sectors in Nigeria increased significantly by 37.7% in 2014. However, Nigeria has not done well in terms of the percentage of women in wage employment in the non-agricultural sector and the percentage of seats held by women in the Nigeria National Parliament as of 2015 (Adeyeye and Ighorojeh, 2019).

The national average mortality of children under five years in Nigeria was reduced from 213 deaths per 1000 live births in 1990 to 104 deaths per live birth in 2015(Ogbuoji and Yamey, 2019). The reduction in national mortality of children under five years signifies significant progress towards the MDG 4. Still, the progress was not enough, and Nigeria failed to meet the MDG 4 target in 2015 (Ogbuoji and Yamey, 2019). According to OSSAP-MDGs (2015), the maternal mortality rate in Nigeria was reduced from 1000 deaths per 100,00 live births in 1990 to 234 deaths per 100,000 live births in 2014. However, Nigeria still lags behind the 2015 target of 250 per 1000 live birth despite the progress (Sarwar, 2015). Stabilised rate of 4.1% for Nigeria's national HIV/AIDS incidence and the evidence of wide disparities across gender and states in Nigeria was recorded in the UN MDG report (Sarwar, 2015). No si0gnificant improvement was made in Nigeria towards access to safe water and sanitation and other environmental issues such as climate change, coastal flooding, and erosion (MDGs (Nigeria), 2010). Therefore, Nigeria was off the track for 2015 targets and failed to achieve the MDG 7 targets (Sarwar, 2015). Regarding MDG 8, Nigeria performed better than other MDGs, and the target was achieved (OSSAP-MDGs, 2015).

Although the majority of the MDGs were not met in Nigeria in 2015, the country ceases no effort to achieve beyond these goals, which led to the proposed Nigeria vision 2020 and the adoption of the post-2015 Development Agenda (Sustainable Development Goals) (SDGs)) (Odunyemi, 2015). Some limiting factors attributed to the inability of Nigeria to meet the MDGs include lack of transparency and accountability, recurring financial crises, poor governance, insurgencies, corruption, policy inconsistency, and lack of appropriate reporting

database (Olabode *et al.,* 2014; Durokifa and Abdul-Wasi, 2016; Oleribe and Taylor-Robinson, 2016; Sakanko and David, 2018; Ukoette *et al.,* 2020).

The MDGs and SDGs are both adopted in Nigeria, and the country's government affirms the support of the SDGs programme to avert the repetition of failures that occurred during MDGs processes (Akinloye, 2018). The SDGs, also known as the Global Goals, is the post-2015 development agenda adopted by all U.N. member countries in 2015 (Ogu *et al.,* 2016; UNDP, 2021b). The SDGs go beyond the MDGs (WHO, 2015). The SDGs comprise 17 goals, and 169 targets are a developmental agenda to tackle complex issues confronting humankind and transform the world by ensuring economic prosperity, environmental protection, and human well-being simultaneously (Pradhan *et al.,* 2017). SDGs aim to solve human problems and make the world a better place to live (Olumıde and Bada, 2021). In addition, SDGs that are sustainable development goals and targets to be achieved by 2030 is set on the MDGs'achievement (Allen et al., 2016). The 17 Sustainable Development Goals to be achieved by the year 2030 are listed in Figure 1.3. The SDGs themselves are universal, but it is up to countries to choose their goals and ultimately determine their priorities and levels of ambition in terms of scope and pace of change. The integrated country-owned SDG strategy will be central to the country's efforts (Allen *et al.,* 2016).

Figure 1.3. The 17 Sustainable Development Goals

According to the 2021 sustainable development report, Nigeria has an index score of 48.9. The SDG index shows the position of a country's outcome of the 17 SDGs with a score between worst (0) and best target (100). Out of the 165 countries assessed, Nigeria was ranked as the 160th position according to the index score (Sachs *et al.,* 2021). Although the index score of Nigeria was reduced in 2021 compared to the score of 49.30 in the 2020 report, the overall index shows that the country is moving halfway through its approach to achieving the best possible results across the 17 sustainable development goals (Ogbodo and Ogbodo, 2021). Nigeria, like other sub-Saharan African countries, is faced with a lot of challenges in meeting most of the 17 SDGs. Compared to other regions of the world, the sub-Saharan African countries perform poorly in SDGs 1 to 9. The 2021 sustainable report shows that Nigeria that major challenges remain in attaining SDG 1, 2, 3, 4,5, 6, 7, 8, 9, 10, 11, 14 and 16. Out of the 13 SDGs with major challenges listed, there was no information on the progress on the score of SDG 4 and 10, SDG 1 and 11 has a decreasing score, while SDG 2, 3, 5, 7, 8, 9 and 14 has a score that is stagnant or a score increasing at less than the 50% rate required. Only SDG 6 showed moderately improving but insufficient to attain the goal among the SDGs with major challenges in Nigeria. Sustainable development goals 15 and 17 were reported with significant challenges and a stagnating score or a score increasing at less than the 50% rate required. The report shows that Nigeria is on track to attaining or maintaining the SDG achievement in SDG 12 and 13; however, the trend information for SDG 12 was not available (Sachs *et al.,* 2021).

Prior to the adoption of the SDG agenda 2030 with 17 goals and 169 targets in 2015, the African Agenda 2063 with 20 goals (embedded into 7 aspirations) and 193 targets was developed by the African Union and adopted in 2013 by African countries (Margarita *et al.,* 2022). An implementation plan for the African Agenda 2063 in the first ten years covering 2013 to 2023 was developed and endorsed in 2015 during the African Union Summit. The Seven aspirations are;

1. Building a prosperous Africa based on inclusive growth and sustainable development
2. To have an integrated continent, politically united and based on the ideals of Pan-Africanism and a Vision of the African Renaissance
3. An African of good governance, democracy, respect for human rights and the rule of law
4. Achieving a peaceful and secure Africa
5. Building an African with a strong cultural identity, common heritage, values and beliefs

6. An Africa whose development is people driven, relying on the potential of the African People

7. Ensuring Africa as a strong and influential global partner (African Union Development Agency, 2022).

Some of the key issues to ensure a successful implementation of the Agenda 2063 in African countries include capacity for implementation, responsibilities and relationships between leaders or stakeholders, coordination of implementation activities and provision of guidance to stakeholders, and communication for stakeholders or citizen involvement (The African Union Commission, 2015). A major factor affecting the development of the African continent is the increasing existence of terrorist groups. For instance, in 2014, a decrease in economic growth was reported in about 10 countries most affected by terrorism. In addition, a decline in the annual percentage of growth rate between 2009 and 2015 was reported by the World Bank among some Economic Community of West Africa (ECOWAS) member countries, particularly those experiencing security and terrorism crises like Nigeria, Mali, and other neighbouring countries like Niger (Ogbonnaya, 2016).

However, positive changes are necessary for Nigeria to achieve the SDGs by 2030 and the aspirations of African Agenda 2063 because positive change is a choice and does not occur by chance (Oleribe and Taylor-Robinson, 2016). In addition, research will help policymakers in their decision-making process at individual or group SDGs managerial leadership levels around the world (Fayomi *et al.,* 2018). The significance of research in different areas of human activities cannot be overstated, as it relates to everything about human being and their entire existence composition (Fayomi *et al.,* 2018). Research is defined as a systematic study involving testing and evaluation, designed to contribute to generalisable knowledge and research development, aiming to establish facts and draw new conclusions (Ahmad, 2015). Scientific research discusses discoveries worldwide, and it helps understand the most challenging social issues such as social principles, human rights, and the prevention of disorder (Olumıde and Bada, 2021). The essence of research is essential in improving a system or an organisation's growth and development (Fayomi *et al.,* 2018). Therefore, research into various sectors will help in the provision and promotion of every sector's developmental processes, which will aid the progress of the SDGs and Agenda 2063.

1.3   Contribution to Knowledge

This study provided findings to inform related health risks associated with working RPSs, risk awareness knowledge in RPS and quality of life of RPS. The study provided information on the potential root cause of poor health and safety management and poor use of PPE in retail petrol stations reported in previous studies. New information on the quality of life of retail petrol station employees in Nigeria was provided to aid further research and appropriate health interventions. The views and recommendations from government officers towards improving health and environmental risk factors related to RPS in this study provided additional knowledge on tackling the environmental issues in Nigeria. It also provides increased knowledge, new understanding, and ideas for future studies relating to retail petrol stations in Nigeria that could be applicable in other African countries. Furthermore, the research study provides additional scientific knowledge that will contribute to further research and drive application for new interventions, either on a small or large scale, to solve human problems relating to targets in SDGs 3 and 8.

1.4   Reason for Choice of Research Location

Ilorin is student-friendly because of the presence of five higher education institutions, and the appreciation of education by the town's inhabitants helps towards accessibility and acceptance during research. Ilorin was considered to have no issue with terrorism when the field study for the research was conducted. The researcher is familiar with the environment and the culture of the people because she has lived and studied in Ilorin for four years. In addition, the researcher had a collaboration with the university in which she had her undergraduate degree. The collaborating university provided a safe working environment during field study and academic colleagues to limit the researcher's lone working time. The researcher had the desire to contribute to community development and health improvement of the people of Ilorin. Finally, the Ilorin metropolis has many retail petrol stations, which was needed for the research study.

1.5   Study Aim

The main purpose of this study is to assess, identify and explore the health outcomes, perception and awareness of health hazards related to retail petrol stations in Ilorin, Kwara State.

1.6   Research Questions

This study is carried out to answer the following research questions:

1) What is the quality of life of retail petrol station employees in Ilorin?

2) What is the perception and awareness of retail petrol station employees of health risks associated with working in a retail petrol station?

3) What are the environmental and health risks concern of people living and working close to a retail petrol station in Ilorin?

4) What is the awareness and perception of retail petrol station owners of health risks associated with working in retail petrol stations in Ilorin?

5) What is the awareness and perception of environmental and public health government officer of health risk associated with retail petrol stations, and how to improve the safety practice and health of retail petrol station employees?

1.7   Study Objectives

1) An in-depth review of existing literature to understand the research area, identify the gap in knowledge for knowledge translation prospects, and derive information to formulate study design, process, and implementation in the study.

2) Conduct a pilot study to achieve twelve sub-objectives to assess accessibility and feasibility to ascertain the likelihood of successful research completion.

3) Identify the total number of retail petrol stations with their coordinates and their closeness to a residential, public, and commercial centre.

4) Develop a questionnaire to assess characteristics, environmental and health risks concerning residential and shop occupants close to retail petrol stations in Ilorin.

5) Examine the safety measures and practices of retail petrol stations in Ilorin using an observation checklist.

6) Assess the quality of life of retail petrol station employees and a comparing population (University Population consisting of staff and students) using the SF-36 questionnaire.

7) Undertake focus group discussions and interview to assess health risks awareness and perception of retail petrol station owner and employee, environmental and public health government officers of health risk associated with retail petrol stations.

8) Analyse and integrate information from literature and findings from the pilot, quantitative, qualitative studies, and other components of the research to provide relating/comparing results to previous scientific studies and develop recommendations towards improving the quality of life of retail petrol stations employees and the general public.

1.8   Research Hypothesis

1) H_0: Retail petrol station employees' quality of life physical component is the same as their peers in other occupation.

   H_1: Retail petrol station employees' quality of life physical component is worse than their peers in other occupation.

2) H_0: Retail petrol station employees' quality of life mental component is the same as their peers in other occupation

   H_1: Retail petrol station employees' quality of life mental component is worse than their peers in other occupation.

3) H_0: Retail petrol station managers' quality of life physical component is the same as retail the petrol station attendant.

   H_1: Retail petrol station managers' quality of life physical component is better than retail petrol station attendants.

4) H_0: Retail petrol station managers' quality of life mental component is the same as retail the petrol station attendants.

H_1: Retail petrol station managers' quality of life mental component is better than retail petrol station attendants.

This research employed a sequential mixed-method design, and four hypotheses were tested in the study.

1.9   Thesis structure

The outline of this thesis is illustrated in figure 1.4.

Chapter 1: Introduction

The study overview, background, and rationale which lead to the research aim, questions, objectives, and hypotheses were discussed in the introduction chapter.

Chapter Two: Literature Review

This chapter provides an in-depth literature review that acts as the theoretical foundation for the study.

Chapter Three: Methods

The methods chapter discussed the information clarifying the research approach, process, data collection, and analysis adopted in carrying out the research. Adopting the mixed-method approach in this study aided the integration of methods to provide a broad understanding and in-depth knowledge.

Chapter Four: Pilot study results and discussion

The foundational supporting information obtained from the field survey in the study area to determine the visibility and appropriate methods for the entire research was discussed in this chapter.

Chapter Five: Quantitative results and discussion

Data collected using questionnaires from study population groups were analysed and discussed in this chapter.

Chapter Six: Qualitative findings and discussion

This chapter discusses the findings obtained through the study population samples' focus group discussion and interview

Chapter Seven: Conclusion and recommendation

The conclusion and recommendation chapter is the final chapter of this thesis, with an overall summary of the empirical evidence obtained through the study. The summary provides the conclusion, recommendation, and challenges encountered during research studies.
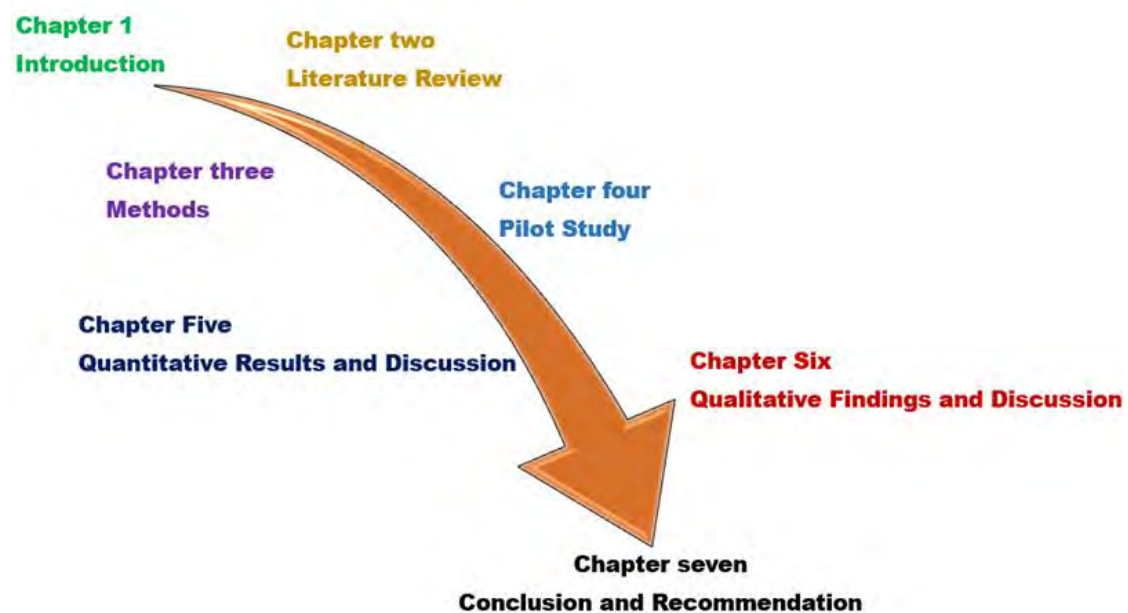
Figure 1.4. Thesis Outline

CHAPTER TWO: LITERATURE REVIEW

2.0   Introduction

The background knowledge and basic information about the cause of research studies are essential to understand the importance and practical application of the knowledge. The main purpose of this chapter is to provide a critical narrative review of the literature around topics. The topics include petroleum, work environment, healthy work environment, environmental pollution, occupational disease and injury, occupational health, safety, work environment, quality of life, the theoretical framework in public health, retail petrol stations in Nigeria, and research methodology. Other topics and sub-topics discussed include petroleum industry, sectors of the petroleum industry and its activities, petroleum products, types of environmental pollution (soil, air, water, noise, and light pollution), and the different work environment types concerning its effect on employees and organisation. The review on the healthy work environment, petroleum industry and environmental pollution, work environment and quality of life, risk factors associated with retail petrol station attendants, and occupational disease aim to reveal the rationale for this research. Relevant theoretical frameworks used in public health for health improvement, promotion, and intervention were also reviewed. The literature review findings in this chapter informed and aided the development of research methods such as questionnaires used in the pilot stage of this research.

2.1   Petroleum

Petroleum, among other energy sources such as hydroelectricity, natural gases, coal, and nuclear energy, is vital to the world. Petroleum meets over thirty per cent (30%) of the world's energy demand since 1990 (Saad *et al.,* 2018). Petroleum comprises crude oil and refined petroleum products. "Petroleum" and "oil" are interchangeably used sometimes (EIA, 2019a). Crude oil occurs through several processes at different stages on plants and animal remains for the past few hundred million years (Kancijan *et al.,* 2015; Ahmed and Fakhruddin, 2018; Stedile *et al.,* 2019). Crude oil is a naturally occurring viscous flammable liquid comprised of a complex mixture of unique liquid and gaseous hydrocarbon compounds of varied compositions and properties used in the production of chemicals, fuels, and derivatives

(Muhsin *et al., 2016*; Santos *et al.,* 2018; Farmani and Schrader, 2019; Vishnyakov *et al.,* 2019). The hydrocarbons (compounds made solely of hydrogen and carbon) contained in crude oil are the alkanes (paraffines), arenes (aromatics or naphthenes), alkenes (olefins), and other complex hydrocarbons such as diphenyl, decalin, and naphthalene.

The elemental composition of crude oil consists of 82-88% carbon, 11-15% hydrogen, 0.2-2% oxygen, 0.05-2% sulfur, 0.06-2% nitrogen, and inorganic salts and organometallic compounds in parts million or billion concentration (Chaudhuri, 2016; Vishnyakov *et al.,* 2019). Crude oil has a specific odour, varying colours such as green, yellow, black, brown, and even clear colours with different viscosity due to its discovery location, age, and depth of the oil field. Different types of crude oil are named based on distinguishing chemical or physical properties, reservoir, and source location (Hsu and Robinson, 2019). Over the years, crude oil has also been described or classified using its odour, viscosity, gravity/density, and boiling points. Odour is used in distinguishing between sour (high-sulfur) and sweet (low-sulfur) crude oil. Crude oil is classified as light, medium, heavy, or extra heavy based on its boiling point, density, and viscosity (Dalvi, 2015; Speight, 2015; Hsu and Robinson, 2019).

Crude oil in its natural state has limited usage, but when it goes through the petroleum process such as extraction, transportation, and refining, it produces more than 2500 useful products such as petrol, kerosene, liquefied petroleum gas (LPG), diesel, jet fuels, lubricating oil, etc. and feedstocks/ by-products for the petrochemical industry (Vandervell, 2015; Muhsin *et al.,* 2016; Jafarinejad, 2016a; Farmani and Schrader, 2019).

2.2   Petroleum Industry

The petroleum industry is an important contributor to the world's economy with various impacts on other industries because the product produced by the petroleum industry is needed to keep other industries functioning and therefore plays a critical role in driving the world's economy (Lisitsa *et al.,* 2019). The oil and gas industries are responsible for more than fifty-seven per cent of the world's total energy consumption (UNDP, 2017). The oil industry consists of various operational and functional processes: the exploration and production, refining and processing, storage, transportation & distribution and retail or marketing of petroleum products. The functional and operational processes of the petroleum industry are embedded

under the three major sectors of the oil industry: the Upstream (exploration and production), Midstream (processing, storage, transport, and distribution) and Downstream (refining, sale, and marketing) sector (Darko, 2014; KPMG, 2014; Yavari *et al.,* 2015; Jafarinejad, 2016a; Mojarad *et al.,* 2018; Saji and Umoren, 2020). Figure 2.1 shows the major operational and functional processes in the petroleum industry, from exploration and production of crude oil and gases to the last process: sales and marketing of petroleum products.
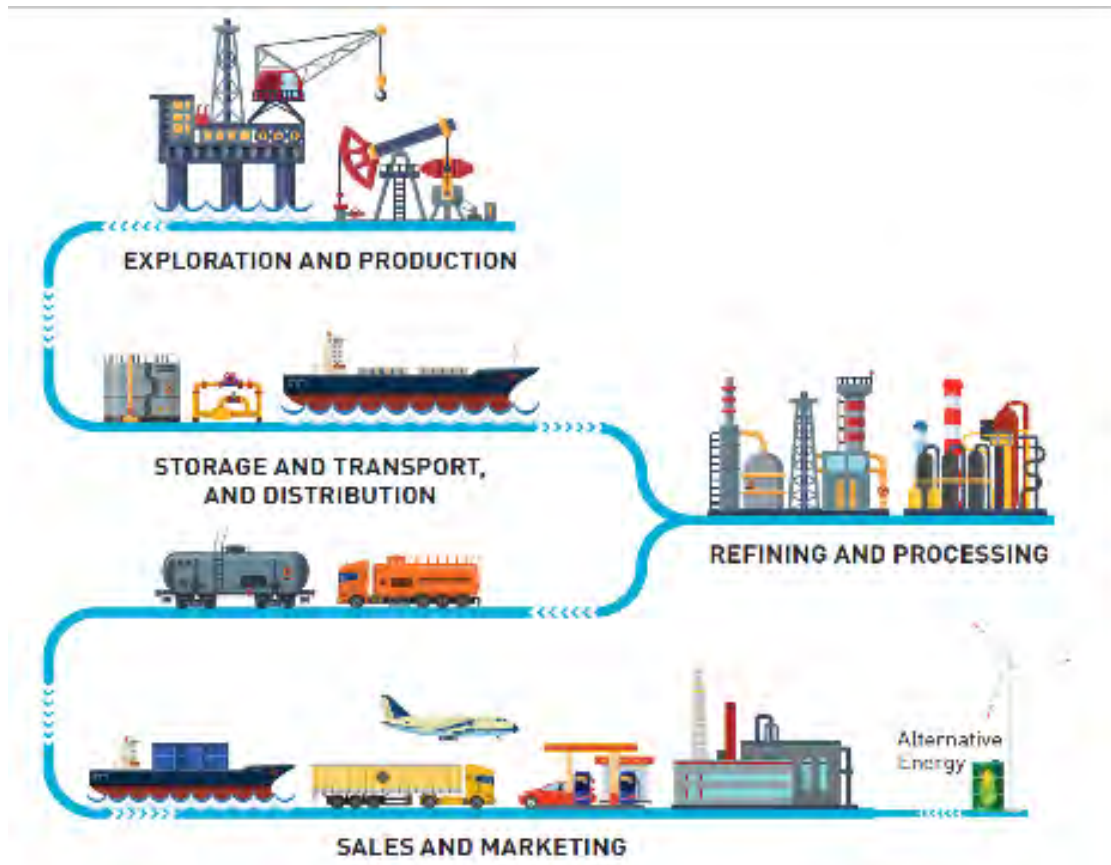
Figure 2.1. Operational and Functional Processes in the Three Major Sectors of Petroleum Industry (UNDP, 2017)

2.2.1 Upstream Sector

The upstream sector activities are mainly the exploration and production of hydrocarbon (crude oil/natural gases). The exploration and production process involves searching for the accumulated hydrocarbon onshore (underground) or offshore (under the water), oil well (a dug hole in the ground for extracting petroleum), drilling, development & production of petroleum products and other resources, and decommissioning (shutting down and dismantling of

production platform) (Furman *et al.,* 2017; Hanania *et al.,* 2017; Al-Janabi, 2020; Shell, n.d). Because of the upstream sector's operational and functional activities, the upstream sector is referred to as the E&P (exploration and production) (Saji and Umoren, 2020).

The search for potential unconventional and conventional oil and gas reservoirs onshore or offshore is regarded as exploration. The discovered oil and gas reservoir (a reservoir is any rock type with an accumulation of hydrocarbon) in a trap (a trap is an impervious rock that restricts the movement of oil and gas) is carefully examined to estimate the quantity of hydrocarbons available. Wells are dug in a vertical direction only or combined with horizontal-lateral drilling using advanced drilling technologies to extract trapped hydrocarbons (Dalvi, 2015; Echarte *et al.,* 2019; Al-Janabi, 2020). An impervious rock that restricts the movement of oil and gas (traps) are of different types, such as the fault trap, salt dome, anticline, etc. An impervious rock that restricts the movement of oil and gas (traps) are of different types, such as the fault trap, salt dome, anticline, etc. Fault traps are formed by offsetting rock strata where the faulted plane or shifted nonporous rock traps oil and hinders its migration. Figure 2.2 shows how the structure of the fault, salt dome, and anticline trap restrict trapped oil and gas movement. A salt dome is formed due to the slow upward movement of salt, which breaks through the overlying rock, causing cracks, bent or folds that often trap oil and gas. Anticline traps are formed by diapirism, faulting, and folding of the earth's crust into a dome structure that traps oil and gas (Bjorlykke, 2015; Dolson, 2016; Wright, 2017; Cheng e*t al.,* 2019). The accumulation of crude oil trapped produces an oil reservoir. An oil reservoir is formed when there is a creation of a petroleum source, and the organic minerals are transformed into petroleum due to heat, pressure, and other conditions. Other conditions for oil reservoir formation are a permeable or porous rock that allows the possible migration of petroleum after formation and accumulation of a substantial amount of petroleum due to trap and other conditions (Wright, 2017).
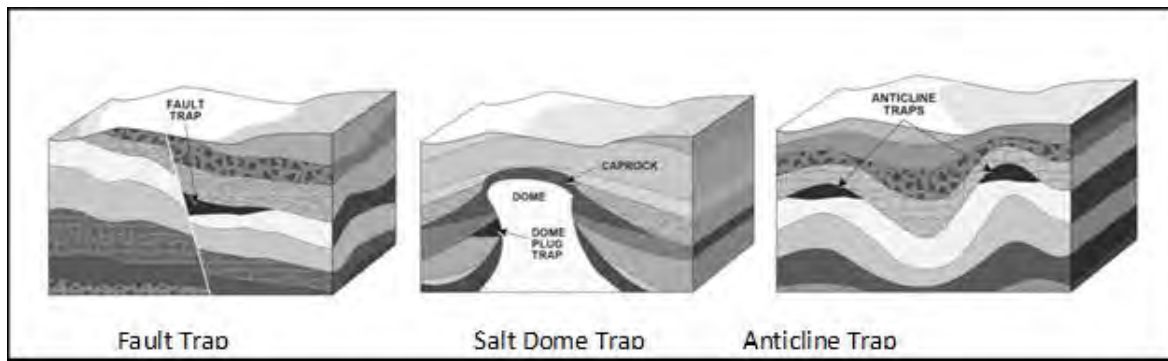
Figure 2.2. Types of Traps (Wright, 2017)

The characteristics of the reservoir rock (external geometry of the reservoir) such as the pore geometry, pore size, porosity, permeability distribution, the pore network mineralogy, and wettability, determine the flow of crude oil and the drilling process techniques for digging oil wells (Bjorlykke, 2015; Cheng *et al.*, 2019). Oil productions consist of two major categories of drilling. The first category is the downward drilling below the water table, reaching the oil reservoir, developing the well hole, and controlling soil and underground water contamination. The second category is the other major drilling and processes that aid the upward oil flow stimulation (Lioudis, 2020).

The different types of wells are production, injection, and disposal well. Production wells produce oil using other associated production fluids such as corrosion reduction fluid. An injection well is used to inject fluids to aid hydrocarbon production, recovery, disposal, and storage. The disposal well is used for injecting waste products and fluids. Other types of wells include offshore and subsea wells. Offshore wells are found on the ocean floor with their production control and monitoring component located topside on a production platform. The subsea well is a type of offshore well where wellhead components for production control and monitoring are placed on the ocean floor and drilled for various purposes to aid the extraction and production of petroleum (Fanchi and Christiansen, 2016; Xu and Wu, 2018; Smart, 2019; Saji and Umoren, 2020). The extracted oil from the well is collected for processing and transported through the pipeline to refineries (Elbashir *et al.,* 2019). An abandonment well that is no more productive in all ways and sealed to restore the environment and adhere to legal requirements (Chen, 2020). Figure 2.3 shows the pictorial representation of crude oil formation resulting from buried animal and plant remains over hundreds of million years. The block diagram in the middle shows the remnants of dead animals and plants embedded between sedimentary rock, which act as traps for crude oil. The block diagram label today shows the trapped crude oil and gases between rocks that are being explored today by drilling of well

through the sedimentary rocks to reach the oil reservoir (Kancijan *et al.,* 2015; Ahmed and Fakhruddin, 2018; National Energy Education Development (NEED), 2018; Stedile *et al.,* 2019).
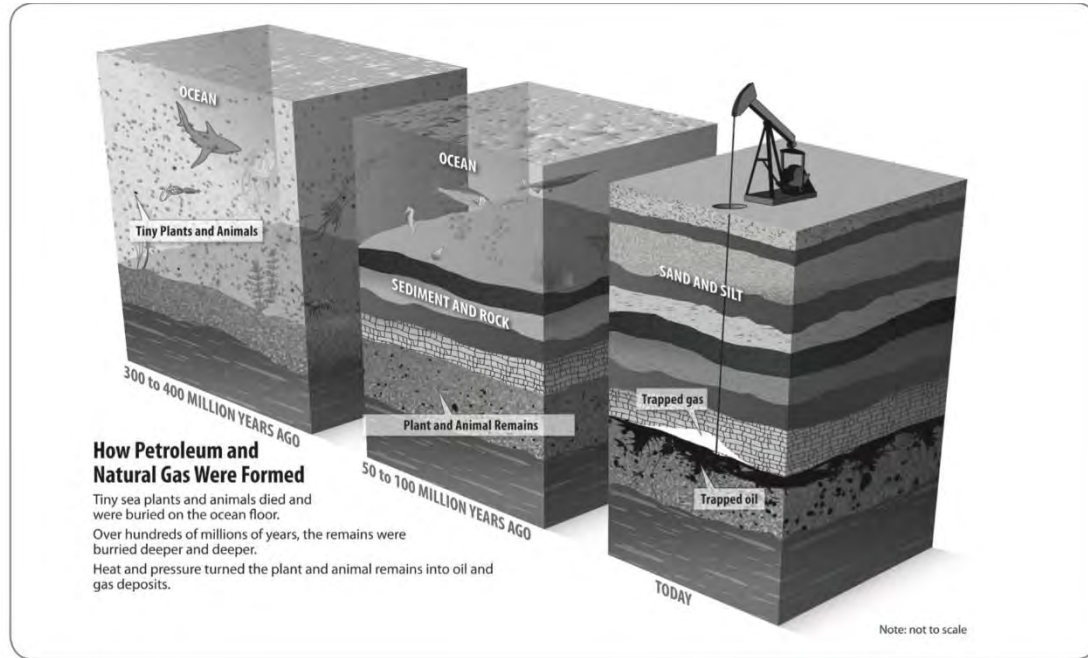
Figure 2.3. Structure of Crude Oil Formation (The National Energy Education Development (NEED) Project, 2018)

2.2.2   Midstream Sector

The midstream sector of the petroleum industry lies between the upstream and downstream sectors in the oil production processes (Lioudis, 2020). The midstream comprises the production, storage, and transportation of oil and gas from upstream to downstream. Figure 2.4 shows different activities that occur in the midstream sector. The diagram shows that midstream processes come after the upstream sector operation and occurs before the downstream sector processes. It also shows pipelines, trucks, and tankers as means of transportation in the midstream sector. The extracted crude oil stored in storage tanks is transported to the downstream sector through pipelines, rail, truck, an oil tanker, or barge (Aalsalem *et al.,*2018).

Furthermore, figure 2.4 shows different activities in the midstream sector: The produced oil and gas from the upstream could be transported for gas processing and fractionation, and then the products are transported to storage facilities and the downstream sector through pipelines.

Oil and gases could also be transported in the midstream sector through the pipeline to barge and truck for downstream distribution. The midstream sector could gather crude oil directly from the upstream sector and transport it for storage and to the downstream sector.
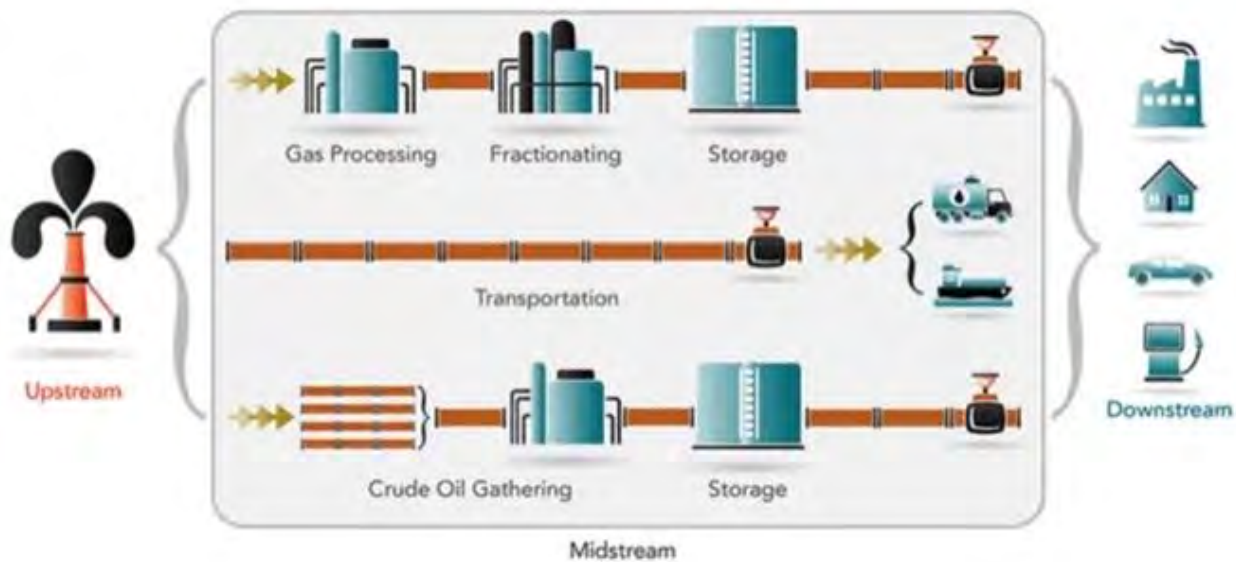
Figure 2.4. Midstream Activities (Gallon, 2016)

2.2.3 Downstream Sector

Refining, marketing, sales, and distribution of processed petroleum products are the main activities in the downstream sector of the petroleum industry. The crude oil is purified, processed, and refined to produce finished petroleum products and other products sold to the end-users (Mukherjee and Das, 2017; Wright, 2017). Crude oil's physical and chemical composition is important in the refining process because no crude oil is the same in structure and properties. A precise and complete analysis of crude oil known as crude oil assay is carried out for the various type of crude oil, which aids effective utilisation, proper stimulation of refining processes, and potential sale value. An assay comprises the bulk properties and fractional properties of crude oil. Bulk properties include pour point, boiling point, flash point, specific gravity, sulfur contents, and metal contents. Nitrogen contents, salt contents, smoke point, freeze point, carbon residue contents, viscosity, bottom and sediment and water, refractive index, light hydrocarbon yields (C_1- C_5), acid number, and cloud point are also bulk properties of crude oil. Fractional properties include naphthene and aromatics contents, octane number for gasoline, freeze and smoke point of kerosene, cetane measure, and cetane index of

crude oil. Due to the changing composition and properties of crude oil, simulation process or modelling processes should be carried out alongside the assay data collected from the oil well (Coker, 2018; Liu *et al.,* 2018; Haydary, 2019).

2.2.3.1 Refining of crude oil

Refining crude oil to produce various products involves a complex operation of physical and chemical processes in the refinery. The physical and chemical processes in the refinery include distillation, fluid catalytic cracking, crude desalting, methyl tertiary-butyl ether production, coking, alkylation, thermal cracking, isomerization, etc. (Malakar and Saha, 2015; Kelly et al., 2017). Figure 2.5 shows the typical complex processes of a refinery operation and the separation of various components from the crude distillation unit leading to the final product stream. Refinery operations consist of main processes such as separating crude oil into different refinery streams by distillation and the improvement of refinery stream quality. The crude oil yield is also adjusted in the refinery to meet market demands through conversion & reforming and sulphur reduction in the refinery streams by desulphurisation. The refinery operations make sure the final petroleum products are produced through the blending of refinery streams process and appropriate waste disposal under current government specifications and regulations (UK Petroleum Industry Association (UKPIA), 2015; UKPIA, 2019; American Petroleum Institute (API) Energy, 2020).

Figure 2.5. A Typical Refinery Process (UKPIA, 2015)

2.2.3.1.1   Crude Oil Distillation

Petroleum refineries worldwide have different specific characteristics, but crude oil distillation is a standard technology used in all these refineries. Distillation is used in the separation process of useful hydrocarbon into fractions. The crude oil is separated into fractions according to their boiling point ranges in the crude oil distillation unit (also known as the crude unit). Crude oil fractionation is the first and key process in the refinery industry (EIA, 2012; Waheed and Oni, 2015; Gomaa and El-hoshoudy, 2018; Martin *et al., 2019*). Crude oil is preheated in a furnace to vaporise before passing it into the distilling column from the bottom, where it boils, and the resulting vapour rises vertically upward in the column. Fractions at different boiling points are drawn off at different levels in the distillation column due to the cooling of the raised vapour by a downward flow of liquid that makes it condense at different boiling points. The distillate from the distillation process is classified into light distillate, Middle distillate, and heavy distillate. Light distillates are products located at the top of the distillation tower, recovered at the lowest boiling point, such as liquid petroleum gas (LPG), gasoline, naphtha, etc. Middle distillates are products like home heating oil, kerosene, diesel, and jet fuel with a boiling point range of 200 to 350° C. Heavy distillates are products located at the bottom of the distillation tower with low volatility, large molecule, and boiling points of above $350^{o}C$ like the residual oil, lubricating, asphalt, etc. (EIA, 2012; Izyan, and Shuhaimi, 2014; Kim, 2018; Bayomie *et al.,* 2019; UKPIA, 2015; API Energy, 2020; Donev *et al.,* 2020). Figure 2.6 shows the crude oil distillation process through a fractional distillation column and the end products at different boiling points. The diagram illustrates that the crude oil goes through the heated inlet into the crude oil distillation unit before being separated into various components. The heavy components are collected at the bottom, while lighter components are collected at the top of the crude oil distillation unit.
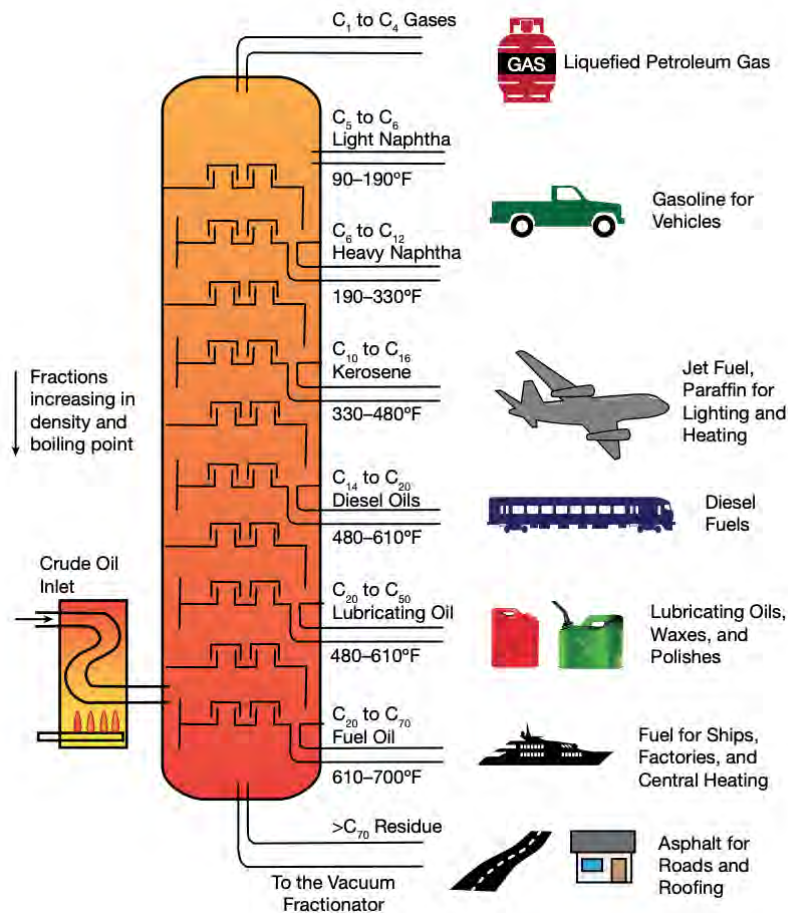
Figure 2.6. Crude Oil Distillation Unit (Olsen, 2014)

2.2.3.1.2   Conversion and Reforming in the Refinery

The conversion process in the refinery involves the chemical process of breaking down the chemical composition of large molecular high boiling-point hydrocarbon liquid produced from crude distillation into lighter molecular low boiling-point hydrocarbon liquids. Jet fuel, gasoline, petrochemical feedstocks, diesel fuel heavy liquid, and other valuable products that meet market demands are lighter molecular low boiling-point hydrocarbon liquids. Hydrocracking, coking, polymerization, and fluid catalytic cracking (FCC) are used in breaking large molecular liquid into lighter molecular liquid (Oyekan, 2018; Kaiser *et al.,* 2019; Speight, 2019a). Reforming is another important process in the refinery that made the use of gasoline as automobile fuel possible. It involves the conversion of hydrocarbon from distillation into other useful forms called reformate (upgrade octane naphtha) through a thermal or catalytic reforming process. Also, hydrogen is produced from crude oil through reforming

processes such as SMR (steam methane reforming), which is further used in other refining processes such as hydrotreating (Speight, 2016; Uner, 2017; Azzaro-Pantel, 2018; Oyekan, 2018; Wypych, 2019).

2.2.3.1.3   Desulphurisation in the Refinery

Desulphurisation is the chemical process of treating petroleum products from distillation by hydro-desulphurisation, flue-gas desulphurisation, heavy-oil desulphurisation, etc., to remove their sulphuric contents. Metal, nitrogen, and sulphur compounds present in petroleum are known as catalyst poison; therefore, desulphurisation is used to pre-treat catalytic reformers before use. Desulphurisation of petroleum products conforms with the current tightened fuel specification. Refineries produce higher sulphur from sour crude oil (high sulphur content crude oil) than sweet crude (low sulphur content crude oil) (Akitsu, 2018; Coker, 2018; El-Gendy and Nassar, 2018; Oyekan, 2018; Akopyan *et al.,* 2019; API Energy, 2020).

2.2.3.1.4   Blending of the refinery streams

Blending the refinery streams to finished petroleum products is the last major step before waste treatment and disposal in the refinery. Blending could occur in the refinery, on ships, or along the pipeline once it leaves the refinery site. Due to economic values and logistics associated with specific petroleum products, alternative options such as producing blended finished products or creating alternative processing units by changing the deposition of intermediate product stream in the refinery are adopted. For refineries to meet the market demands and specifications, most refinery products are produced through the blending of stocks or blending different stream components (API Energy, 2020; Speight, 2017). Gasoline/petrol used for the operation of vehicles results from the combination of several components in a process referred to as gasoline blending. Gasoline blending involves combining several petroleum streams produced through the different refinery operation processes (distillation, reforming, polymerisation, cracking, etc.) (Speight, 2017). Refineries may produce more than eight different hydrocarbon stream, which is then mixed to produce gasoline. Additives such as demulsifiers, oxygenates, metal deactivators, antioxidants, detergents, corrosion inhibitors, anti-knock agents, and anti-icing additives are also mixed into hydrocarbon streams during

blending. The essential elements required for product blending include analysis infrastructure, storage facility, blendstock properties, blending frequency, post blending consideration, transportation infrastructures, product flexibility, and product quality waiver. In addition, real-time database advance control facilities, product certification methods, and the number of finished products are also essential elements required for product blending (Srivastava and Hancsok, 2014; Fink, 2016; Hsu and Robinson, 2017; Hsu and Robinson, 2019).

2.2.3.1.5   End Process of Refinery Process (waste treatment)

In a product stream containing sulphur, waste hydrogen sulphide is taken by sulphur recovery unit and combined with oxygen to give solid sulphur and water vapour sold to sulphur processing industries after treatment (UKPIA, 2015). Petroleum waste treatment marks the end of petroleum refinery processes and is inevitable in the manufacturing of products. Petroleum waste streams are treated according to current specifications and regulations. Waste treatment is crucial to the petroleum industries; the type of waste, waste quality, and quantity produced determine the means of waste treatment, waste treatment cost, and disposal. Waste streams, such as air streams, gas streams, water streams, etc., are treated in various ways to make them environmentally safe and friendly (Heck *et al.,* 2016; Schnelle Jr and Brown, 2016; Bahadori, 2019; Kulkarni, 2019).

2.2.3.2 Marketing, Sale, and Distribution of Petroleum Products

Marketing, sale, and distribution of petroleum products occur after petroleum production and refining. It involves the transportation of petroleum products (gasoline, kerosene, diesel, jet fuel, etc.) from the refineries to the end-user. The finished products are transported through the pipeline to large terminal storage centres. Figure 2.7 shows petroleum products such as kerosene, gasoline, diesel, and other fuel transported to large storage deport through tanker trucks and then distributed to retail sale locations for easy accessibility to end-users (American Petroleum Institute, 2014). Retail petrol stations are an essential part of the downstream sector of the petroleum industry that plays a crucial role in the sale & marketing of petroleum products. Retail petrol stations are structures or buildings certified to sell petroleum products such as gasoline, diesel, cooking gas, and kerosene to motorists and other local consumers.

These structures are called different names, such as service stations, fuelling stations, petrol stations, petrol bunks, filling stations, garage, gas stations, etc., in different countries worldwide (Mshelia *et al.,* 2015; Odipe *et al.,* 2018).
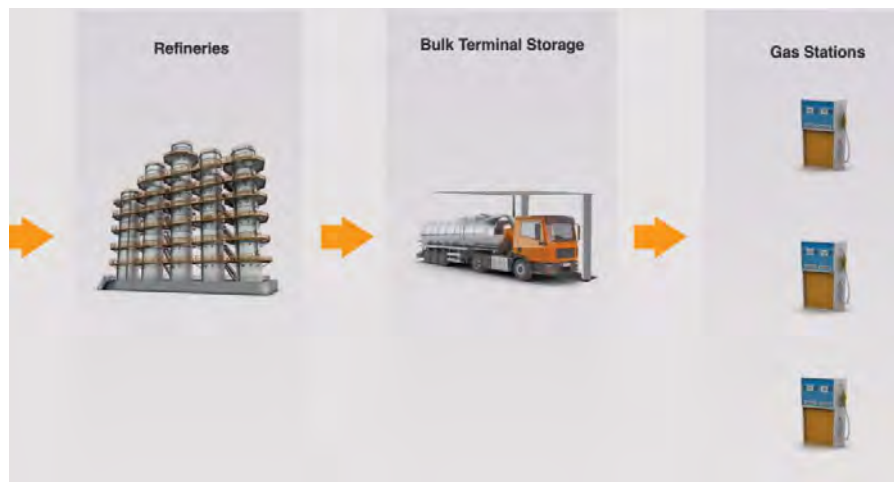
Figure 2.7. Petroleum product distribution to end-users (American Petroleum Institute, 2014)

The functions of retail petrol stations are the same throughout the world, although the types of petroleum products sold may differ as well as the structures of these various stations. Figures 2.8 to 2.10 below show examples of retail petrol station structures with different designs around the world. They all have a large canopy over their forecourt where the dispensing pumps are located. All the petrol stations also showed their bold signpost with the petroleum product prices sold at the stations.

Figure 2.8. Retail Petrol Station in Morocco (Sparks, 2015)

Figure 2.9. Retail Petrol station in Northern Ireland (Bridges, 2017)

Figure 2.10. Retail Petrol Station in Nigeria (Total Nigeria, 2019)

The three types of service rendered to customers at these various retail petrol stations worldwide are self-service, minimum service, or full service. Self-service at a petrol station allows the customers to pump their fuel with the provision for easy payments (gasoline, diesel, or kerosene). Full service involves pumping fuel and rendering other services such as cleaning the windshield, oil checking, etc., to customers and collecting payments by an authorised employee known as a petrol station attendant or jockey. Minimum service is the least popular petrol station service where attendants only pump fuel for customers due to specific legislation that prohibits self-service by customers (Donofrio, 2012; Basker *et al.,* 2015; Busolo, 2018). Full-service type of operation is adopted by retail petrol stations in various African countries,

including Nigeria. Both males and females are employed to fuel vehicles with octane leaded or unleaded fuel and render other services daily to customers at filling stations (Moolla *et al.,* 2015).

2.3 Petroleum Products

Petroleum products are produced after the refining of crude oil. These petroleum products include various liquid and gaseous fuels (gasoline, kerosene, liquid petroleum gas, jet fuel, diesel, naphtha, etc.), coke, waxes, asphalts, lubricating oil, and solvent. Also, petroleum products are used to produce petrochemical products such as plastics, rubbers, soap and detergent raw materials, paints, alcohols, pharmaceuticals, synthetic fibres, etc. (Chaudhuri, 2016; Trimm and Hunter, 2016). Due to the lower density of petroleum products produced after the refining process, the volume of output (a petroleum product) increases more than the volume of input (crude oil) refined. The increased volume between the output and input is referred to as processing gain (EIA, 2019). Figure 2.11 shows the percentage of products in a barrel of crude oil. The volume of petroleum products produced in the petroleum industry is measured in barrels. Heavier products are located at the bottom, while the lighter product is located at the top of the barrel. Gasoline, kerosene, and diesel are the three main petroleum products commonly sold in retail petrol stations.
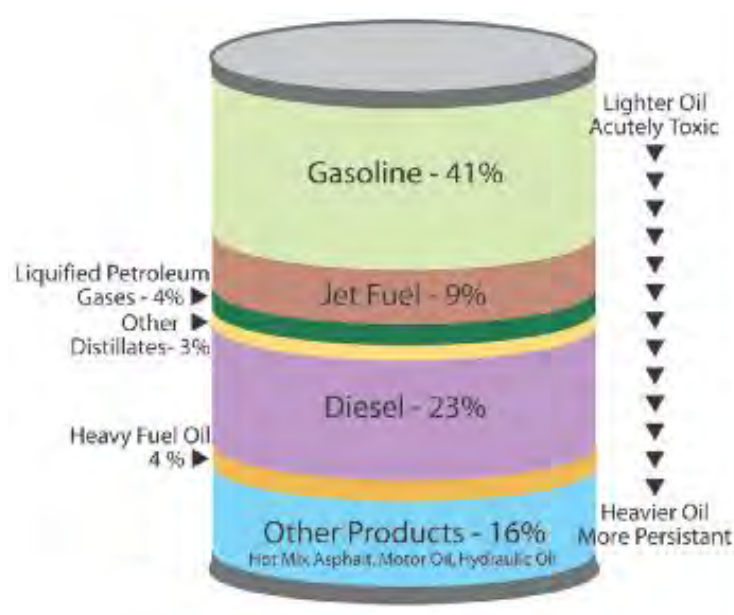
Figure 2.11. Barrel of Crude Oil Composition (Department of Ecology, 2016)

2.3.1 Petrol

Petrol, also referred to as gasoline, is produced from the refining of crude oil. It comprises a complex mixture of a large quantity of volatile hydrocarbons (alkenes, alkanes, and cycloalkanes) with the addition of various additives for quality improvement and to meet other specific functions through a process known as gasoline blending (Campo *et al.,* 2015; Speight, 2017). Additives in gasoline should exclude the presence of compounds such as solvents or sediment, acids, and metallics in any amount (Worldwide Fuel Charter (WWFC), 2019). Petroleum products constitute 95% of the energy used in the global transport system, in which nearly 40% of the energy is used by vehicles running on finished gasoline fuel from blending refineries (Sarathy *et al.,* 2018). Gasoline sold in different countries varies in its formulation due to the various government specification and guidelines concerning fuel efficiency and emission control, such as EU CO_2 target, Euro 6c, Euro 6d, China 6a, Euro 6dTEMP, China 6b, etc. (WWFC, 2019).

Leaded gasoline is finished motor gasoline containing alkyl lead compounds such as tetramethyl Pb and tetraethyl, which serve as octane boosting and antiknock additives for vehicle engines. Due to the increase of lead (Pb) emission from incomplete combustion of vehicles causing air pollution, leading to adverse health effects, leaded gasoline was banned. Unleaded gasoline was introduced when leaded gasoline was banned. The unleaded gasoline contains additives like ethanol, benzene, toluene, and methyl tertiary-butyl ether instead of tetramethyl Pb and tetraethyl Pb (Yao *et al.,* 2015; Compound Interest, 2016; Amine & Barakat, 2019). Transportation contributed about 23% of carbon emission in 2013, and the increasing projected carbon emission from transport will likely continue due to the increasing level of rapid global motorisation and urbanisation (Zhang *et al.,* 2018). Therefore, additives in transportation fuel that lower exhaust emission is needed to reduce the transport sector's contribution to the massive global emission associated with climate change, environmental problems, and health issues (Sarathy *et al.,* 2018; Amine and Barakat, 2019).

One of the important gasoline additives to improve fuel efficiency and reduce spark ignition engine exhausts are oxygenates such as alcohol, methanol, ethanol, and tertiary-butyl ether (Iliev, 2018; Miller, 2019). Methanol is a widely used gasoline additive in China, while ethanol is widely used as a gasoline additive in the United States of America (Wang *et al.,* 2019b; EIA, 2020). The use of octane booster additives to increase the low octane rate of unfinished gasoline from petroleum refineries to satisfy the requirement of modern engines has led to the sale of different grades of gasoline. Regular/ unleaded, midgrade/super, or premium/super-premium

are different grades of gasoline sold in retail petrol stations. Gasoline with a higher octane rating is sold at higher prices at retail petrol stations (Balakrishnan *et al.,* 2017; Amine & Barakat, 2019; EIA, 2020). Although gasoline is a highly flammable, dangerous volatile liquid that could explode when mishandled, the danger is considered insignificant compared to its benefits due to the high dependency on the usage of gasoline and other petroleum products by the public (Gilbert & Gilbert, 2019).

2.3.2   Kerosene

Kerosene, commonly known as paraffin, is a crude oil distillation fraction made up of mixtures of hydrocarbons. Kerosene is used for jet fuel production, home heating fuel, solvent production, and domestic product production (a deodorised form of kerosene) (PHE, 2016b). Kerosene is a stable refined petroleum product that does not need additives and consists of hydrocarbons containing nine to sixteen carbon atoms per molecule. Some of the hydrocarbons present in kerosene are naphthalene and its derivatives, n-dodecane (n-$C_{12}H_{26}$), and alkylbenzene (PHE, 2016b; Speight, 2019b; Worsfold *et al.,* 2019). Kerosene is pale-yellow or colourless with a boiling point between 175 to 325°C and a flashpoint of 38°C. Also, it is less volatile than gasoline which makes it safe to store (Kuppusamy *et al.,* 2019; Speight, 2019a). Saturated hydrocarbon is the desirable constituent of kerosene due to the use of kerosene as burning fuel. To maintain the lowest smoke level for kerosene as burning fuel, it undergoes the 'Edeleanu process' to remove excess aromatic and unsaturated hydrocarbons to meet specifications and be free of obnoxious gases such as sulphur compounds (Speight, 2019b). Despite the extraction of aromatic and unsaturated hydrocarbons in kerosene, traces of small aromatic and unsaturated hydrocarbons are still found in kerosene (Speight, 2019a).

2.3.3   Diesel

Diesel is made of a mixture of hydrocarbons (consisting of 3 major classes of hydrocarbon, which are aromatic hydrocarbon, paraffinic, and cycloparaffinic) and distillates during the refining process between 150 to 380°C boiling points (Palanisamy *et al.,* 2014; Majewski and Jääskeláinen, 2016). Diesel is a direct fraction of crude oil distillation that contains hydrocarbon with ten to nineteen carbon atoms per molecule (C_{10} -C_{19}) and a flash point of 52°C. Diesel is a liquid with varying colours from brown to colourless; it is also of higher energy, heavier, and less volatile than gasoline (Kuppusamy *et al.,* 2019). Diesel is thicker and

heavier than gasoline and kerosene with increased evaporation time, compressed more and less refining process than gasoline. It is used for powering cars, buses, trains, boats, and other large vehicles (NCH Europe, 2018). Light diesel ($C_{12.3}H_{22.2}$) and heavy diesel ($C_{14.06}H_{24.8}$) with a molar weight of 170 and 200 g/mol respectively, are the two groups of diesel used in diesel engines (Sarıkoç, 2020).

2.4   Petroleum Industries and Environmental Pollution

The introduction of pollutants (substances or energy) into the environment, which causes harmful effects on the natural resources, human health, and the entire ecosystem, is known as pollution or environmental pollution (Nathanson, 2017; United Nations Environment Programme (UNEP), 2017; Manisalidis *et al.,* 2020). A pollutant is defined as any energy or substance in the form of solid, liquid, or gas introduced to the environment that could cause short or long-term adverse effects on everything within it (Chaudhry and Malik, 2017; Viatte *et al.,* 2020). The environment is polluted by pollutants from natural sources (cyclones, earthquakes, drought, volcanic eruptions, floods, etc.) and anthropogenic sources. Effects of pollutants on different environmental components may vary due to the different chemical compositions of pollutant types (Viatte *et al.,* 2020). Petroleum is toxic to all living things despite being found in its naturally occurring state beneath the earth's crust. Its complicated extraction, production, and transportation processes cause unfortunate results causing pollution from oil spillage, wastewater discharge, chemical emission, etc. Chemical emissions, wastewater discharge, oil spillage, etc., are the major source of environmental problems contributing to land pollution, water pollution, and air pollution (RAO, 2016; Ugwoha and Omenogor, 2017; Varjani *et al.,* 2020). Globally, effects of oil pollution that occur from increasing exploration, production, and utilization of petroleum products and spills during transportation of petroleum products constitute major health concerns (Mishra and Kumar, 2015; Michel and Fingas, 2016; Zhang *et al.,* 2019; Jafarinejad and Jiang, 2019).

Emission of volatile organic compounds (VOCs), especially benzene, toluene, ethyl-benzene, and xylenes, collectively known as BTEX, are also associated with petrochemical industries and incomplete combustion of petrol products (Bolden *et al.,* 2015; Faraji *et al.,* 2017; Abbasi *et al.,* 2020; Fendi *et al.,* 2020). BTEX is included in thinners, cleaners, liquid fuel, degreasers, and lubricants (Choudhury *et al.,* 2020). BTEX pollutes the underground water and the soil through accidental petroleum oil spillage and improper discharge of untreated industrial

effluents. Its presence in the atmosphere causes air pollution, and it can be easily transported into natural water bodies when it rains. BTEX are known to be toxic, and its exposure damages human health causing acute skin mucous membrane infections, fatigue, liver cirrhosis, central nervous system damage, congenital disability, organ irritation, and cancer (Bretón *et al.,* 2017; Abbasi *et al.,* 2020; Akinsanya *et al.,* 2020; Tawabini *et al.,* 2020; Usman *et al.,* 2020). BTEX is highly soluble in water than other hydrocarbons, and they can be easily transported in the environment either in its solid, liquid, or gaseous phase. Also, BTEXs accounts for about 80% per cent of the VOCs emitted in petrochemical industries and 50% of the pollutant from gasoline (Tawabini *et al.,* 2020; Usman *et al.,* 2020). Humans contact BTEXs compounds by inhaling polluted air, digesting contaminated water, and absorbing through skin contact (Moridzadeh *et al.,* 2020; Mohammadi *et al.,* 2020).

Benzene, also referred to as Benzol or Cyclohexatriene, is a toxic and hazardous chemical found in crude oil or produced during the crude oil refining process. It is a volatile, highly flammable, colourless aromatic hydrocarbon with an odour like gasoline. Benzene is used as a solvent in the industrial production of paint, gasoline, varnishes, thinners, rubbers, drugs, etc. Benzene is classified carcinogenic to human health, and its exposure is related to health problems such as aplastic anaemia, bone marrow dysplasia, and detrimental damage to the immune system. Benzene is also associated with an increased risk factor for developing chronic lymphocytic leukaemia, hematopoietic and lymphatic cancers, acute myelogenous, etc. Also, there is an association between benzene exposure and a decrease in haemoglobin levels, white and red blood counts (European Chemical Agency (ECHA), 2017; National Centre for Biotechnology Information (NCBI) 2018a; Choudhury *et al.,* 2020; Ren *et al.,* 2020; Scholten *et al.,* 2020; Sun *et al.,* 2020).

Toluene, also called Toluol or Methylbenzene, is a liquid aromatic hydrocarbon that is water-insoluble, colourless with vapours heavier than air. It is present in many commercial and industrial products like benzene and veterinary medicine as an organic solvent. The respiratory system is the main route of absorption due to its high volatility. Toluene is toxic to human health by affecting the function of the central nervous system and leading to toluene-induced neurotoxicity, blurred vision, seizure, etc. when in contact with the skin, inhaled, and ingested (Drug bank, 2016; NCBI, 2018b; Abouee-Mehrizi *et al.,* 2020; Braunscheidel *et al.,* 2020; Kuang *et al*., 2020; Soares *et al.,* 2020).

Ethylbenzene (C8H10) is also an aromatic hydrocarbon with a colourless benzene substitute, highly flammable, and occurs as a natural element in coal, cigarette, gasoline, and crude oil. It is primarily used to produce styrene and as a solvent for producing rubber adhesives, paints, varnishes, and inks. Human exposure to ethylbenzene through inhalation, skin contact, eye contact, and ingestion is known to cause both short and long-term health effects such as irritation of the larynx and eyes, dizziness, drowsiness, headaches, brain damage, kidney and liver problems (Babu and Londhe, 2014; National Institute for Occupational Safety and Health (NIOSH), 2015; NCBI, 2018c; Derakhshan-Nejad *et al.,* 2020; Hedayatzade and Hassanzadeh, 2020).

Xylenes are cyclic aromatic hydrocarbons; colourless and sweet-smelling liquids are used to produce ethylbenzene. Xylenes are volatile and flammable. It consists of three isomers which contain 20, 20 and 40-65 per cent of para-xylene (p-), ortho-xylene (o-) and meta-xylene (m-), respectively. Xylene is not classified as Group 1 (severe carcinogenic compounds for humans), like benzene, and Group 2 (possibly carcinogenic to humans) like ethylbenzene. But exposure to xylene still causes both short- and long-term health problems such as eye irritation, skin inflammation, neurological effects, central nervous system, breathing, and gastrointestinal problems (ATSDR, 2014; Niaz *et al.,* 2015; EPA, 2016b; Boonhat and Lin, 2020; Hedayatzade and Hassanzadeh, 2020; Mohammadi *et al.,* 2020; Tualeka *et al.,* 2020).

2.4.1   Types of Environmental Pollution

There are various environmental pollution types, including water pollution, land pollution, air pollution, noise pollution, and light pollution (Mitra, 2018). The various pollution types arise from different sources and are caused by a single or combination of pollutants. Environmental pollution has a higher pollutant concentration at its emission point. Pollution can travel from one point to another through various transport mediums, including water transport, air transport, sediment transport, bio transport, and soil transport, to cause detrimental effects to the environment and its inhabitants in different ways (Hill, 2020). Physical, chemical, biological, and radiological pollutants in the air, soil and water have an influence the health of working population in small and large workplace settings (Tulchinsky and Varavikova, 2014).

2.4.1.1 Water Pollution

Water is an essential natural resource that forms an integral component of the environment because it makes up over 70% of the earth's crust. Also, water constitutes more than 50% of the human body (Fatima *et al*., 2020: Rosinger and Brewis, 2020; Qadri *et al.,* 2020). As one of the basic requirements for human survival, water is essential for the earth's sustainability. Water is referred to as the most delicate component of the environment, and access to good quality water is an important factor needed for improving living standards and the general health of people in developing countries such as Africa or any part of the world. Therefore, water pollution poses a danger to healthy living (Hannemann, 2015; Lapworth *et al.,* 2017).

Water pollution occurs from the introduction of pollutants into water sources through human and natural processes affecting water quality, and its resulting impact has been an ongoing global problem over the years (Charlesworth and Booth, 2019). Water pollution is the presence of a certain degree of a small or large amount of substances (pollutants) in water that alters the water quality making it unsuitable for specific purposes such as domestic activities, agricultural purposes, industrial activities, and other uses (Owa, 2014; Halder and Islam, 2015; Gana and Peter, 2015; Alrumman *et al.*, 2016; Markham, 2019; Qadri *et al.,* 2020). Water pollution has been identified as a significant source of environmental problems in recent years (Afroz *et al.,* 2014). Water pollution is a global problem and has been on the rise both in developing and developed countries, causing damage to economic growth and the physical and environmental health of the entire world population. Also, water pollution contributes to water scarcity in many countries due to the continuous decline in water quality, thereby limiting the quantity of safe and reliable water sources (Imoukhuede and Afuye, 2016; Mateo-Sagasta *et al.,* 2017; Ali and de Oliveira, 2018). About 11% of the world's pollution in 2015 and an estimated 785 million people in 2017 lack access to basic drinking water services (Rosinger and Brewis, 2020; WHO, 2019). Furthermore, according to Pawari and Gawande (2015), 3.1% of global deaths occur due to poor hygiene, water scarcity, and poor water quality.

Pollution of water sources could occur directly (direct release of pollutants into water bodies or water sources) or indirectly (water pollution that happens from transported pollutants from other pollution sources) (Singh *et al.,* 2020). Rainwater, natural water run-off, deposition of surrounding vegetation, and atmospheric composition such as dust are natural sources of water pollution (Singh *et al.,* 2020). Numerous factors are responsible for water pollution, but industries, agricultural and domestic sources are considered the major cause of water pollution, of which industrial wastes account for a higher percentage (Haseena *et al.*, 2017; Chaudhry

and Malik, 2017). Wastewater containing high toxicity of concentrated industrial pollutants with significant potential of causing a detrimental effect to water inhabitants, human health, and the entire environment are released from industries and other small enterprises directly into the environment. These constitute part of the 80 to 90 per cent of untreated wastewater discharged into the water bodies by the community (World Water Assessment Programme (WWAP), 2017; UNESCO World Water Assessment Programme, 2020). Water pollution caused in some industries, mainly in the developing countries, is due to the recent exponential growth rate and carrying out large production without modern types of equipment. These industries still use outdated and old equipment that produces high pollutants such as pesticide, phosphate, lead, asbestos (Carcinogen), chlorobenzene, volatile organic chemicals, dyes, mercury, toluene, noxious solvents, acids, nitrates, alkali, sulphur, and benzene (Shah, 2017).

People whose work involves handling human waste and sewage are likely to be at higher risk of being exposed to waterborne diseases (Centres for Disease Control and Prevention, 2021). Ecological workers working on contaminated sites can be occupationally exposed to hazardous chemicals in water consumed, and soil handled when in contact with contained building or materials (Burger and Gochfeld, 2016). Respiratory, skin, eyes, neurovastibular and headache symptoms related to occupational exposure were found in workers involved in the clean-up operation of the water pollution caused by Hebei sprit oil spill on the yellow sea in 2007 (Na *et al.,* 2012).

The release of industrial effluents has destroyed the chemical, biological, and physical nature various water bodies. Industrial effluents that pollute water sources are wastewater from soap-producing industries, which contain complex chemicals that are highly toxic and harmful to marine habitats, and effluents generated during oil treatment processes from palm oil industries. And wastewater containing various chemicals concentration of dyes is also released from textile industries. Another industrial effluent that pollutes water sources is brewery effluents rich in carbohydrates, nitrogen, and washing reagents. The contamination of surface and groundwater from mining, and oil spillage, which occurs during liquid petroleum production in petrochemical industries, also leads to water pollution (Ado *et al.,* 2015; Institute of Marine Affairs, 2015; Michel and Fingas, 2016; Singh *et al.,* 2020). Developing countries where a small fraction of wastewater is treated before discharge into the environment suffer from widespread water-related diseases such as cholera (UNESCO World Water Assessment Programme, 2019).

Agriculture as a non-point source of water pollution remains a global environmental challenge (Okumah *et al.,* 2019; Davey *et al.,* 2020). Agricultural activities with poor management and bad practices affect water quality negatively. The continuous growth in agricultural production due to the world's rapid population growth has resulted in the use of high-level manure and fertilisers. The manure and fertiliser used in agricultural produce release surplus nutrients such as phosphorus and nitrogen, which are potential water pollutants (Centre for Disease Control and Prevention (CDC), 2016). Pesticides, nutrients, sediments, organic carbon, drug residues, pathogens, salts, insecticides, and metals are major pollutants from agricultural processes contributing to water pollution. Livestock systems, aquaculture, and cropping expansion to meet up the agricultural pressures towards meeting up with changing habits and growing demands of food due to increasing population also lead to the increases in the reduction of water quality (Stehle and Schulz, 2015 and Mateo-Sagasta *et al.,* 2017). Agricultural processes promote eutrophication, resulting from the release of excess nutrients in water bodies during agricultural run-off, leading to the loss of water habitats (Ondieki, 2015; Okumah *et al.,* 2019). Infiltration of agricultural chemicals such as nitrogen from an increased level of pesticides, fertilisers, and salt pollutes water bodies by destroying the water quality and making it unsuitable for irrigation and other uses (UNEP, 2016; Xu *et al*., 2020).

Domestic activities contribute to water pollution through improper sewage disposal into water bodies which is a major contributing factor to poor water quality. Sewage drainage could lead to major water pollution sources, increasing the burden of wastewater management due to the introduction of a wide range of chemical contaminants and increasing the financial budget for water treatment (Norah *et al.,* 2015). Domestic sewage is wastewater from the public consisting of 1 % solids and 99% water (Singh *et al.,* 2020). Water reservoirs polluted with untreated sewage effluents from human activities are responsible for the spread of water-borne diseases because they contain bacteria, toxic organic compounds, fungi, heavy metals, viruses, and parasites that could cause various types of infections (Patel *et al.,* 2015; Olds *et al.,* 2018). Slum in developing countries is associated with an increase in wastewater generation. There is improper disposal of human excrete because of the lack of toilets, and available communal toilets are poorly managed. Poor sanitation is also practised due to the inadequate availability of water. However, wastewater from domestic sources is relatively free of hazardous pollutants; still, the appearance of new contaminants, even low concentrations, could lead to a bad long-term effect on general global health (WWAP, 2017).

2.4.1.2 Soil Pollution

Soil is another important natural element on earth that plays a diverse role in nature and sustains life. Also, it acts as a filter of toxic substances for water required for human survival. Waste products disposed of all over the world finally end up in the soil leading to soil pollution. Soil pollution can be defined as the presence of undesirable toxic contaminants with higher concentrations than in its naturally occurring state in the environment; therefore, it poses a great danger to humans and the entire ecosystem (Petal and Vashi, 2015; Stolte *et al.,* 2016; Environmental Pollution Centres, 2017; Rodríguez-Eugenio *et al.,* 2018). Soil pollution occurs through both intended and unintended human activities leading to direct or indirect soil pollution. The soil's natural structure and composition are affected by soil pollution. Soil quality is also reduced by soil pollution (Hernawati, *et al.,* 2017; Savasan, 2017; Rodríguez-Eugenio *et al.,* 2018). Also, soil pollution occurs due to the decreased recovery capability of the ecosystem caused by rapid industrialisation, urbanisation, and population growth (Yap, 2019).

As one of the major factors of environmental pollution, soil pollution remains of great concern because of its health risk to all life forms (Savasan, 2017). The common sources of soil pollution are agriculture, industrial processes, and domestic waste. The various pollutants from these sources include petroleum hydrocarbons, heavy metals, lead, and pesticides (Gangadhar, 2014). Pollutants from agriculture activities like fertilisers, pesticides, animal wastes, herbicides, and sediments result from improper waste disposal and poor irrigation systems. Fertilisers contain heavy metals (Cu, Cd, Ni, & Hg) and non-organic fertilisers contain nitrate, potassium salts, phosphates, and ammonium. The release of these chemicals into the soil causes soil degradation. In modern agriculture practices, pesticides play a vital role in food production for the growing population. Pesticide contamination in the soil occurs through water run-off from foliage or seed treatment and during spraying on farmland resulting in the irreversible reduction of soil microbes, limiting the chemical, physical and biological composition (Tetteh, 2015; Arora *et al.,* 2017; Harizanova-Bartos and Stoyanova, 2019). Agricultural activities also lead to soil erosion which causes damage to the soil structure and properties (Harizanova-Bartos and Stoyanova, 2019).

The study conducted by Galindo-Reyes and Alegria (2018) found that farmworkers are affected by chronic exposure to chemicals used in their workplace. According to the study, the same measure of pesticide types found in the water and soil assessment in and around their workplace were also found in the urine and blood of the farmworkers. In addition, people exposed to a

high level of pesticides due to intensive usage suffers from genetic damage associated with pesticides (Galindo-Reyes and Alegria, 2018).

Accumulation of heavy metals in the soil from technogenic wastes contributes to land degradation leading to soil pollution (Afonina and Oshirova, 2020). soil pollution from industries occurs from the release of toxic substances from production and processing activities, gas and oil leakage, improper waste treatment, and poor mining practices. Human health, plant survival, and soil quality are significantly affected by land pollution (Paz-Ferreiro *et al.,* 2014; Guan *et al.,* 2015). Soil pollution from industries is associated with increased rapid industrial growth. The natural structure of the soil is altered through chemical contamination from damaged underground oil storage and accidental discharge from industries (Ashraf *et al.,* 2014; Khalilova, 2015). There is variation in the concentration of heavy metals polluting the soil and causing a reduction in plant growth (Chibuike and Obiora, 2014).

Domestic and human activities such as solid waste disposal, construction, and transportation produce various types of pollutants that lead to soil pollution, which threatens the health of the world. Prolonged exposure to toxic pollutants like metals causes adverse health effects on humans (Namuhani and Cyrus, 2015; Staszewski *et al.,* 2015). Increased waste dumps, solid waste landfill, and animal burial site resulting from enormous urban and rural development has been a source of public health concern because of the imposing danger on more than 60 per cent of the world's ecosystem (Pasko and Mochalova, 2014). Cities are becoming threats to the environment by generating an estimated amount of 62 million tonnes of solid waste in sub-Saharan Africa and a total estimate of 1.7 to1.9 billion metric tons globally (Mohammed and Elias, 2017). The improper disposal of municipal solid waste is a potential source of harmful exposure to toxic pollutants in the growing communities (Adamcová, 2016).

2.4.1.3 Air Pollution

Air pollution is defined as the presence of a complex mixture of gases, biological, or physical agents that pollute the atmosphere's natural composition (Health Effects Institute (HEI), 2017a; Mahajan *et al.,* 2020; Schikowski and Hüls, 2020). Air pollution contaminates indoor and outdoor environments (Puri *et al.,* 2017; Schikowski and Hüls, 2020). Air pollution results in poor air quality, damaging human health and leading to premature death (HEI, 2019). Air pollution occurs through both anthropogenic and natural sources. Air pollution variations and effects from anthropogenic and natural sources are often challenging to differentiate (Pöschl,

2020). Air pollutants can be directly emitted into the environment from its sources (these are known as primary pollutants) or formed through the interaction of primary pollutants in the atmosphere (these are known as secondary pollutants) (Spinazzè and Cavallo, 2019). Due to the universal presence of air pollution and its contribution to huge health burdens, this has made it one of the most important environmental exposures widely studied (Andersen, 2020). The general impact of air pollution on the ecosystem and human health has been a major focus of research over the last two decades. Air pollution is identified to be strongly associated with climate change. Evidence has shown an association between air pollution to cardiovascular and respiratory diseases (Forlani *et al.,* 2020; Pope III *et al*., 2020; Ramanathan, 2020). Air pollution adversely affects human health and well-being (Mahajan *et al.,* 2020). Globally, air pollution is also a major concern for policymakers (Forlani *et al.,* 2020). In the United States of America, environmental regulation is based on a fundamental parameter such as air pollution effect on deaths that occurs before the average age of death which is 78.9years as of 2019 (United Nations, Department of Economic and Social Affairs, Population Division, 2019; Anderson, 2020).

Air pollutants of varying sizes ranging from micrometres to nanometres, arise from various sources around the world. Atmospheric wind aids the transportation of air pollution from one point to another worldwide (Ramanathan, 2020). Clean air is essential for human survival and a healthy environment (Department for Environment, Food, and Rural Affairs (DEFRA), 2017). Ninety-two per cent of the world's population still lives without clean air, thereby making the world recognise air pollution as an increasing environmental problem that causes a high mortality rate globally (HEI, 2017b; Zou *et al.,* 2020). Outdoor air pollution is a major known cause of early death and ill-health in the general population (Samet, 2020). Annually, 3.3 million premature deaths are caused by outdoor air pollution, while an estimated number of 3.1 million premature deaths are because of indoor air pollution worldwide (Liu *et al.,* 2018; Haggerty *et al.,* 2020). Indoor and outdoor air pollution exposure cause one-ninth of the total deaths in the world (Zou *et al.,* 2020).

An individual's personal exposure to air pollution is influenced by their daily activities or task (McCreddin *et al.,* 2013). Research shows that exposure to particulates in the workplace is associated with possible adverse health effects such as cardiovascular disease (Fang *et al.,* 2010; McCreddin *et al.,* 2013). The Cohort study by Bauleo *et al*. (2019) reported higher risks of respiratory disease, lung cancer, digestive disease, neurological disease and kidney cancer mortality among transportation, construction, docks, agriculture, and construction product

workers that are occupationally exposed to air pollutants. Outdoor workers (e.g., street vendors, construction workers, etc.) are more susceptible to occupational exposure to multiple risks related to vehicular emission, dust, industrial fumes, construction dust and so on (Barthwal *et al.,* 2022). Occupational groups, including gasoline pumpers, auto service workers, traffic police officers or controllers, chefs using oven or charcoal grills and personnel who repair exhaust pipes, are at greater risk of carbon monoxide poisoning due to occupational exposure (Bol *et al.,* 2018). People working in industries such as power plants, coke ovens, foundries, mining, ore smelters and ore refining are often exposed to sulphur dioxide, known to be corrosive and associated with short and long term health effects (Badenhorst, 2007). The worker involved in battery manufacturing, care repairs, soldering, recycling, jewellery production and smelting is occupationally exposed to lead (American College of Obstetricians and Gynaecologists, 2013).

The major air pollutants from primary and secondary sources with increasing public health concerns have been identified as carbon monoxide, sulphur dioxide, ozone, nitrogen dioxide, lead, and particulate matter. A large percentage of health-related problems are associated with air pollution (CDC, 2014; Brockmeyer and D'Angiulli, 2016; EPA, 2017; Spinazzè and Cavallo, 2019).

Carbon monoxide (CO) in its natural state is an odourless, colourless, tasteless inert gas known to be a silent killer through the formation of carboxyhaemoglobin (COHb) in the human blood that could result in death unnoticed. The effect of carbon monoxide exposure in humans varies from one individual to another based on the person's overall health, age, length, and concentration of exposure (EPA, 2016a; Kourti et al., 2017; Zhao *et al.,* 2019; Kinoshita *et al.,* 2020; Mattiuzzi and Lippi, 2020; MENG *et al.,* 2020). CO is released into the environment from human activities and natural sources, and the major route of human exposure is through inhalation from the atmosphere. Anthropogenic sources of CO are from the incomplete combustion of solid, gas, and liquid carbonaceous fuel such as charcoal, petroleum products, diesel, and other domestic gas. The natural sources of CO include photochemical reactions, wildfires, volcanoes, and a small amount is also produced in the human body (Public Health England, 2016a; Hanley and Patel, 2017; Can *et al.,* 2019; Kinoshita *et al.,* 2020; Lee *et al.,* 2020; Mattiuzzi and Lippi, 2020). Globally, CO poisoning is one of the most common types of poisoning that causes fatal death and fifty-eight to seventy-five per cent of death by poisoning is associated with inhalation of CO (Gozubuyuk *et al.,* 2017).

Sulphur dioxide (SO2) is a colourless gas formed from the oxidation of sulphur fuel during combustion, and it has a sharp smell. SO2 is known as one of the air pollutants that has been classified as a hazardous substance that exerts various environmental and human health effects (Okedere *et al.,* 2017; Bešenić *et al.,* 2020; Shen *et al.,* 2020). The emission of SO2 reduces the oxidizing capacity of the atmosphere, and its increased emission accelerates greenhouse gases and other pollutants concentration in the atmosphere (Shikwambana *et al.,* 2020). The primary source of sulphur dioxide includes volcanic eruption, high sulphuric soil, and biomass burning. Human activities as a secondary source of SO2 contribute about 99 per cent of the SO2 in the air from sources such as industrial processes and fossil fuel combustion. Annually, 50% of sulphur dioxide emission is caused by burning coal, making it the largest anthropogenic source of SO2 globally. Also, the production of sulphuric acid, petroleum refining, and metal smelting are some industrial processes that also emit SO2 (European Petroleum Refiners Association, 2016; Yang *et al.,* 2016; Dai *et al.,* 2019; Zhong *et al.,* 2020). SO2 enters the human body through skin contact and inhalation, causing damage to the respiratory organs and lungs (Okedere e*t al.,* 2017). Oxidative stress and systematic inflammation that could play a role in human stroke could be induced by SO2. The worst symptom of SO2 is felt between 10 to 15 minutes after exposure. Furthermore, sulphur dioxide irritates the human airway, which could cause shortness of breath, coughing, or wheezing. Also, SO2 has been associated with the destruction of the lung and infection of the airway, constituting decreased respiration in animals (Harutyunyan and Mantashyan, 2017; Kumar and Francisco, 2017; Morakinyo *et al*., 2020; Shen *et al.,* 2020).

Ozone (O3) is a secondary pollutant gas produced by the reaction between nitrogen oxides and volatile organic compounds (VOC) in the presence of sunlight (photochemical reaction). It is a major pollutant present in the troposphere with the ability to travel a long distance from its original source, reaching high concentrations (DEFRA, 2016; Pope *et al.,* 2016; Hayes *et al.,* 2020). Ozone air pollution affects the terrestrial ecosystem and plants (Agathokleous *et al.,* 2020). O3, as one of the major air pollutants, is of global concern due to its effect on plant health and human health. Ozone causes an increased rate in daily mortality rate, reduced lung function, and heart diseases when it is present in the air at higher concentrations (Karthik *et al.,* 2017; Sujith and Sehgal, 2017; Bates and Jacob, 2020; Grulke and Heath, 2020; Pepper *et al.,* 2020).

Nitrogen dioxide (NO2) is the most toxic nitrogen oxide family that helps in the formation of troposphere ozone (smog). It could form organic nitrate and high toxic nitric acid because of

its strong oxidising properties, and nitrogen oxides are produced from both natural and human activities (Brand *et al*., 2016; Wang *et al.,* 2016; Wang *et al.,* 2019; Wang *et al.,* 2020; Zhua *et al.,* 2020). Lightning, forest and grassland fires, bacterial processes, biological growth, and decay are natural sources of NO2. The combustion of fossil fuels, especially when burnt at high temperatures, such as in power plants and vehicles, is the major source of NO2 emission from human activities (Tunlathorntham and Thepanondh, 2017; Ogen, 2020; Stieb *et al.,* 2020). Heart, hypertension, cardiovascular disease, and respiratory mortality are associated with high concentrations of NO2. The presence of nitrogen oxide in the air affects human health and plays a significant role in the acidification of the soil and the formation of ozone that leads to water pollution. A high concentration of nitrogen dioxide is also emitted along major highways and cities (Peterson *et al.,* 2017; Arulprakasajothi *et al.,* 2020; Demetillo *et al.,* 2020; Ogen, 2020; Kephart *et al.,* 2020).

Lead (Pb), as an abundant heavy metal, despite being known to be toxic, has lots of useful properties, making it an important element for production in industries. Because of the extensive industrial use of lead, the environment is polluted by this toxic heavy metal emission into the atmosphere. It enters the human body through the skin, inhalation, and ingestion and can affect the nervous system, kidneys, liver, and other human organs (World Health Organisation (WHO), 2015; Moya-Alvarez *et al.,* 2016; WHO, 2019b; Charkiewicz and Backstrand, 2020). Lead occurs naturally, and it is emitted from both indoor and outdoor sources such as the use of petrol containing Pb for powering motor engines, wastewater from battery and metal smelting industries, cosmetics, and paints (Ghorani-Azam *et al.,* 2016; Public Health England (PHE), 2017; ATSDR, 2019).

Particulate matter (PM) consists of a complex combination of very small liquid and solid particles formed from the incomplete combustion of fossil fuels, such as biomass, gasoline, coal, and diesel. Also, it is a complex mixture of inorganic and organic substances in liquid and solid form suspended in the air, referred to as airborne particulate matter. These various particles suspended in the air also constitute the components of particulate matter, which varies in origin, size, and composition (Araújo *et al.,* 2014; Kim *et al.,* 2015; Oregon PSR, 2015; Santibáñez-Andrade *et al.,* 2020). Particulate matter is divided into the following principal group known as coarse particles, fine particles, and ultrafine particles. The particulate matter groups were classified by the use of the particulate matter's aerodynamic properties, and these properties have been outlined based on the aerodynamic diameter (size of a unit density with the same aerodynamic characteristics) of these particles (Robertson and Miller, 2018;

Schraufnagel *et al.,* 2019). Ultrafine particles have an aerodynamic diameter of 0.1 μm or less; PM$_{2.5}$ has an aerodynamic diameter of 2.5 μm or less; PM10 has particles with an aerodynamic diameter of 10 μm or less (De Jesus *et al.,* 2019).

Air pollution is recognised by most developing African countries as one of the biggest problems caused by particulate matter (Pipal and Satsangi, 2015; Haggerty *et al.,* 2020; Miller and Newby, 2020). Worldwide, PM$_{2.5}$ pollutants are the biggest threat to air quality because fifty-eight per cent of the world's population resides in a different geographical location with concentrations of PM$_{2.5}$ (Kanawade *et al.,* 2020). Particulate matter has been associated with numerous and severe environmental problems such as global warming, visibility reduction, change in cloud formation, and the changes in earth radiation balance (Yang *et al.,* 2015; Pipal and Satsangi, 2015; Tiwari *et al.*, 2015 and Tiwari *et al.* 2016). The size of the particles mainly determines the extent to which airborne particles can penetrate the human respiratory system and the possible health effects that could occur based on the presence of the toxic particles (Araújo *et al.,* 2014; Miller and Newby, 2020).

2.4.1.4 Noise Pollution

Noise pollution is a pervasive global environmental problem across the ecosystem that adversely affects the natural system, wildlife, and human health. Despite noise pollution being a global environmental problem, it varies across various geographical locations, sources, exposure, and impact levels (Akintunde *et al.,* 2020; EEA, 2020; Klingbeil *et al.,* 2020; Senzaki *et al.,* 2020). Noise pollution can be defined as the unpleasant, unwanted elevated level of sound that causes disturbance and discomfort to every living thing within the ecosystem (Jain *et al.,* 2016; Mesfin *et al.,* 2018; Sweeney and Mitchell, 2019; Bala and Verma, 2020). Noise pollution is a serious environmental problem often overlooked because it cannot be smelled, tasted, or seen but is regarded as a natural phenomenon (Mesfin *et al.,* 2018; US EPA, 2019). Noise pollution occurs from various anthropogenic activities. Sources of noise pollution include road traffic, aircraft traffic, railways, industries, factories, highways, construction activities, and machines (Ma *et al.*, 2018; Bala and Verma, 2020; Wokekoro, 2020).

Noise pollution has been associated with human health and well-being and has been identified as a significant health problem for the entire human population. Health effects such as annoyance, sleep disorders, diabetes, hypertension, learning impairment, hearing impairment,

neurological disorders, cardiovascular diseases, psychological disorders, ischemic heart disease, and metabolic syndrome are associated with noise pollution.

Noise pollution also contributes to the reduction of quality of life (Sears *et al.,* 2018; Ghaderi *et al.,* 2019; Begou *et al.,* 2020; Clark *et al.,* 2020; Han, 2020; Yang *et al.,* 2020; Yu *et al.,* 2020). In addition, the population affected by frequent and prolonged exposure to vehicular emissions and noise are people who work as Taxi, bus, or truck drivers, traffic police officers or controllers, the trucking industry and tool station workers (Brucker *et al.,* 2020; Niba Rawlings *et al.,* 2021). Zeydabadi e*t al.* (2019) reported in their study that workers in industrial plants such as the metal industry are exposed to a high level of noise which may impact their health. Noise pollution also affects the health of wildlife within the ecosystem. It causes changes to the vocal behaviours of birds and disruption during reproductive periods of birds. Noise pollution that occurs underwater from impulsive sources such as seismic airguns used for oil and gas exploration, percussive pile driving for the installation of offshore wind turbines, and the explosion also affects marine life negatively (McMahon *et al.,* 2017; Berger-Tal *et al.,* 2019; Zollinger *et al.,* 2019; Klingbeil *et al.,* 2020; Merchant *et al.,* 2020).

2.4.1.5 Light pollution

Light pollution relates to all adverse effects of artificial lighting at night. Approximately 80% of the world's population lives in the region with polluted night skies by artificial lighting (Nadyba *et al.,* 2020; Peña-García and Sędziwy, 2020; Stone *et al.,* 2020). Since the creation of electric lighting in 1879, it has been used extensively to ensure efficient transportation, increase recreational activities and economic time, and promote a greater sense of security (Boyce, 2019; Falchi *et al.,* 2019; Nadyba *et al.,* 2020). Artificial lighting is now used globally due to its benefits in commercial, residential, and recreational environments (Kyba *et al.,* 2017; Boyce, 2019). Artificial public lighting is a prevalent feature of roads, small villages, big cities, and various open space infrastructures. An estimated 30% of outdoor lighting costing over 7 billion dollars in the USA is considered wasted annually (Peña-García and Sędziwy, 2020; Stone *et al.,* 2020). Light pollution is an environmental problem that consumes a large amount of energy, costs billions of dollars, hiders natural night sky experience, and negatively affects human health, wildlife, and ecosystem (Silver and Hickey, 2020; Stone *et al.,* 2020). Light pollution is associated with various health disorders in humans, such as insomnia, prostate cancer in men, breast cancer in women, and depression (Hatori *et al.,* 2017; Kim *et al.,* 2017;

Garcia-Saenz *et al.,* 2018; Falchi *et al.,* 2019; Hicks *et al.,* 2020). An increase in women's risk of lung, breast and colorectal cancer was found in workers exposed to artificial light at night due to shift work (Nadybal *et al.,* 2020). Light exposure during working hours may have an effect on workers, such as reduced duration or quality of sleep (Boubekri *et al.,* 2014). Furthermore, the germination and flowering aspects of the plant life cycle are also affected by light pollution. However, plants and animals are at higher risk of light pollution's adverse effects than humans (Xue *et al.,* 2020).

2.4.2   Effects of Environmental Pollution

According to the world health organisation (WHO), drinking water sources used by at least 2 billion people globally are contaminated with faeces. Polio, cholera, typhoid, diarrhoea, and dysentery are transmitted through contaminated water (WHO, 2020b). Water act as a transportation medium for infectious agents that causes various diseases. Infectious diseases transmitted through contaminated water are referred to as water-borne diseases (Ohw, 2019). Globally, an estimated 2.3 billion people are affected by water-related diseases (Ahmed *et al.,* 2020). Polluted water remains a potential threat to public health and the most significant risk to the world's health. Also, it changes the emergency health costs, health service budget, and reduces life expectancy. Water pollution results in water scarcity, contamination of crops, animal production, and health, and increases the cost of water management (Edokpayi *et al.,* 2017; Organisation for Economic Co-operation and Development (OECD), 2017). Diarrhoea, a water-borne disease, claims the lives of about 2.2 million people and reported cases of four billion diarrhoea infections per year. Children under the age of five are at higher risk & of death from water-borne diseases. An estimated death of 361 000 children under the age of five due to diarrhoea are reported yearly (Jabeen *et al.,* 2015; Ahmed *et al.,* 2020; Hind *et al.,* 2020; Magana-Arachchi and Wanigatunge, 2020).

Polluted water causes numerous damages and affects human skin, liver, lungs, kidney, and brain. It also causes congenital disabilities, cancer, and other infections (Khatun, 2017). An estimated seven million people die globally every year because of air pollution (WHO, 2020b). Mostly in low-income and medium-income countries, household air pollution from exposure to cooking fires results in 3.8 million premature deaths annually. Also, a wide range of adverse health effects in children and adults, such as cancer, eye problems, and respiratory problems, can be caused by exposure to various indoor air pollutants (WHO, 2020c). Air pollution is

associated with almost 30% of new lung cancer cases (Santibáñez-Andrade *et al.,* 2020). Air pollution is an environmental risk factor for respiratory allergies that occurs both in developing and developed countries. Hay fever, rhinitis, and asthma are the most common allergic respiratory disease. Millions of the world population are suffering from rhinitis, and more than 272 million people are also currently suffering from asthma (Deng *et al.,* 2020). Air pollution has been associated with human suicide, depression, drug abuse, anxiety, and cognitive decline (Chen and Samet, 2017; Gładka *et al.,* 2018; Braithwaite *et al.,* 2019; Szyszkowicz, 2019; Zeng *et al.,* 2019; Szyszkowicz *et al*., 2020). Household pollution results in the emission of black carbon, volatile organic compounds that contribute to climate change, outdoor air pollution, and negatively affect agricultural production (WHO, 2020c). Growth retardation is associated with exposure to air pollutants like SO_2 and CO (Dutta *et al*., 2018).

2.5   Work Environment

The definition and description of the words "work" and "environment" give a comprehensive understanding of the term "working environment." Definition of work according to Marriam-Webster (2020) and Cambridge (2020) definition are, "work as an activity in which one utilises intelligence and strength to perform or do something," "accustomed means of livelihood such as labour, duty or task", and "a specific function, duty, task, or assignment often being a part or phase of some larger activity." Work also includes paid jobs and unpaid jobs that include voluntary work, education and training, family responsibilities, and care (Waddell and Burton 2006, p. 4; College of Occupational Therapists, 2010). Work is classified as an essential economic activity regarded as an integral part of modern life, contributing to the quality of life and self-esteem (European Agency for Safety and Health at Work, 2004; Waddel and Burton, 2006; WHO, 2010; Abuhashesh *et al.,* 2019). Work is important for various reasons that are not limited to its economic advantages (Warhurst *et al.,* 2017). Work gives a sense of belonging, identity, and purpose with the hope of building decent lives by glimpsing optimistically to our future. Also, social cohesion may be formed through a network of interactions and connections provided through work (International Labour Organization (ILO) 2019).

The word "environment" is derived from the French word "environ," which means "surrounding," and it has a different meaning to different people in all aspects of life. The environment is made up of a combination and interaction of the abiotic (hydrosphere,

lithosphere, and atmosphere) and biotic (living organisms and microorganisms) (Manisalidis *et al.,* 2020). The environment encompasses the whole context that shows how human lives and how they perceive their life. The environment surrounds living things, sustains, nurtures, and provides all basic requirements of living and amenities needed for modern life (Hunter and Smith, 2012). The environment is a collection of all those things that impact human beings during their lifetime (Awan and Tahir, 2015).

Therefore, the "work environment" or "working environment" can be described as the surroundings or the geographical location where people carry out their daily activities (Awan and Tahir, 2015; Massoudi and Hamdi, 2017; Atmaja and Puspitawati, 2018). The working environment incorporates the characteristics of the job itself (example: complexity, task, workload), the physical scenery (examples: heat, noise, equipment), different business backgrounds (example: workers' relation, industry setting), and even extensive business features (example: history and culture) that defines the setting of where the employee operate (Gitonga, 2015; Organization for Economic Cooperation and Development (OECD), 2017). The working environment describes the surroundings at a place of occupation, outside, inside, at a cubicle, or desk (Rezaul, 2014; Amran *et al.,* 2019).

The term working environment has also come to mean the mental state of an individual while on the job. The working environment could be positive, negative, or friendly (Hamid & Hassan, 2015). The working environment consists of recognition of good performance, job security, safety to employees, good relationship with co-workers, motivation for good performance, and participation in the decision-making process of the firm or organisation (Raziq and Maulabakhsh, 2015). The working environment could be defined as the sum of the interrelationship between the employee and the employee's work environment (Bushiri, 2014). Opperman's 2002 definition of the working environment (cited in Waktola, 2019) indicates that "the working environment is a combination of three main sub-environments: the technical environment, the human environment, and the organizational environment". The technical environment refers to technological infrastructures, equipment, tools, and other physical or technical elements that enable employees to assume their respective responsibilities and activities. The human environment refers to peers, others with whom employees relate, team and work groups, interaction issues, leadership, and management designed to encourage informal interaction in the workplace to enhance the ability to share knowledge and exchange ideas, which is the basis for maximum productivity. An organisational environment is also regarded as the institutions or forces surrounding an organisation that includes the systems,

procedures, practices, values, and philosophies that affect all parts of the organisation (Owuor *et al.,* 2018). The workplace environment is the totality of human, technical and organisational interrelationship that occurs at the workplace (Anjum *et al.,* 2018).

2.5.1 Types of Work Environment

An organisation's work environment is grouped into external and Internal work environments (Akpoviroro and Owotutu, 2018; Otter and Wetherly, 2018). Understanding the various factors of internal and external work environments will or may help determine an organisation's future. Knowledge of the major forces that constitute the work environment is fundamental in ensuring proper planning and effective productivity (Babatunde and Adebisi, 2008; Otter and Wetherly, 2018). Success in improving an organisation's performance depends on managing these two factors by analysing environmental factors and establishing and implementing business strategies. Success will be achieved if there is conformity between the internal and external environments through implementation and an appropriate work environment (Indris and Primiana, 2015). Figure 2.12 shows the diagrammatic representation of the two types of an organisation's work environment with the key components of the two main types of the external work environment.
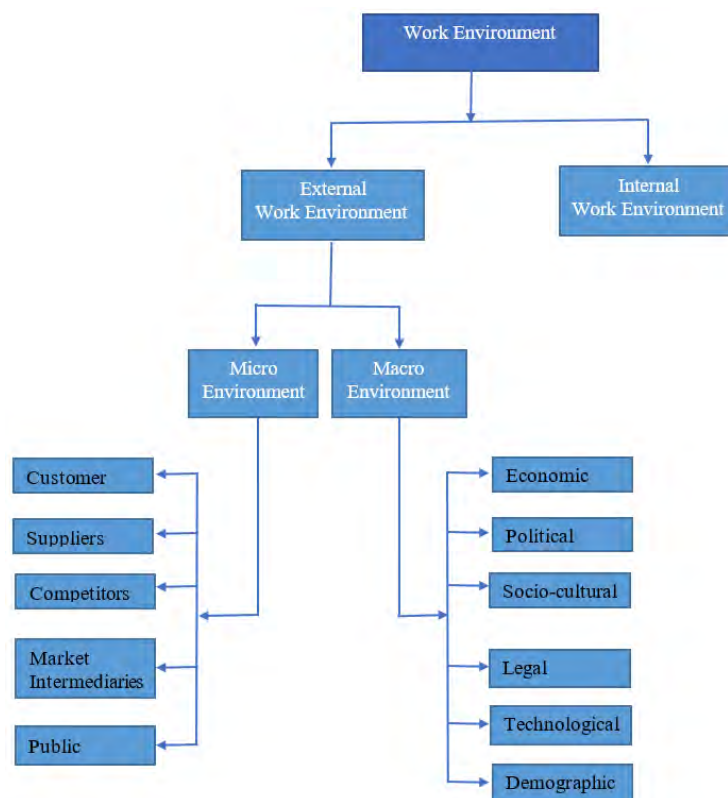
Figure 2.12. Types of Work Environment (Anonymous)

2.5.1.1 External Work Environment

The external work environment includes all entities outside an organisation's border, which significantly influences its growth and survival (Gupta, 2009; Akpoviroro and Owotutu, 2018; Cherunilam, 2018). Indris and Primiana (2015) define the external work environment as all events outside the industry that can affect the industry. Yu and Zhang (2010) state that the external work environment is frequently dynamic, making it difficult for industries and their managers to deal with the changing situation in their organisations. An organisation has little or no control over the external work environment but must constantly monitor and adapt to external changes because proactive or reactive reactions lead to significantly different results (Gupta, 2009; Akpoviroro and Owotutu, 2018; Cherunilam, 2018). The key dimension of the external environment consists mainly of a microenvironment and macro environment. The external work environment offers a wide range of challenges, opportunities, threats, and pressures, thus affecting the structure of the organisation and its functions. The external work environment can provide influences that facilitate or hinder organizational performance (Perera, 2017; Chavan, 2018; Cherunilam, 2018). An example is the emotional impact of acute stressors from an external work environment, leading to organisational trauma (Háša and Brunet-Thornton, 2017).

2.5.1.1.1   Micro-Environment

A micro-environment is related to a small area or close to an organisation that affects its capacity to work (Emeka and Eyuche, 2014; Sekar, 2019). The micro-environment influences an organization regularly and directly within the immediate environment in which the organisation operates (ICIA, 2008; Sekar, 2019). The micro-environment consists of customers, suppliers, competitors, market intermediaries, and the public (Bastani *et al.,* 2020; Pourmohammadi *et al*., 2020).

> ➢ Supplier: The supplier is the main force of an organisation's micro-environment because the suppliers provide inputs such as raw materials and other components for the operation of an organization. Organisations depend on several reliable suppliers of the same raw material rather than one supplier because of the uncertainties created during raw material supply due to changes in suppliers' attitudes. Thus, multiple sources often help reduce risk factors that

could affect the operation of an organisation. Inventory maintenance and inventory delays for the organisation are the major problems of supplying raw materials. Many organizations attach great importance to supplier development, vertical integration to solve supply problems (Emeka and Eyuche, 2014; Hiriyappa, 2018).

➢ Customers: Customers are groups of people who pay money to buy an organisation's products in the form of goods or services. It is a micro-environment component considered most vital. An organisation exists and operates only because of its customer. Hence, the success of any organisation is determined through the level of their customers' satisfaction. Customers are referred to as the king of the market because the main task of an organisation is to create and develop the different things wanted by customers. The customer may or may not be the consumer; therefore, a prerequisite to an organisations' success is monitoring the customer's behaviour. The consumer finally uses the products and services of an organisation (Institute of Chartered Accountants of India (ICIA), 2008; Emeka and Eyuche, 2014; Padgett and Loos, 2019).

➢ Competitors: Competitors are other organisation entities competing for markets and resources. An organisation's competitors may include other organisations with similar products or the same market and those competing for the customer's discretionary income (Hiriyappa, 2018). Competition can be direct or indirect. Direct competition happens between organisations with similar products or services targeting and making their whole money from the same market. Indirect competition is between organisations with certain products or services that are different but competing for the same market or consumers. Indirect competitors are difficult to identify (Brijs, 2016; Greene, 2016). Organisation uses competitor's analysis to identify and tackle various competitions (Barringer, 2016). Competition in business drives output growth and productivity (Feliz and Maggi, 2019).

➢ Market intermediaries: In a business micro-environment, the market is regarded as the most basic element. Market intermediaries are collections of buyers and sellers that help distribute, sell, and promote goods and services to final consumers. Market intermediaries serve as a link between an organisation and its final consumer. Some market intermediaries may principally be found in the immediate environment of an organisation. Actions exerted by the intermediaries considerably influence organisations. Examples are middlemen, agents, merchants, advertising agencies, media, and consulting firms (Hiriyappa, 2018; Padgett and Loos, 2019).

➢ Public: The publics represent the general group of people who may or may not be a user of an organisation's products or services but has the potential or actual impact on the ability of an organisation to achieve its goals (Pîndiche and Ionita, 2013). One of the important market intermediaries that promote awareness of an organisation's product and services is the public. Also, the success of an organisation depends on the acceptance of its product or services by the public (Hiriyappa, 2018). Organisation's sensitive response to its environment and the public's aspiration helps improve its image and products (Yilmaz and Flouris, 2017). Local public, financial public, media public, and citizen action groups are examples of public categories that could affect an organisation positively or negatively (Sinha, 2020).

2.5.1.1.2   Macro-Environment

The macro-environment, also known as the remote environment or general environment, is an uncontrollable environment with factors that forcefully influence an organisation's operation. The macro-environment is beyond the direct influence and control of an organisation; therefore, an organisation's adaptability to the macro-environment determines its success. The components of the macro-environment, such as the technological, economic, political, social, legal, and demographic environments, pose threats and create opportunities for businesses (Sinha, 2020). PESTEL (Political, Economic, Socio-cultural, Technological, Environmental/Demographic and Legal factors) is one of the frameworks adopted for analysing the macro-environment (Mhlanga and Steyn, 2017).

➢ Economic environment: Economic environment is dynamic and complex due to its continuously changing characteristics resulting from political situations and policies. The different organisation in the same economic system operates and make decisions differently due to the complexity of the economic environment. The economic environment consists of a mixture of national and international economic environments (Yilmaz and Flouris, 2017; Cherunilam, 2020). In an economic environment, business organisation is affected by different economic conditions. Economic factors influence the nature and level of demand and consumption. Factors affecting the economic environment include the economic structure, policies, growth rate, per capita income, etc. Also, economies go through a recession and a booming period (Cherunilam, 2020).

➢ Political Environment: The Political environment comprises the total issues and factors resulting from the government's political actions that alter the achievement of business objectives through its capability of changing the expected value and outcome of a given economic entity. Political uncertainty causes instability in organisations' political environment, leading to decreased economic growth and investment (Dewi Navisa *et al.*, 2019; Olubodun, 2019). The political environment affects different industries extensively. The components of the political environment include fiscal policy, tax policy, tariffs, political climate, and the strength of institutions such as the federal banking system. Some political factors like rescue plans are industry-specific. Other political factors like energy policy affect only specific industries (energy producers and energy-intensive users) more than others (Gamble *et al.,* 2005; Prasad, 2010; Mark and Nwaiwu, 2015).

➢ Socio-cultural Environment: The social environment describes people's attitudes, social behaviour, the impact of education, the explosion of knowledge, and public opinion. The cultural environment deals with accepted values, norms, and behaviours that distinguish a group of people from another (Masovic, 2018; Deirmentzoglou *et al.,* 2020). The socio-cultural environment in which an organisation operates is comprehensive because it comprises all the total cultural

and social factors within the geographical location (Sinha, 2020). The functioning of an organisation is significantly affected by the social values and structures cherished by society (Janković *et al.,* 2016). An organisation must adjust its methods of operation according to the evolving socio-cultural values. The interaction of a person with the society they live in refines, shapes, or even modifies their beliefs, values, and norms, which determines their taste, preference, and even quickens them in absorbing specific worldviews. The socio-cultural environmental processes define people's relationships with others in society, institutions, and the universe. Cultures and subcultures sometimes tend to lose their uniqueness and individuality within a social group. The socio-cultural environment factors shape a man's attitude, although there may be great diversity in its impact. The socio-cultural environment factors include the attitude of people to work, family system, traditions, caste system, religion, customs, education, life expectancy, ethnicity, gender, age, marriage, etc. (Fernando, 2011; Wetherly and Otter, 2011; Walsh and Winsor, 2019).

➢ Legal Environment: The legal environment comprises all the legal aspects of organisations such as justice activity, laws and government regulations governing business activities within an organisation and general market, etc. The highly changing part of the work environment is the legal environment. The law that constitutes the legal environment changes every day and contributes to the complexity of the work environment (Cross and Miller, 2016: Nogal-Meger, 2018). The legal environment determines the parameter that allows the possible operation of a business. The prevailing value within the society surely influences the legal environment. It is important to stress that the law does not only act as a constraint to business operation or work activity (e.g., by establishing minimum health and safety standards at work that are legally enforceable). But the law also helps (e.g., by providing a means by which a work unit can exist independently from its members) and, in doing so, contribute to the achievement of the organisations' objectives (Worthington and Britton, 2006; Wetherly and Otter, 2011; Cross and Miller, 2020).

- Technological Environment: Technology is understood as the systematic application of scientific or other organised knowledge such as inventions, advanced mobile technologies and the internet, e-commerce, etc., to practical tasks. Organisations should be alerted to keep pace in adopting changed technology in their work because technology changes fast due to technological development (Prasad, 2010; Meskhia and Shaburishvili, 2015). New technologies that tighten international competitiveness and shorten product life cycles require business organisations to deliver cheaper, better, faster and more innovative products continually introduced through technological development (Dubrovski, 2020). Technology is considered one of the most important factors of any work environment—the experiences of humankind accumulated in various ways and improved on formed the basis for technological development. Therefore, the government has assigned great importance to sophisticated technology in its industrial policy resolutions, industrial licensing policies, and other regulation and policies. The technological environment alters the work environment by providing new opportunities. The external work environment is transformed by the development or advancement of the technological environments (Saleem, 2010; Dauda and Ismaila, 2013; Wetherly and Otter, 2014; Ivanova *et al.,* 2019).

- Demographic Environment: Demography is studying populations based on two characteristics such as their overall size and structure. From a work point of view, the main areas of interest include the population's age structure, gender balance, geographical distribution, and the tendency for the population size and structure to change over time. Demographic change can have important implications for both supply and demand sides of the economy; therefore, it affects all kinds of organisations. The country's population normally increases over time but varies according to some factors like changes in birth rates, death rates, and net migration rates. The differences in total population size have significant economic implications on potential market size, availability of workforce, government spending, economic growth, and international trade. People can also be examined in several other ways, including ethnicity and geographic distribution. In addition, population movements between regions and other factors such as international migration and birth rate and mortality rate can lead

to significant changes at local and regional levels in the population over time, trawling effect on the public and private work sectors. Age, sex, religion, ethnicity, family size, the stage of the family life cycle, life expectancy, work participation rate, rural-urban divide, levels of education, and employment status has an enormous impact on work because the two most important constituent in the work environment is the producer and consumer (Worthington and Britton, 2006; Fernando, 2011; Cherunilam, 2020).

2.5.1.2 Internal Work Environment

The internal environment comprises everything within the organisation and its dynamic relationship that functions to moderate and mediate organisational components such as leadership, culture, structure, resources, decision-making process, workforce, and strategies (Sekar, 2019; Singh and Rani, 2019; Tengtarto, 2020). The internal work environment concerns all the various relationships and activities within an organisation that add value to the organisation and transform the inputs into outputs (Halmaghi *et al.,* 2017). The organisation has control over the internal environment and determines their potentials to deal with the challenges of the environment (Senapti, 2011; Shiamwama *et al*., 2014; Adagba and Shakpande, 2017). Organisational culture as an internal environment component occurs at every level of the organisation playing a significant role in how an organisation interacts internally and how they are viewed externally, i.e., the culture defines an organisation's brand (Wallace, n.d; Kirsop-Taylor *et al.,* 2020). Organisation culture can be defined as the basic assumptions, beliefs, and values shared among organisation members that influence their behaviour, thoughts, and feelings (Vito, 2020). One of the most important components of the internal environment is the human assets acquired by an organisation over time. The success of an organisation depends highly on the skill sets and expertise, attitude, morals, and commitment of its workforce (Fernando, 2011; Jane *et al.,* 2014). An organisational structure is another component of the internal environment defined as the allocation and the undertaking of task processes in an organisation, i.e., it determines the operation of an organisation. Organisation structure also impacts decision-making, task allocation and delegation, reporting practices, and communication within an organisation (Lawson *et al.*, 2019).

2.5.2 Influences of Work Environment on Organisation and Employee

The condition of the working environment is very crucial to profit and non-profit-oriented industries because both organisations are working towards the effective production of their various services. Studies have shown that the condition of the working environment is inextricably linked to the productivity of the workplace (Saha and Mazumder, 2015; Atmaja and Puspitawati, 2018). Most importantly, the type of working environment in which an industry operates determines whether such an industry will prosper (Samson *et al.,* 2015). The work environment is an important determinant of employees' productivity performance within an organisation (Saidi *et al.,* 2019). The work environment is related to employees because they spend most of their time generating activities in the workshop, thereby making the environment where employees spend significant time working a vital component of their work-life ((Mathews and Khann, 2016; Hafeez *et al.,* 2019). An important contributing factor to employee productivity improvement in an organisation is a comfortable work environment (Atmaja and Puspitawati, 2018).

The influences of the work environment on employees are not limited to their performance but also have a positive and negative effect on employees' psychology and welfare (Hope *et al.,* 2017). Anjum *et al.,* 2018 state that a collaborative work environment creates the sensation for cooperation, facilitation, kindness, happiness, politeness, harmony, and joy. A toxic work environment is associated with stress, health problems, anxiety, absenteeism, fatigue at work, depression, degraded productivity, and harmful work behaviour within the workplace. Conditions that aid the effective performance of employees through the best use of their skills, knowledge, competencies, and the available organisation resources to provide high-quality service can be found in an attractive and supportive work environment (Waktola, 2019). Therefore, an attractive and supportive work environment can be described as an environment that helps people's focus, stirring them to be in its workforce, providing them with a prospect of effective performance (Awan and Tahir, 2015; Hafeez *et al.,* 2019; Rasool *et al.,* 2020).

One of the key variables important in determining the learning and incorporation of employees' knowledge and skills into their work activities and responsibilities is the work environment (Alias *et al.,* 2017). Studies show that the working environment plays a major role in impacting employees' job satisfaction and motivation in an organisation (Abualrub *et al.,* 2016; Agbozo *et al.,* 2017; Suifan, 2019). An increase in workplace violence has been associated with a poor working environment. Features of a poor working environment like workplace bullying produce negative organisation outcomes and negative health consequences (Teo *et al.,* 2019;

Rasool *et al.,* 2020). A positive work environment eliminates unnecessary stress on the employee because they can effectively carry out their work and boost their work performances (Saidi *et al.,* 2019). The protection of peoples' health and improvement of the work environment through risk management and collaborative effort of both the manager and workers constitutes the quality of a healthy workplace (Rožman *et al.,* 2019).

2.6 Healthy Work Environment

According to the World Health Organisation (WHO) (2010), "a healthy workplace is defined as one in which workers and managers work together to use a process of continuous improvement to protect and promote the health, safety, and well-being of workers and the sustainability of the workplace by considering the following requirements based on the needs identified:

- health and safety concerns in the physical work environment;

- health, safety, and well-being concerns in the psychosocial work environment, including organisation of work and workplace culture;

- personal health resources in the workplace

- and ways of participating in the community to improve the health of workers, their families, and other members of the community" (Burton, 2010; WHO, 2010; Global Centre for Healthy Workplace, 2017).

The Royal College of Nursing also defines a healthy workplace as a workplace that offers fair wages and bonuses, possesses high-quality recruitment procedures and practices that stimulate dignity at work, and provides a certain degree of autonomy and control to employees through job design. In addition, a healthy work environment offers good work-life balance, provision to all employees with equitable access to development opportunities, learning and training, and ensuring the promotion of health and safety of employees at work (Royal College of Nursing (RCN), 2015). A healthy workforce makes up a healthy society (Cooper and Leiter, 2017). A healthy workplace is crucial in an organisation; therefore, to create a work environment that promotes, protects, and supports the workers' mental, physical, and social well-being, an organisation should address the healthy workplace's four avenues of influence based on the needs identified. An employer collaboratively working with their workers can use the "four avenues of influence" to change the health condition of the workers and the organisation as a

whole in terms of its productivity, efficiency, and competitiveness (WHO, 2010; European Agency for Safety and Health at Work, 2013; CBE *et al*., 2014: Global Centre for Healthy Workplace, 2017).

The "Four Avenue of Influence" determines the internal environment of an organisation, and their various actions overlap each other, as shown in figure 2.13. The avenues of influence are:

- ➢ Psychosocial work environment

- ➢ Personal health Resources

- ➢ Enterprise community involvement

- ➢ physical work environment
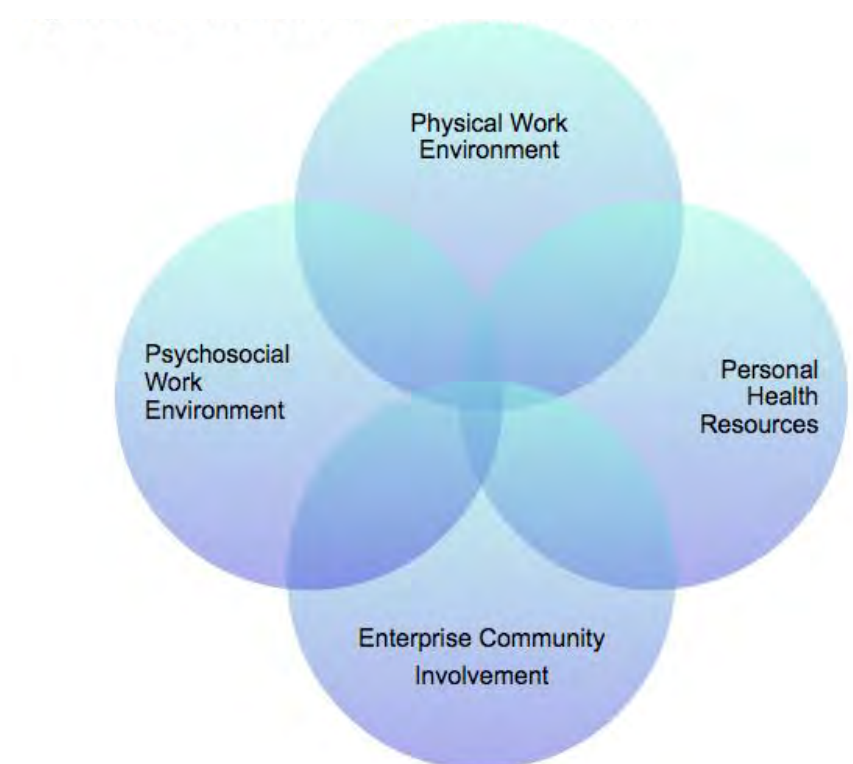
Figure 2.13. Avenues of Influence for a Healthy Workplace (Burton, 2010)

2.6.1 Psychosocial Work Environment

Psychosocial is defined as the influence of social factors on the behaviour or mind of an individual (PHE, 2017). Various factors reflecting the organisational process of work are often used in defining the term "psychosocial work environment" (NIOSH, 2008). So, the

psychosocial work environment is defined as an environment that pertains to the interrelation of organisation culture, beliefs, values, work organisation, daily practices, and attitudes and how it affects the physical and mental well-being of the employees in the organisation (WHO, 2010; Jacobs, 2013; Biron and Burke, 2017). The various factors known as psychosocial work environment features are non-physical hazards that are sometimes generally referred to as "psychosocial stressors or factors" or "workplace stressors," which may cause employees mental and emotional stress. The psychosocial factors of a psychosocial work environment include discrimination, violence, harassment, poor work-life balance, high work pressure, inequitable treatment of employees, job training, job design, and so on (National Institute for Occupational Safety and Health (NIOSH), 2008; WHO, 2011 and Eurofound, 2015; Isha e*t al.*, 2020). The conditions of the psychosocial work environment act as a vital well-being predictor for workers both in terms of their work-life balance and immediate daily well-being at work (Clausen *et al.,* 2019). The consequences of employees being exposed to psychosocial stressors at work are believed to significantly affect the workplaces, workers, and even society. Some of the consequences are stress, reduced quality of life, sleep disorder, cardiovascular diseases, decreased motivation, burnout, musculoskeletal disorders, and reduced productivity at the workplace (Kristensen *et al.,* 2005; Nieuwenhuijsen *et al.,* 2010; Eurofound, 2015; Anskär *et al.,* 2019; Mokarami *et al*., 2020).

2.6.2   Personal Health Resources

Personal health resources in the working environment are opportunities, information, resources, health services, and the flexibility provided by the organisation to motivate and supports their workers' effort to maintain and improve their personal lifestyle and general health (Burton, 2010; Workplace Safety & Prevention Services 2011a; Public Health Agency, 2014; Chen and Fellenz, 2020). An individual's job often disrupts their healthy living lifestyle. An organisation can provide information or resources that can support employees' personal health goals such as sun safety, smoke-free living, stress management, regular sleep, and regular health check-ups. Other information that an organisation can provide for employees includes resources on physical activities, healthy eating, strategies for reducing drug use and alcohol, and so on (Workplace Safety & Prevention Services (WSPS), 2011b and Biron *et al.,* 2016; Biron and Burke, 2017).

2.6.3 Enterprise Community Involvement

The World Health Organisation defines enterprise community involvement as the knowledge, activities, and other resources an organisation applies to provide or participate in the communities they operate. The participation of an organisation in the physical and social community affects the mental and physical health, safety, and the general well-being of the employees and their respective families (Scriven and Hodgins, 2012; Business Services Organisation Health and Wellbeing Strategy, 2014). Global or local community issues that an organisation can improve through participation are community disasters such as earthquakes and floods, unemployment, and lack of literacy among employees and their families. Organisations could also participate in community issues like lack of community security and infrastructure to encourage easy and effective transportation during work and leisure time (Burton, 2010).

2.6.4 Physical Work Environment

The physical work environment is a part of the working environment that includes tangible components such as furniture, machinery, structures, production layout, chemical, production material, products, and air. The tangible components have been identified with the ability to affect the working condition, mental health, physical health and safety, and employees' general well-being in a workplace (Heryanto, 2019; Pradnyana *et al.,* 2019). The effect of the physical work environment cannot be overstated because; various hazards in this environment can often cause quick death (Kyko, 2005; Oswald, 2012; Foldspang, 2014; Adewale *et al.,* 2020). The physical environment also influences employees' knowledge-sharing behaviour within an organisation (Weijs-Perrée *et al.,* 2019). The various hazards that could affect a healthy workplace in a physical work environment include:

➢ Physical hazards (air, noise, vibration, heat, nanoparticles);

➢ Chemical hazards (asbestos, smoke, silica, dust, solvents, pesticides);

➢ Biological hazards (HIV, lack of clean water, tuberculosis, respiratory diseases, toilets);

➢ Mechanical hazards (machinery hazards related to forklifts, Kiln, cranes);

➢ Ergonomics hazards (hazards caused by heavy lifting, awkward working posture);

➢ Energy Hazards (electrical hazard, fire hazard, falls from height);

➢ Mobile hazards (e.g., driving on an unfamiliar road, on ice, in a rainstorm, or poorly maintained vehicles driving) (Burton, 2010 and WHO, 2010).

2.7   Occupational Disease and Injury (Work-related Disease and Injury)

According to the World Health Organisation (WHO), occupational disease/ work-related disease is defined as any form of disease developed because of risk factors exposures during work activity. Factors in the work environment and other risk factors may play a role in the development of work-related diseases that have multiple causes (WHO, 2020d). Various occupational risk factors contribute immensely to the global burden of disease, although its contribution varies greatly in and between countries according to the occupational disorders incidence estimates (GBD 2016 Occupational Risk Factors Collaborators, 2020). Particulate matter, gases, and fumes; occupational injury risk factors; asthmagens; second-hand smoke; noise and ergonomic risk factors are included as occupational risk factors in the Global Burden of Disease (GBD) 2016. Also, occupational morbidity and mortality vary across the world, with an estimated percentage contribution of 65% from Asia, followed by Africa with 11.8%, Europe with 11.7%, America with 10.9%, and 0.6% from Oceania (ILO, 2019).

According to Bepko and Mansalis (2016), an occupational disorder is described as a workplace event or exposure that causes occupational health problems or contributes to existing or pre-existing health conditions. Occupational injury is a fatal (resulting in death) or non-fatal injury (disease or personal injury) resulting from an occupational accident (Arezes *et al.,* 2016; Nghitanwa and Lindiwe, 2017). Furthermore, any undesirable and unplanned occurrences resulting from doing work that causes injury damage to the work environment, property, plant and leads to increased encumbrance or production losses is referred to as an occupational accident (Nghitanwa and Lindiwe, 2017). Work-related accidents resulting in injury and death are issues recognised as a global phenomenon (Berhanu *et al.,* 2019). Workers may fully recover and return to their normal daily life, while some workers suffer from aliment even years after occupational accidents. After an occupational injury, post-traumatic stress disorder, elevated depression, and suicidal ideation are exhibited by work-related injury workers (Chin *et al.,* 2018).

Deaths of workers from work-related diseases account for a higher percentage, resulting in 2.4 million out of 2.78 million annual workers' deaths from occupational accidents. About 374

million workers also suffer from non-fatal occupational accidents (ILO, 2019). Globally, there are about 340 million occurrences of occupational accidents and an annual work-related illness of 160 million victims. The young and older workforce are the most vulnerable to occupational accidents (ILO, 2020). More than 300 000 deaths annually and many disability-adjusted lives are related to occupational injuries globally (Lin *et al.,* 2020). A high percentage of fatalities among workers is caused by work-related diseases. Annually, more than one million of the world's workforce die as a result of hazardous substance exposure. The poorest countries with the least worker's legal protection account for the larger majority of work-related deaths (LaDou *et al.,* 2018). An estimated 1000 people die daily from occupational accidents, and an additional 6,500 die each day from occupational diseases. About 5-7% of deaths globally are associated with work-related disease and injury. Nearly three-quarters of the total work-related deaths are contributed from the estimates by circulatory system disease, work-related cancer, and respiratory diseases contribute 31%, 26%, and 17%, respectively (ILO, 2019). Asbestos exposure contributes to the largest proportion of occupational cancer (Rushton, 2017). Work-related injuries could lead to adverse psychological and physical effects on affected people, and it places economic burdens on the individual, industries, and the entire health system (Lin *et al.,* 2020).

2.8   Occupational Health and Safety

Occupational health is crucial in tackling work-related accidents because most occupational accidents and diseases are preventable using control measures that focus on particular risk factors. High priority should be given to occupational health and safety because these preventable work-related injuries and diseases have a serious impact on the global economy and greatly impact the social well-being of workers and their families, work income, and productivity. Furthermore, all workers have the fundamental right to a safe and healthy working environment (LaDou *et al.,* 2018; GBD 2016 Occupational Risk Factors Collaborators, 2020). Prevention of work-related injuries and disease requires accurate and vast information on its prevalence, but basic and statistical information on various occupational diseases and injuries are absent due to insufficient attention, lack of awareness, diagnostic problems, and a limited reporting system (Davoodi *et al.,* 2017).

Occupational Health and Safety (OHS) is also referred to as occupational health (OSH), occupation safety, and occupational health. Occupational health and safety is a

multidisciplinary area with a comprehensive approach that deals with people's general health, mental health, social well-being, physical health, and personal development (Alli, 2008; Khan *et al.,* 2014). OHS is defined as the science of awareness, identification, evaluation, and control of hazards related to the work environment that could affect workers' health and wellbeing, considering the possible impact on surrounding communities and the general environment (Alli, 2008; Ilbahar *et al*., 2018). The principal aim of OHS is to develop and promote safe and healthy work, organisation of work, and work environment, contributing to positive sustainable development and encouraging workers' behaviour to live economical and socially productive lives. Occupational health and safety also aim to promote and protect workers' health by controlling and preventing work-related accidents and diseases, eliminating hazardous conditions, and eliminating occupational risk factors to health and safety at work. Furthermore, OHS helps improve workers' physical, social and mental well-being, development and maintenance support of working capacity, and development of social and professional at work (WHO, 2001; Khan *et al.,* 2014; Bhagawati, 2015).

Despite the implementation of occupational health and safety, workers' access to OHS worldwide has remained at a very low level. However, positive responses are shown about the implementation of OHS in developed countries, but OHS implementation in developing countries remains at a suboptimal level (Moyo *et al.,* 2015). An increase in the rate of work-related injuries was associated with incompetent and dysfunctional OHS regulatory and enforcement systems and under-reported occupational accidents (Idoro, 2008, Diugwu *et al.,* 2012; Umeokafor *et al.,* 2013; Umeokafor *et al.,* 2014b). To ensure a safe work environment, workers should have the right to be educated, well informed, and trained in health and safety at their workplaces all over the world (Van Dijk *et al.,* 2015). Different approaches are adopted to understand the various cause-effect relationships within the work environment to ensure OHS aims and goals are achieved (Zahir, 2019). Occupational health and safety, injury prevention, and health promotion are combined to promote and protect workers' health, safety, and well-being in an integrated approach. An integrated approach is defined as the "strategic and systematic integration of distinct environmental, health and safety policies and programs into a continuum of activities that enhance the workforce's overall health and well-being and prevent work-related injuries and illnesses" (Cooklin *et al.,* 2017).

A systematic approach to hazard management in a company that involves the roles, functions, and practices associated with remaining safe, consisting of consistent communication about safety issues, employee involvement, and commitment to safety, describes the safety

management approach adopted by various industries (Liu *et al.*, 2020). OHS aims to reduce the likelihood and consequences of work-related accidents as much as possible, thereby promoting risk management adoption in different organisations. Risk management refers to coordinated activities used to control and direct an organisation about risk, which involves risk assessment, treatment, acceptance, and communication (Arezes *et al.,* 2016). Organisations also ensure OHS by carrying out their primary responsibility is meeting and obeying occupational health and safety legislation which is a legal requirement. This legislation is an important component of organizations' management process (Salguero-Caparrós *et al.,* 2020). Transfer of tacit knowledge is suggested to support the appropriate shaping of skills & habits for OHS that will eventually contribute to the reduction of workers, unsafe attitudes (Duryan *et al.,* 2020). The awareness of workers' occupational health and safety that describes how workers are aware and knowledgeable about hazards in their work environment and the employer & workers' OHS rights and responsibility at work helps reduce their vulnerability. Supervisor safety support and knowledge are important elements towards reduced work-related injuries and improved safety conditions. It is widely acknowledged that supervisors influence workers' safety rules compliance and behaviour (Yanar *et al.,* 2019). Health and safety at work are essential and vital to achieving the 2030 Sustainable Development Goals (SDGs) (ILO, 2019).

2.9   Work Environment and Quality of Life

A safe work environment contributes to employees' quality of work-life, which is associated with their well-being, health, safety, motivation, job security, job satisfaction, and productivity (Leitão *et al.,* 2019). The work environment also affects the professional quality of life (the quality a person feels about their work) (Monroe *et al.,* 2020). Also, the ability of a lot of people to strike a work-life balance is a crucial factor in achieving good quality of life (Royal College of Nursing (RCN), 2015). In recent years, different discipline within health and medicine has established quality of life (QoL) as an important area of research because of its identification as an important indicator of health outcomes used in health service research, epidemiological studies, and clinical trials. Quality of life is regarded as a complex concept defined and interpreted differently within or between various disciplines (Fayers and Machin, 2016; Bloemeke *et al.,* 2019). Leading health organisation also recognises that identifying the quality

of life relative to an individual's health or disease status across all life stages is crucial for health practitioners, researchers, and policymakers (Bakas *et al.,* 2012).

Quality of life can be measured over a wide range which can be affected in various ways by an individual's personal beliefs, environmental interactions, physical and psychological health. Quality of life refers to people's perceptions of their position in life in the context of the cultural and value systems in which they live and about their goals, expectations, norms, and concerns. Quality of life (QoL) is an integral part of assessing people's health. Quality of life often focuses on individuals' physical and mental health and functional performance (Page *et al.,* 2017; Wong *et al*., 2018; Gebremedhin *et al*., 2019). Health-related quality of life (HRQoL) is a term introduced in the mid-1980s that refers to the health aspects of quality of life. Health-related quality of life is defined as the measure of the value attributed to life expectancy, altered by functional conditions, impairments, perceptions, and opportunities due to illness, injury, treatment, and policies (Post, 2014; Haraldstad *et al.*, 2019). HRQoL is a part of the quality of life that focuses on the health concept directly or indirectly affected by injury, disease, and treatment. Although many researchers and clinicians use the term "health-related quality of life" and "quality of life" interchangeably or treat it as synonymy but fail to explain that HRQoL and QoL are two different entities (Post, 2014; Sait and Srinivasaiah, 2019).

2.9.1 Quality of life Measuring Instrument

The HRQoL measuring tools are very useful in comparing the health status across different diseases, different severity, and the effectiveness of any intervention (Zhou *et al.,* 2013; Hafizan *et al.,* 2018; Sait and Srinivasaiah, 2019). The generic or disease-specific instrument is used to measure health-related quality of life (HRQoL) based on the purpose of measurement (Makatita *et al.,* 2019). A generic tool is designed to measure the global assessment of general health, including physical symptoms, functioning, and emotional health dimensions relevant to all health conditions, including healthy individuals. The disease-specific instrument is designed to detect the slightest change in a group of patients with a specific disease to compare their specific physical, mental, and social aspects of health caused by the disease (Zhou *et al.,* 2013; Hafizan *et al.,* 2018; Sait and Srinivasaiah, 2019). The Nottingham health profile (NHP), Medical outcomes study short form-36 (SF-36), Psychological general well-being index (PGWB), and WHO quality of life health survey (WHOQOL-BER) are examples of the generic instrument (Krantz *et al.,* 2019; Wong *et al.,* 2018). Schizophrenia Quality of Life Scale

(SQLS), Caregiver Quality of Life (CGQOL), and Quality of Life Scale for Drug Addicts (QOL-DAv2.0) are examples of disease-specific instruments. (Zhou *et al.,* 2013; Brown *et al.,* 2019; Seow *et al.,* 2019).

2.9.1.1 Medical outcomes study short form-36 (SF-36)

The SF-36 is a generic 36-item tool commonly and widely used to measure individuals' health-related quality of life across the world in studies (Zhu *et al.,* 2016). SF36 is a 36-point questionnaire to measure responses in 8 areas of health (physical functioning, functioning of the physical role, body pain, general health, vitality, social functioning, role of emotional functioning, and mental health). The eight areas of the SF-36 can be combined to produce a summary of health measures, i.e., the PCS score for the physical component summary and the MCS score for the mental component summary. The SF-36 summary of the physical component (PCS) assesses functional capacity, physical aspects, pain, and overall health, while the summary of the mental component (MCS) assesses the vitality, social functioning, the role of emotional functioning, and mental health (Wang *et al.,* 2019; Standaert *et al.*, 2019; Pérez-Flores *et al.,* 2020). The translated version of the SF-36 in various languages has been used to conduct multiple studies published in peer-review journals (Garratt and Stavem, 2017).

SF-36 is easy to use, and it can be completed within 10 minutes. SF-36 is scored using Quality Metric Health Outcomes Scoring instructions that rate participants' results between 0 to 100, where a low score represents poor health-related quality of life, and a high score indicates good health-related quality of life. SF-36 can be self-administered, administered through one-on-one interviews, or through telephone interviews (Augusto, 2016; Bourdel *et al.,* 2019; Louthrenoo *et al.,* 2020). SF-36 was developed from the 149-item used to gather functional and well-being profiles in a four-year study that examines the specific impacts on medical care outcomes (Medical Outcomes Study (MOS)). SF-36 (Ware-36), developed in the 1980s, was published in 1992 by Ware and Sherbourne work with the RAND Corporation. Hays, Sherbourne, and Mazel, in 1993, released a different version of SF-36, referred to as the RAND-36, that has the same number of thirty-six items as Ware-36, but they are both scored differently. Ware-36 and RAND-36 are both referred to as SF-36 due to their identical thirty-six item despite their different scoring instruction. Also, a shortened version of SF-36, such as SF-12, SF-8, and SF-6D, is developed and used in research studies (Der-Martirosian *et al.,* 2010; Laucis *et al.,* 2015; Garratt and Stavem, 2017; Bourdel *et al*., 2019).

The Short-Form 12 survey (SF-12) is a widely used shorter version of SF-36 that is reliable and valid in measuring health-related quality of life regarding mental and physical function. SF-12 consists of 12 items that cover the same eight health areas as the SF-36. The SF-12 is easy and can be completed in less than 2mins due to fewer questions (Der-Martirosian *et al.,* 2010; Doris *et al.,* 2015; Tucker *et al.,* 2016; Huo *et al.,* 2018). The Short-Form 8 (SF-8) consists of eight items, and the eight health domains are represented by one question each. SF-8 is used in larger population studies and can be completed in one or two minutes (Laucis *et al.,* 2015; Mytton et *al.,* 2016; Tapper *et al*., 2019; McKerrow *et al.,* 2020). The Short-Form 6 dimensions health survey (SF-6D) is a relatively new measuring approach for health-related quality of life status that yields a preference-based health measure with a six-dimensional health classification (Mental health, physical functioning, social functioning, vitality, role functioning, and pain and fatigue) based on items from SF-36 and SF-12 (Fu *et al.,* 2019; Kularatna *et al.,* 2019; Dawoud *et al.,* 2020).

2.10   Theoretical Framework in Public Health

Models can be defined as the simplification of a condition that includes phases or stages, and theories are variables and predictions of the relationship between the variables. Frameworks consist of constructs, categories of concepts, and the identification of the relationship between variables without predicting the relationship (Bergeron *et al.,* 2017). Theories explain the spontaneous relationship between a phenomenon and an outcome in social science. There is a frequent promotion of theory-based evaluation with a conceptual framework used to guide research processes focusing on the analysis and interpretation in global health intervention research. Theories describe the process of unfolding and the change of processes of an intervention and the relationship between the inputs, outputs, and results (Ridde *et al*., 2020). Also, theory serves as a way for new knowledge generation and the development of public health as an academic discipline. Health improvement is aided by health education, programme planning, and health behaviour theories. Furthermore, the explanation of population health patterns linking the social with the medical and the enrichment of research base are aided by epidemiological theories (Gauffin and Dunlavy, 2019). The various theoretical framework and approaches include the transtheoretical model, ecological model, social cognitive theory, health belief model, theory of reasoned action/theory of planned behaviour, and many others.

2.10.1 Transtheoretical Model (Stages of change model)

Transtheoretical Model (TTM) is also referred to as the stages of change model (SCM) because of the assumption stated by the transtheoretical model that an individual has to go through pre-contemplation, contemplation, preparation, action, and maintenance, which are the five stages of change. Transtheoretical Model was developed in the late 1970s with credit to Prochaska DiClemente, Norcross, and Velicer in a study that examines the reason for the capability of some smokers to quit smoking on their own (Greyson and Johnson, 2016; Zimmerman *et al.,* 2016; Moreira *et al.,* 2020). The pre-contemplation phase is the first stage that shows that an individual is unaware of the adverse effect of their present behaviour or believes that the impact of the present behaviour is insignificant and has no motive for changing the behaviour. The contemplation stage involves the start of an individual thought towards changing their behaviour within the next six months. When an individual starts planning to make change within a month and takes gradual steps towards changing is considered the preparation stage. The action stage is when individuals have newly changed their behaviour and actively try to modify the negative behaviour to acquire new behaviours. The final stage of the transtheoretical model is when the maintenance starts. The individual has been able to manage the change for more than six months while actively trying to prevent a relapse (a fallback by one or two stages of change which can happen at any stage) (Friman *et al.,* 2017; Liu *et al.,* 2018b; Mettling *et al.,* 2018).

Furthermore, stages of change, self-efficacy, decisional balance, and processes of change are the four core constructs of the transtheoretical model (Liu *et al.,* 2018b; Li *et al.,* 2020). Stages of change classify individuals into the five stages based on the readiness level of an individual to behavioural change. Self-efficacy refers to an individual's recognised ability to carry out a task and one's self-confidence in a condition. Decisional balance is the transtheoretical model core construct that concentrates on the advantage and disadvantages of behaviour change. The processes of change comprise the elements needed for behaviour change and the behaviour changing process at each change. In addition, the process of change construct is divided into experimental and behavioural processes (Kim, Kang, and Hwang, 2017; Jahromi *et al.,* 2020). The processes of change are the transition period between the different stages of change that can be affected by a set of independent variables (Zimmerman *et al.,* 2016).

Transtheoretical Model is a well-established and widely used integrative framework in health research and intentional behavioural change description (Friman *et al.,* 2017; Han *et al.,* 2017; Moreira *et al.,* 2020). The TTM is also used to explain the process of change in a cycle.

Identifying an individual in the various stages in the cycle helps design motivational interventions that aid an individual in making desirable changes (Watakakosol *et al.,* 2020). Figure 2.14 shows the cyclic diagrammatic representation of the five stages of change in a transtheoretical model showing the series of stages for behavioural modification and what each stage of change represents. Relapse can occur at any of the five stages; therefore, different processes of change and principles are applied at each stage to facilitate progress, reduce resistance, and prevent relapse (Tucker, 2019).
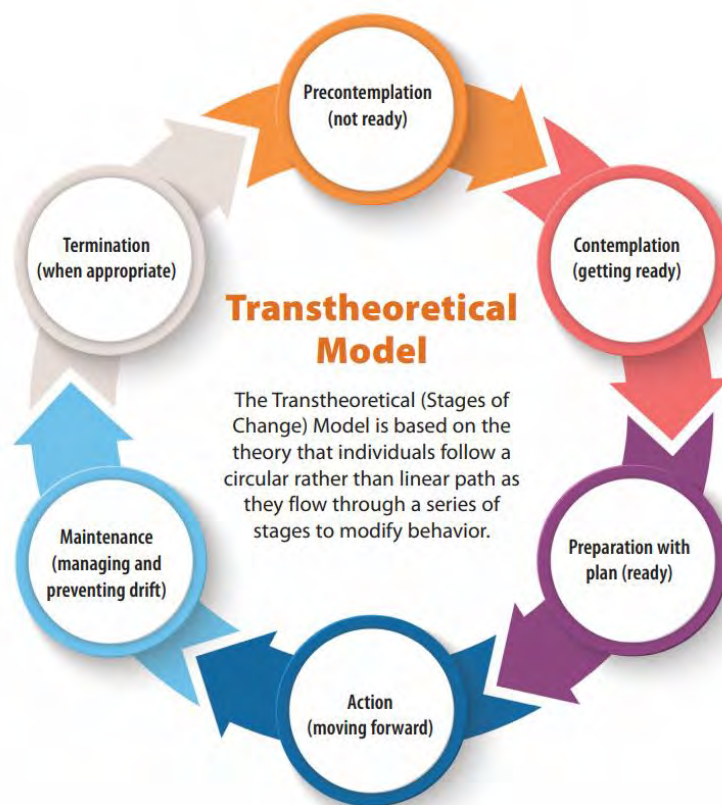
Figure 2.14. Transtheoretical Model (Stages of Change) (Tucker, 2019)

2.10.2 Ecological Models

Ecological Models (EM) encompass various models with similar approaches developed to understand and influence people's behaviour at the social, environmental, and individual levels. Different ecological models are usually paired with other individual theories that target behaviours, feeling, and beliefs (Greyson and Johnson, 2016; Hagger *et al.,* 2020). Ecological models provide an integrating framework for multiple theories that ensure policy and environmental factors to be considered in developing comprehensive approaches to study and

intervene in health behaviours. Ecological models allow a combination of other health behaviour in a broader context, recognising each theory's values rather than displacing the theories (Glanz *et al.,* 2015). The different ecological models revolve around essential principles, which include interactions across a level of influence and multiple levels of influence for health behaviours (Ding, 2013). The socio-ecological model (SEM) is an example of an ecological model introduced in the 1970s by Bronfenbrenner. The socio-ecological model is highlighted as an approach for complex public health challenges acknowledging the interrelation between the multiple levels of influences (individual, interpersonal, community, organisational, and policy level) that affect health outcomes (Mahmudiono *et al.,* 2019). An individual level includes attitude, skills, knowledge, experience, psychological, biological, and demographic characteristics of a person. The interpersonal level includes people's culture, friends, peers, family, and other social networks that are formal and informal. The organisational level comprises personal affiliations, social and organisations such as professional and personal affiliations, educational settings, and workplaces. The community level comprises interaction and relationship between the natural and built environment and the organisations, while the policy level includes regulations, laws, policies, rules that could be at the local, state, and national levels (King and Gonzalez, 2018).

PRECEDE-PROCEED model is not regarded as a theoretical framework, but it adopts the ecological approach in health promotion program planning and evaluation (Johnson, 2016; Whatnall *et al.,* 2019). Green and Kreuter develop the PRECEDE-PROCEED model with a planning approach that evaluates the factors affecting behavioural change and a planning structure of systematic application of concepts and theories of assessing programmes for changes in health behaviour (Porter, 2016; Jeihooni *et al.,* 2019; Chaboksavar *et al.,* 2020; Mosavi *et al.,* 2020). PRECEDE-PROCEED model is a widely adopted model for planning health programs in various settings such as the workplace, education, health, and societal settings (Handyside *et al.,* 2020a). PRECEDE in the model stands for Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation, and the PROCEED represents Policy, Regulatory, and Organizational Constructs in Education and Environmental Development (Garcia *et al.,* 2019; Farisni *et al.,* 2020).

The PRECEDE phase of the model describes the health problem identification process, prioritisation of underlying sources exploration, and the identification of appropriate interventions. The PROCEED phase of the model describes the implementation and evaluation of health intervention outcomes (Handyside *et al.,* 2020b). The PRECEDE-PROCEED model

consists of eight steps with four planning steps (social assessment; epidemiological, behavioural, and environmental assessment; educational and ecological assessment; administrative and policy assessment). The PRECEDE-PROCEED model consists of One implementation step (program implementation) and three evaluation steps (process evaluation, impact evaluation, and evaluation of outcomes) (Savciuc and Timotin, 2019; Ghaffari *et al.,* 2020; Handyside *et al.,* 2020a). Furthermore, the PRECEDE-PROCEED model is a complete model for assessing peoples' health and quality of life. Also, the PRECEDE-PROCEED model is an effective method for health promotion and quality of life improvement steps. Quality of life and health status of the people is measurable when there is a compilation of successful information by utilising the PRECEDE-PROCEED model (Chaboksavar *et al.,* 2020; Handyside *et al.,* 2020b).

2.10.3 Social-Cognitive Theory

Social Cognitive Theory (SCT) originated from Bandura's social learning theory, which focuses on the importance of motivation and people's behavioural and social variables (Schunk and DiBenedetto, 2020). SCT theoretical framework proposes that human behaviours are promoted by variables that could be external or internal, which act as a stimulus. Some of the variables include obstacles, interpersonal states, environmental context, observed behaviour, perceived social support and verbal persuasion, internal and external cues to action, skills training, etc. (Wang *et al*., 2019c; Otaye-Ebede *et al.,* 2020). The social cognitive theory revolves around the "Triadic Reciprocity Causation" that explains the framework based on the reciprocal co-interaction of personal, environmental, and behaviour (Beauchamp *et al.,* 2019).

The main concepts of the social cognitive theory include observational learning, environmental and situational determinants, self-efficacy, emotional adaptation, task efficacy, self-regulation, and outcome expectations (Laranjo, 2016; Ghoreish *et al.,* 2019). The utilisation of the interactionist perspective in the SCT framework explains moral phenomena in which personal factors, moral conduct, and environmental factors all act as interacting factors that affect each other in outcome measurement (Otaye-Ebede *et al.,* 2020). Social cognitive theory is a common behavioural change model adopted for the management of chronic health conditions. One of the SCT concepts focuses on the importance of self-regulation that comprises core components: self-monitoring, self-judgment, and self-evaluation as a source of behaviour change (Tougas

et al., 2015). An individual's self-regulative capability in SCT emphasises the dynamic and cyclical phase of human functioning (Schunk and DiBenedetto, 2020).

Self-efficacy is an important SCT concept required for behavioural change. Task efficacy is the confidence in an individual in their ability to perform a specific area of a task (Shamizadeh *et al.,* 2019). Self-efficacy is an individual judgment about their capability to organise and perform their task efficacy; therefore, it is considered an important determinant for an individual's task performance. Also, self-efficacy affects individual choice to perform, the effort extent prepared to be utilised, and the length of their persistence in overcoming obstacles (Tsai, 2014). The SCT concept of outcome expectation refers to an individual's value placed on the anticipated outcome of a behaviour (Cox *et al.,* 2017). Social cognitive theory is recognised as the most important theory for behaviour change based on social learning principles (Chichirez and Purcarea, 2018). A limitation of social cognitive theory in health promotion is that it focuses heavily on the learning process and may omit an individual's health condition and biological differences that affect their behavioural changes and pattern because of its origin from social learning theory (Thojampa and Sarnkhaowkhom, 2019).

2.10.4 Theory of Reasoned Action and Theory of Planned Behaviour

The Theory of Reasoned Action (TRA) suggests that the creation of specific intentions to behave predicts an individual's behaviour, and the two major determining factors of behavioural intention are "attitude towards behaviour" and "subjective norm" (Sarbazi *et al.,* 2019; Ramayah *et al.,* 2020). "Attitude" comprises beliefs towards behaviour and expectation outcome, while "subjective norms" reflect the motivation and normative beliefs needed to engage or comply with the behaviour (Arevalo and Brown, 2019; Goodarzi *et al.,* 2019; Sharma, 2019). Figure 2.15 shows the graphical representation of the theory of reasoned action showing the determining factors and what each sub-component contains.
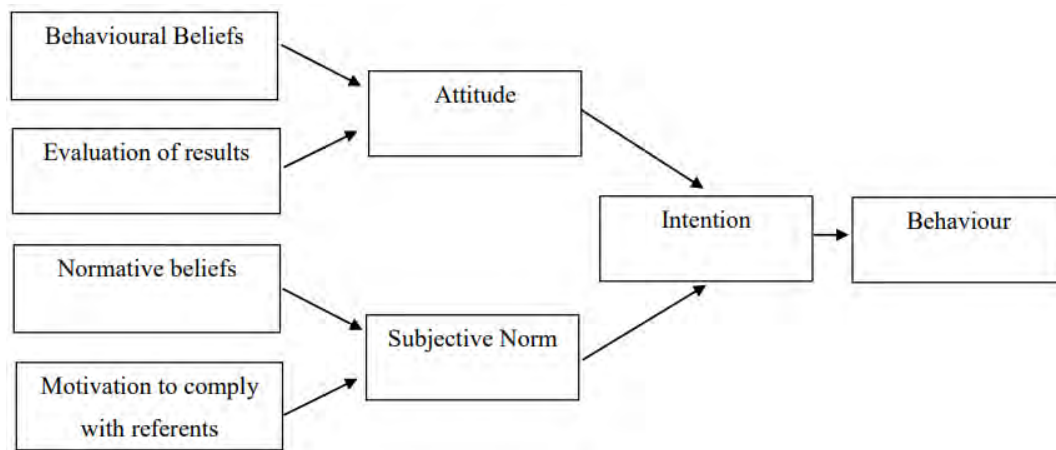
Figure 2.15. Theory of Reasoned Action (Sharma, 2019)

An individual attitude towards behaviour and subjective norm co-exists and interacts, affecting the individual's behaviour and other people's behaviour afterwards. The theory of reasoned action framework provides useful tools that help determine why an individual makes their decision (Breslin *et al.,* 2019). The hypothesised theory of reason action by Fishbein and Ajzen shows that the stronger the intention of an individual to perform a behaviour, the more likely the individual takes on the action (Muralidharan *et al.,* 2018). The direct antecedent to behaviour results from the planned readiness to engage in the behaviour (Molloy *et al.,* 2019).

Theory of Planned Behaviour (TPB) is an extension of the theory of reasoned action's modification in 1992 by Ajzen, Madden, and Ellen. The theory of planned behaviour adopts a theoretical framework that aids the understanding of people's behaviour in a specific context because it is based on cognitive theories (Liu, 2019a; LaCaille, 2020). The theory of planned behaviour is behaviour centred and used widely in modifying, understanding, and predicting people's actions. Furthermore, the determining factors in the theory of planned behaviour are "attitude towards behaviour," "subjective norm relating to the behaviour," and "perceived behavioural control" (Ajzen and Kruglanski, 2019). Figure 2.16 shows the diagrammatic description of the theory of planned behaviour with the additional determining factors to the two factors of the theory of planned action, thereby making three subcomponents. The arrow in the diagram shows how the subcomponents affect the behavioural intention of an individual.
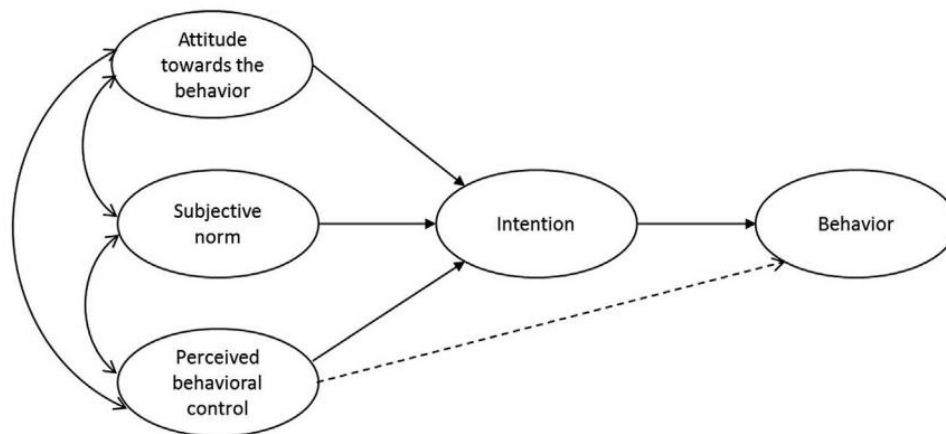
Figure 2.16. Theory of Planned Behaviour (Ajzen, 1991, cited in Knauder and Koschmieder, 2019)

An individual attitude towards a behaviour refers to the positive or negative evaluation of the future performance of the behaviour. Subjective norms show the expectation of other people significant in an individual performing the behaviour. The intention-behaviour relationship strength is determined by the perceived behavioural control factor of the theory of planned behaviour (Hagger, 2019). Despite the wide use of the theory of planned behaviour in health-related behaviour research, the theory has been subjected to various critics over the past three decades (Savciuc and Timotin, 2019). Although the theory of planned behaviour provides an understanding of factors that could affect behavioural intention, it does not explain the behavioural change process (Watakakosol *et al.*, 2020).

2.10.5 Health Belief Model

The Health Belief Model (HBM) developed in the 1950s is based on social and psychological theory. HBM is a widely used theoretical framework in public health and health promotion to understand the health behaviour of people (Luquis and Kensinger, 2019; Carico *et al.*, 2020; Raamkumar *et al.,* 2020). The health belief model was first used in research attempting to understand the failure in the uptake of free tuberculosis screening programmes aimed at early detection of symptoms (Barakat and Kasemy, 2020). The health belief model has been adopted for different research such as the study on adherence, self-care, medication, use of condoms, vaccination and other behaviours that require modification of patient's behaviour to reduce a risk to health (Carico *et al.*, 2020). The multi-dimensional complexity of human behaviour can be explained entirely by the health belief model, unlike most other theories. The health belief

model is a recognised behavioural theory that predicts "the perceived threat" and "perceived expectation", which are the two major groups of behavioural beliefs (Tajeri Moghadam *et al.,* 2020).

Furthermore, each of these two major categories comprises another sub-group. The sub-group consists of five components: perceived severity, perceived susceptibility, perceived benefit, perceived barriers, self-efficacy, and cues to action. The influences of these components on attitude and behaviour help the health belief model explain an individual's health-seeking behaviour (Almadi and Alghamdi 2019).

The perceived threat is made up of an individual's perceived susceptibility and perceived severity to a specific risk or disease. The interaction between an individual's perceived benefit of the health behaviour and the perceived barriers to engaging in the action to reduce the risk or disease determines the effectiveness of the specific health behaviour. Cues to action comprise internal and external factors that trigger interest in specific health behaviour. Lastly, self-efficacy shows an individual's confidence and willingness to perform a specific health behaviour based on the value of their health (Goodarzi *et al.,* 2019; Raamkumar *et al.,* 2020).

An individual's perception of their vulnerability to a threat or condition is explained by the individual's perceived susceptibility. The perceived outcome of an individual due to the retention of a condition relates to the individual's perceived severity (Liu *et al.,* 2019; Weber Rawlins *et al.,* 2020). Perceived benefits are an individual's expected benefits from engaging in a preventive action to reduce the susceptibility or severity of a specific risk or disease. Perceived barriers refer to an individual's expected obstacle to performing a preventive action (Ban and Kim, 2020; Barakat and Kasemy, 2020). Over the years, the health belief model has been widely used for interventions guiding framework for change in health behaviour (Goodarzi *et al.,* 2019).

2.11   Methodology

Research methodology shows the utilisation process of various research methods in solving or investigating a precise set of problems created by different concluded ontological and epistemological hypotheses (Daniel, 2018a and Daniel, 2018b). The path researchers follow to conduct their research completely is referred to as research methodology (Sileyew, 2019).

Importantly, the research methodology gives a detailed outline of the research processes (Bhaskar and Manjuladevi, 2016).

2.11.1 Research Paradigm

The world view or the most fundamental system of ideas adopted by the research community for generating and sharing the knowledge, which consists of sets of assumptions, method of knowledge acquisition, and how this knowledge is shared within the community of researchers, is referred to as research paradigm (Levers, 2013 and Friedrich *et al.,* 2017). According to Mertens and Wilson (2018), the research paradigm comprises four major philosophical assumptions: ontology, epistemology, methodology, and axiology. Ontology assumptions raise concerns with what is the nature of reality; therefore, it is said to be the study of beings (Scotland, 2012). Epistemology assumptions raise questions on how knowledge is created, its nature, and how knowledge is communicated among human beings (Levers, 2013; Boon and Van Baalen, 2019). Axiology assumptions raise questions about the nature of ethics to identify in a precise way what is essential, precious, and valuable in a human being's life (Aliyu *et al.,* 2014). Methodology assumptions create questions on what method and how knowledge is acquired (Kamal, 2019). Constructivism, post-positivism, participatory, and pragmatism are the four main research paradigms used in conducting social research. Although, interpretivism, post-positivism, positivism and pragmatism are identified as the most extensively used research paradigm (Kankam, 2019).

2.11.1.1   Interpretivism

According to Chowdhury (2014), interpretivism is defined as an approach that emphasises meaningful human personality in their cultural and social lives. Interpretivism researchers believe that the context surrounding any conducted research is crucial in interpreting the obtained research data; interpretive research is also known to be more subjective than objective (Thanh and Thanh, 2015). Interpretivism originated from the philosophical phenomenology of Edmund Husser, Wilhelm Diltheyand, and the hermeneutics philosophical understanding from other German philosophers' interpretive studies (Kankam, 2019). Interpretivism is sometimes referred to as anti-positivism because it opposes the view of positivism (Flick 2014). The interpretive paradigm reveals that multiple realities are formed from the various reality or perceptions of different individuals. These various realities are influenced by the individual's

understanding, norms, social perception, and culture (Ryan, 2018). The method of collecting, analysing, and interpreting data are unavoidably influenced by the researchers' own beliefs and values because they can never be completely separated.

2.11.1.2 Positivism

The term "positivism" was introduced by Auguste Comet in 1844, and since then, it has been a central topic in the philosophy of science debate. The word "positivism" comes from "*positum*", which is a Latin word that means "to position or laid down something" (fact, data) in the presence of a researcher (Alvesson and Sköldberg, 2017). Positivism is often linked with realism (critical realism is close to positivism & it is a form of realism that knows the reality of the natural order and the social world events & communications). Positivism also has a negative representation in the science world because of its extreme emphasis on direct observation and its reliance on the natural science model (Bryman, and Bell, 2015; Alvesson and Sköldberg, 2017; Bell, Bryman, and Harley, 2018). Positivism can be defined as an epistemological position that promotes the study of social reality using natural scientific methods (Flick, 2018). Epistemology positivist explains that knowledge from the application of scientific methods can be verified and reproduced, axiology positivist state that inquiring about knowledge is value-free, and ontology positivist agrees that reality exists as a single objective reality. Positivism in the methodological view inclines towards the experimentation side (Dieronitou, 2014; Jaworsky, 2019). Phenomenalism principle, deductivism principle, inductivism principle, the principle stating that science must and can be carried out in a value-free process & objective, and the principle stating a distinctive clarity between a normative and scientific statement are the major forms of principle that positivism relies upon (Flick, 2018).

Phenomenalism principles are knowledge & phenomena accepted by sense and justifiable as knowledge. Deductivism principle hypotheses allow the assessment of the evidence of law to be tested and generated through theories. The inductivism principle collects evidence that forms the basis for law to produce knowledge (Flick, 2018).

2.11.1.3 Post–positivism

Post–positivism is considered to represent thinking that comes after the positivism assumption because its philosophy is deterministic in nature. Therefore, research problems studied under the post-positivism assumption show the need of identifying and assessing the cause that

influences experimental results. The post-positivist assumption can be traced back to 19th-century writers such as Phillips, Burbules, Newton, Mill, Comte, Locke, and Durkheim (Creswell, 2014). The Post-positivism paradigm can be used in social and physical science due to its effect on challenging the absolute truth notion. Some essential features of post-positivism include the deterministic assumption, reductionism idea, the use of approaches for testing theories to determine the relationship between variables, and the emphasis on the importance of reliability and validity of accurate observation and measurements. And another feature is that post-positivism explains that scientific research is governed by hypotheses and research questions (Grove, 2015). Deterministic assumption states that the external behaviour of human beings and matter in the surrounding environment results from causes; therefore, causes determine the effect. The reductionism idea revolves around how large ideas could be reduced into a smaller set of ideas that can be tested out as variables assessing & identifying causes that influence research or experimental outcomes (Grove, 2015).

2.11.1.4 Pragmatism

Pragmatists are referred to as anti-dualist due to their argumentative opinions about the imposed choice dichotomy of constructivism and post-positivism while suggesting the merge of qualitative and quantitative methods. Pragmatism emphasises that in analysing or carrying out a study, many commonalities of qualitative and quantitative methods are shared with no differences at an ontological or epistemological level (Yvonne Feilzer, 2010). Pragmatism tends to view the world through a combination of different approaches rather than being restricted to one approach. The pragmatism assumption guides the use of mixed methods that challenge the world's exclusive idea of using quantitative or qualitative methods because it is not merely about data types (Cohen, Manion and Morrison, 2018). Darnell and Wolstencroft (2018) report an argument that states that scientific research that uses mixed-method/ multiple approaches can result in more reliable and highly authentic results/ information being achieved than using a single method. Also, there has been ongoing recent advantageous identification of multiple approaches, precisely the mixed-method approach. Pragmatism values the objective and subjective view to reveal answers to research problems because it considers the research question important. Pragmatism allows the researcher to use "what works" to get answers to research questions based on the belief assumption that analysing the transferability of theories in another setting can be generalisable and contextual (Halcomb and Hickman, 2015). Pragmatism also focuses on the research product or shows interest in determining the meaning

of something, and it is considered out-come oriented (Biesta, 2010; Shannon-Baker, 2016). Pragmatism connects abstract problems on the epistemological level to the methodological level and focuses on what will make a difference as well (Shannon-Baker, 2016).

2.11.2 Research Study Design Approach

Research study design can be defined as a framework or set of procedures and methods used to collect and analyse data on variables associated with a specific research problem. Study design represents the overall structure of a research process needed to derive good results from the data collected, i.e., it comprises the blueprint for collecting, measuring, and analysing research data (Mohajan, 2017; Malalgoda *et al.,* 2018; Ranganathan and Aggarwal, 2018). Furthermore, research design acts as the master plan that determines the structure, methods, and research strategy to provide appropriate and alternative tools needed for solving research problems and minimising variances. The role of research design in optimising data validity and understanding the strength and limitations of the chosen type of design for a study is important (Mohajan, 2017; Ranganathan and Aggarwal, 2018). The study design also plays a crucial role in the critical connection between arguments and the theories that inform the research and the observational data collected (Zefeiti and Mohamad, 2015). According to Leavy (2017a), qualitative, quantitative, mixed-method research, community-based participatory research and art-based research are the five major approaches to research design used by social researchers.

2.11.2.1   Community-Based Participatory Research (CBPR)

Community-based participatory research (CBPR) is regarded as an approach to research design that applies multiple research study designs such as longitudinal, staggered intervention trials, cross-sectional study designs, and different research methods like the quantitative, qualitative, and mixed methods (Galea *et al.,* 2019). Community-based participatory research as a research approach has been increasingly popular and used among community stakeholders and researchers that are both individuals and organisations, to form equal partnerships in achieving mutual benefit, generation of knowledge, and community improvement through joined research (Israel *et al.,* 2012; Jagosh *et al.,* 2015; Michalak *et al.,* 2016). The community-based participatory research approach comprises seven main components that can also be referred to as the stages or phases for conducting CBPR research (Israel *et al.,* 2012). Figure 2.17 below

shows the diagrammatic representation of the seven core components of the stages in community-Based participatory research (CBPR).
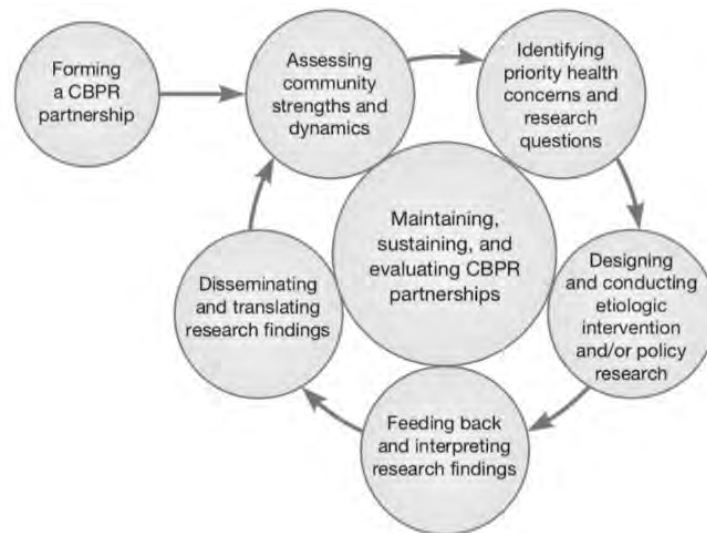
Figure 2.17. Stages in Community-Based Participatory Research (CBPR) (Israel *et al.,* 2012)

2.11.2.2   Art-Based Research

Art-based research (ABR) as a research design approach involves applying creative art assumptions in solving social research questions, and art-based research is stated to be an appropriate approach when the purpose of the researcher is to describe, explore, evoke or provoke (Leavy, 2017a). Art-based research existed through researchers' views of creating a new way of thinking, visualising, and communicating new insight or questions by exploring the power of art. The term art-based research was introduced in the early 1990s by Eisner and the epistemological assumption of art-based research views that arts can create and convey meaning based on artistic work or knowing (Leavy, 2017b).

2.11.2.3   Qualitative Research Approach

Research involving the exploration of conflict or change finds the application of qualitative approaches useful. The basis of qualitative research promotes the interpretive approach in the description of human life experiences and social reality. Therefore, qualitative research can be defined as a method of analysing human beings' social life, focusing on the world people live

in and how they understand their experiences (Holloway and Galvin, 2016; Queirós *et al.,* 2017). Data collected through qualitative research methods such as observation, documentary analysis and interviews are presented in written words or spoken words rather than numbers as in quantitative research. Common data analytical methods for qualitative research include thematic analysis, discourse analysis, the framework approach and content analysis (Astin and Long, 2014). The advantages of using qualitative research are: it provides knowledge derived from the meaning of various events through individual case or event studies, and it allows a great extent of construction and reconstruction of its flexible design structure due to its interactive approach. In addition, qualitative research allows researchers to discover a comprehensive understanding of the inner feelings and how culture shapes participants' opinions, feelings, and experiences (Merriam and Tisdell, 2015; Rahman, 2017). The limitations of qualitative research show that its findings cannot be generalised to a larger population because of the assumption that no test was performed to ascertain if the findings were due to chance or statistically. Other qualitative research limitations suggest that it significantly overlooks important issues, time-consuming and shows the inseparable ambiguities in human expression (Atieno, 2009; Choy, 2014).

2.11.2.4   Quantitative Research Approach

Quantitative research design assesses information using numbers with an objective aim and evaluates its finding using statistical analysis. The conceptual framework in a quantitative design is well-developed, showing types of variables and their relationship to each other. Quantitative research effectively answers the "how" or "what" of research questions which are usually quantifiable and direct. Quantitative research lies mainly on positivistic philosophical assumptions (Punch, 2013; Goertzen, 2017). The data in quantitative research are collected objectively and systematically using formal instruments through the application of structured procedures (Queirós *et al.,* 2017). The benefits of quantitative research include that its data sets are large, its findings are generalisable to a wider population, and replication of the study is permitted due to the application of standardised methods and research frameworks. The main limitation of quantitative research is that the evidence of feelings, views or why the understanding of a population is in a certain way is not provided by the quantitative research data; therefore, difficulties are encountered when reaching vulnerable groups or other specific demographic groups. Quantitative research requires the collection of data over a long period.

The data collection method in quantitative research uses surveys & questionnaires using statistical and mathematical models to analyse collected data (Yilmaz, 2013; Goertzen, 2017).

2.2   Conclusion

Although petroleum is an important energy source, the petroleum industry is closely associated with factors that increase the risk of ill health through environmental pollution. Health-related risk factors are associated with all the sectors of the petroleum industry. Therefore, workers in retail petrol stations that form a part of the downstream sector of the petroleum industry are exposed to various health risk factors in doing their work. The health effect of retail petrol stations is not limited to the retail petrol station employees but also affects the general population. The literature review outlines the various health problems (e.g., COPD, headache, throat irritation, and neurological damage) and hazards (physical, biological, psychological, and chemical hazards) associated with working in retail petrol stations.

Furthermore, the literature review shows that the work environment plays an integral part in a worker's quality of life. The literature review indicated that the work environment affects workers' quality of life, thereby supporting the rationale of this study to determine the effect of working in a retail petrol station on the quality of life of retail petrol station workers. This chapter also provides frameworks and methodology chosen for the research. In chapter three, the research method is described. The mixed-method research approach adopted for this study is discussed in the next chapter highlighting the types, strengths & weaknesses, and rationale for choosing the research approach.

CHAPTER THREE: METHODS

3.0   Introduction

In this chapter, the methods applied in the research were described. A sequential explanatory strategy mixed-method approach was used to provide comprehensive information on the research aim and objectives. Research can be described as the scientific understanding of existing and new knowledge that comprises detailed and reviewed issues, developing hypotheses for possible solutions by collecting, measuring, and analysing data. Data obtained from research are used for making deductions and creating conclusive results that could be used for further testing and may be applied for the progressive development of humankind (Greenfield and Greener, 2016; Bairagi and Munot, 2019). Therefore, research methods are a sequential set of well-defined steps or activities required for conducting research. When performed correctly, it ensures the achievement of specific results (Friedrich *et al.*, 2017). Furthermore, research methodology shows the utilisation process of various research methods to solve or investigate a precise set of problems created by different concluded ontological and epistemological hypotheses (Daniel, 2018a; Daniel, 2018b).

3.1   Mixed-Method Research Approach

Mixed-method research is generally accepted and defined as a research approach that involves the integration of qualitative and quantitative research approaches using the set of data collected through these approaches and interlinking their components (mixing) to produce comprehensive information for a research problem (Plano Clark *et al.,* 2015; Palinkas *et al.,* 2019).   There is an intentional combination of quantitative and qualitative approaches, perspectives, data collection and form, and analyses in mixed-method to develop a comprehensive and distinctive understanding of an issue (Plano Clark, 2019). A clear definition of the sequence of quantitative and qualitative research components and the process of data triangulation steps is highlighted explicitly in the mixed-method research approach (Täuscher and Laudien, 2018).   The mixing phase that can occur at any stage of mixed-method research is vital to the accuracy of the research approach (Leech & Onwuegbuzie, 2015; Halcomb and Hickman, 2015; Shannon-Baker, 2016).   Data integration in mixed-method helps one set of data provide information about another set of data. A set of data can also enhance the result of

another set of data in an analysis procedure. Also, two or more data sets collected are compared to provide comprehensive research information (Guest, 2013; Plano Clark *et al.,* 2015). One reason for using mixed methods in research is the need for different approaches to investigating and solving complex social and educational issues. Also, researchers' use of a mixed-method approach are encouraged by major funding organisations like the Institute of Educational Science and the National Science Foundation (McCrudden *et al*., 2019). Different types of mixed-method research strategies used by researchers have been classified by various typologies (tools that aid research design) into six: convergent parallel, explanatory sequential, exploratory sequential, embedded, transformative, and multiphase but only three major types of mixed-method research design will be described in this study (Creswell, 2011; De Lisle, 2011; Creswell, 2012; Caruth, 2013).

3.1.1 Sequential Mixed-Method Design

Sequential mixed-method design involves the collection of a set of data at a different time in a sequence to enhance comprehensive knowledge of a research study, while sequential explanatory strategy and sequential explanatory strategy are the two forms of sequential mixed method (Fetters *et al.,* 2013). The sequential mixed-method is the chronological mixing of quantitative and qualitative analyses, which are dependent on each other (Hitchcock and Onwuegbuzie, 2020).

➤ Sequential Explanatory Strategy: Sequential explanatory strategy involves a sequence whereby quantitative data are collected and analysed first then, followed by the collection and analysis of qualitative data maintaining equal priority to both the quantitative and the qualitative stages (Onwuegbuzie *et al.,* 2010; Subedi, 2016; Mahmood *et al.,* 2018). Mixing of data occurs during interpretation. The main reason for a sequential explanatory strategy is to provide comprehensive information on a quantitative result by applying a qualitative approach to give a more detailed view of the research problem. Although the sequential explanatory strategy is time-consuming due to maintaining equal priority to both stages involved but has distinct stages that are easy to describe (Onwuegbuzie *et al.,* 2010; Terrell, 2012; McCrudden *et al*., 2019). Figure 3.1 shows the diagrammatic illustration of the process in a sequential explanatory strategy. The quantitative component comes first, followed by an integrative analysis connecting to the qualitative component. The finding from the

quantitative and qualitative components are integrative at the interpretation stage of the research findings. This study adopted the sequential explanatory strategy in its data collection.
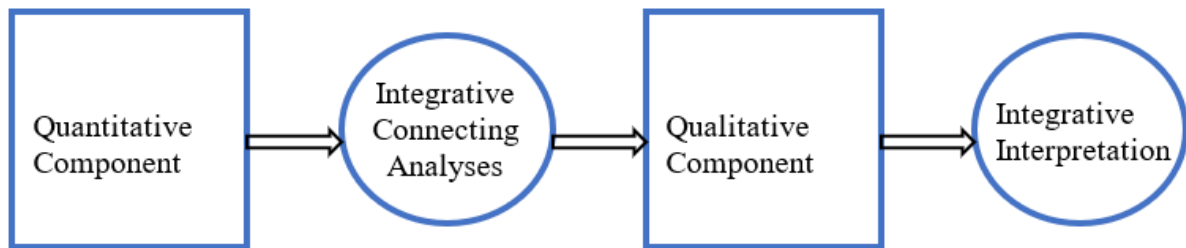
Figure 3.1. Sequential Explanatory Strategy Process (Edited image from Plano Clark, 2019)

> Sequential Exploratory Strategy: In a sequential exploratory strategy, the qualitative data is collected and analysed first, followed by the quantitative data. The main purpose of this strategy is to explore phenomenon by gathering qualitative data first and then using quantitative data collected after to describe the relationship within or between the qualitative data (Terrell, 2012; Subedi, 2016; So *et al.,* 2018; Guetterman and Fetters, 2018). Figure 3.2 shows the diagrammatic illustration of the sequential exploratory strategy process in a mixed-method approach. The qualitative and quantitative components are carried out and analysed separately, but both component findings are integrated at the interpretation stage.
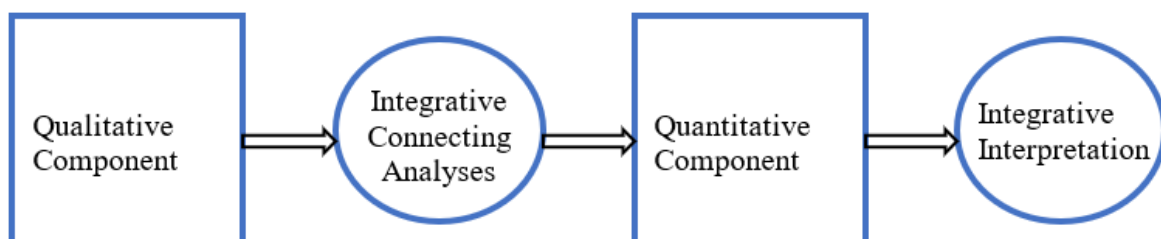
Figure 3.2. Sequential Exploratory Strategy (Edited illustration from Plano Clark, 2019)

> Convergent Parallel Design: Quantitative and qualitative data are collected and analysed simultaneously in separate stages. The results of both stages are compared

to provide detailed information at the interpretation stage to determine the relationship between the results and whether it contradicts or supports each other. The focus of the convergent parallel design is gotten from the comparison of the two datasets in a study (Östlund *et al.,* 2011; Caruth, 2013; Kerrigan, 2014; Guetterman and Fetters, 2018; Creswell and Hirose, 2019). Figure 3.3 shows the diagrammatic illustration of the convergent parallel design process in a mixed-method approach.
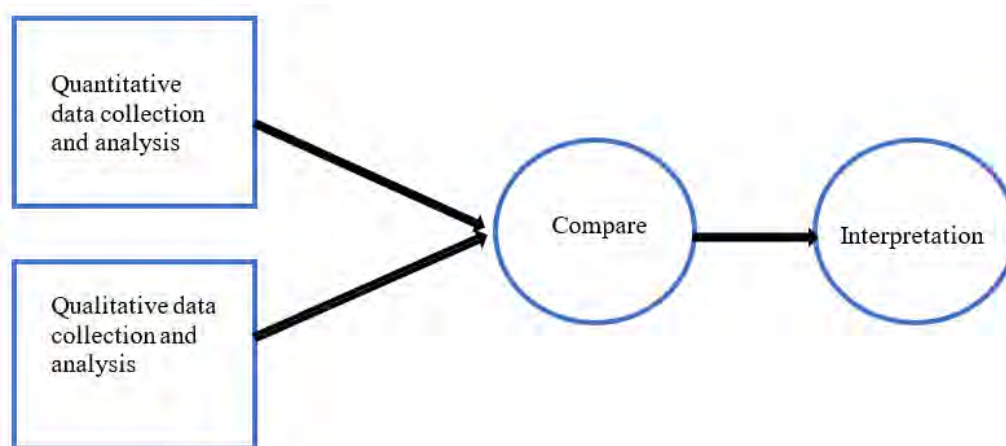
Figure 3.3. Convergent Parallel Mixed-Method Design (Edited illustration from Subedi, 2016)

- ➢ Embedded Mixed-Method Design: Embedded (nested) design involves the collection of both qualitative and quantitative data concurrently or sequentially with a view of one dataset playing a supportive role to another or both datasets playing a supporting role in a larger design study. Therefore, either quantitative or qualitative data can play a supporting role, and data mixing occurs throughout the entire study (Daly *et al.,* 2009; Harrison & Reilly, 2011; Creswell, 2012; Yu and Khazanchi, 2017).

- ➢ Transformative Mixed-Method Design: Transformative Mixed-Method Design: The transformative mixed-methods design, as Creswell and Plano Clark (2011) highlighted, aims to use one of the four designs (convergent, explanatory, exploratory, or embedded) enclosed within a transformative framework. An orientating lens for the mixed-method design is provided within the transformative framework. Transformative mixed-method design informs a study's overall

purpose, the research questions, the data collection, and the study's outcome. The framework intends to address a social issue for a marginalised or underrepresented population's engagement in research that brings about change (Subedi, 2016). Transformative mixed-method allows a flexible opportunity for researchers in a study as unexpected findings develop, thereby emphasising methodological flexibility (Barnes, 2019).

➢ Multiphase Mixed Method Design: Multiphase design is a complex form of mixed-method design that involves elements from embedded, convergent parallel, and sequential designs. Multiphase design is usually adopted in a multiphase project consisting of various phases carried out with quantitative, qualitative, mixed-method, and other study designs. The phases are linked, and each phase informs another, providing information towards a general objective such as designing and testing health intervention or prevention study project. (Creswell *et al.,* 2011; Creswell and Plano Clark, 2011; Subedi, 2016; Schoonenboom and Johnson, 2017).

3.1.2   Strengths and Weakness of Mixed Methods Design

All research methods have their strengths and limitations because various research problems are best solved using suitable research methods; therefore, not all research studies use mixed methods. Mixed methods are usually adopted in studies where insufficiency of one data source providing comprehensive information on a research problem is predicted. Mixing two or more research methods enhances the understanding of the stages in the research process. A single research problem can be investigated using different methods that support the comparison or integration of data from the various combined methods (Bradt *et al.,* 2013; Shorten and Smith, 2017). Combining both quantitative and qualitative methods could potentially provide a solution to both confirmatory and exploratory questions in a single research study; also, mixed-method aids the combination of research methods, which creates a counterbalance of their strength and weakness.

Furthermore, mixed-methods involves using a multidisciplinary approach to shed more light on a research problem being studied, thereby creating more significant intellectual interaction, enriching the understanding and experience of the researcher (Abowitz & Toole, 2009; Venkatesh *et al.,* 2013; Regnault *et al.,* 2018). Using one or more research methods within a

single study could increase the complexity of research processes and resources, such as personnel and time, often required in a mixed-method study (Zhang 2011). The mixed-method lacks rigour in its qualitative methodology, has publishing limitations and additional research training of personnel to enhance the understanding of other different research approaches, methods, and paradigms due to the multidisciplinary composition of the research team (Zhang 2011; Shorten and Smith, 2017; Regnault *et al.,* 2018).

3.1.3   Rationale for using Mixed-Method Design

The mixed-method approach was chosen for the research method due to the research questions and study population reflected in the research aim. The research study assessed the practice of safety measures, perception & awareness of health hazards related to working in retail petrol stations among retail petrol station employees, and the quality of life of retail petrol station employees in Ilorin. Also, it assessed the awareness and perception of retail petrol station owners, environmental health officers and public health government officers. The study further evaluated the health risks of population sub-groups living and working close to retail petrol stations in Ilorin. as stated in chapter one.

Comprehensive information is needed to understand the working condition of petrol station employees in Nigeria and develop intervention packages that promote quality of life. The researcher's understanding of the petrol station workers, petrol station owners, and government environment & health officers' knowledge, practice, and perception about health risk factors associated with petrol stations within the study region were crucial. Isolated use of quantitative or qualitative methods will be insufficient for an in-depth finding for the research problems. Thus, the use of quantitative and qualitative methods in the mixed-method design where the data and results will aid a comprehensive understanding of the phenomenon and provide more findings that will answer the research questions appropriately. The mixed-method design adopted was the sequential explanatory strategy. The researcher followed a sequence of quantitative data collection and analysis first, then followed by collecting and analysing qualitative data, which was used to investigate further, and evaluated the quantitative data that was collected first.

The researcher chose the mixed-method approach because of its easy understanding. The mixed-methods approach also had five recommended reasons that were also relevant to the

study. Three of these reasons were triangulation which supports different findings within a single phenomenon; complementarity helps clarify results from one method to another, and development helps develop methods from the results of another approach. The remaining two reasons include initiation, which helps to commence the discovery of new perspectives or processes, and expansion, which helps expand one method of findings in providing background to another method (Kay & Kucera, 2018).

In this research, triangulation was applied by using two different methods in gathering numerical and descriptive data from three groups of participants (petrol station attendants, petrol station managers, and a representative of the general population (university population) and qualitative data from three focus groups (petrol station attendants, petrol station owners, and environmental government officials) and one to one interview from another group public health government official and a retail petrol station manager.

The focus group information clarified some of the results obtained from Short Form -36 quality of life questionnaires exhibiting complementarity reason for mixed-method. Also, the findings from the quantitative surveys aided the development of interview questions asked during the qualitative phase. Initiation was applied by seeking new processes and consistency across methods and findings that helped review the research question. Finally, expansion was exhibited in this research by expanding the quantitative survey result from the questionnaires administered to the petrol station workers with findings obtained through the focus group and interviews in the qualitative phase of the research.

The advantages of mixed-method outlined by the researcher in the previous paragraph show that the research questions for the study were well investigated hence the rationale for choosing the mixed method. Also, the quantitative phase was designed to determine the knowledge of retail petrol station employees related to health risk factors associated with retail petrol stations, general properties of the retail petrol station, and the quality of life of the petrol station employees compared to the quality of life of the general population.

Subsequently, the results from the quantitative phase were analysed and applied to build up the next stage of the research – a qualitative study. The qualitative phase used focus group discussion and semi-structured interviews to investigate the perception and health risk awareness of retail petrol station employees, owners, and government officials about the risk factors associated with the retail petrol stations. Therefore, the mixed method provided an in-

depth understanding of how the knowledge and perception of the government officials, retail petrol station employees, and owners about the risk factors associated with working in a retail petrol station in Ilorin affect the quality of life of petrol station employees.

The different types of a mixed-method design show the various stages in which the mixing occurs within a specific design; integration of QUAL (qualitative) and QUAN (quantitative) usually occurs during data analysis and interpretation, and it is an important stage in the mixed-method approach (Leavy, 2017a). However, the mixing/ integration of data in this research was determined according to the mixed-method design adopted for this study, an explanatory sequential design, so data integration occurred during the interpretation stage of the method.

3.2   Study Design

3.2.1   Cross-Sectional Study

This research was conducted as a cross-sectional study, which examined more than one group of adults at a particular time using an explanatory sequential mixed method design. Cross-sectional studies refer to research studies carried out at a given point in time or observational snapshot of the exposure of a proportion of individuals in a population. There is no time dimension in these types of studies, as all the collected data refers to or presents the time at or around the time of data collection (Turner, 2013; Kesmodel, 2018; Saunders *et al.,* 2019). Cross-sectional studies may be used either analytically or descriptively. Analytical cross-sectional studies focus on determining the association between different research parameters, while descriptive cross-sectional studies aim to characterise prevalence (a measure of disease amount in a population at a given time) of disease, traits (health behaviour, attitude, smoking behaviour, etc.) (WHO, 2011; Kesmodel, 2018). Also, cross-sectional studies may be aimed at an entire population or a relevant proportion of population data.

3.2.1.1 Strength and Weakness of Cross-Sectional Study

A cross-sectional study is comparatively easy, inexpensive than cohort studies, and faster to conduct (Carvalho *et al.,* 2018). Cross-sectional studies give information on the prevalence of exposure or outcome, and this information can be used for a cohort study design. Cross-sectional study designs are useful in planning, monitoring, and evaluating public health issues (Turner, 2013; Setia, 2016). These studies are used to assess exposure to risk factors and assess

more than one outcome (Sedgwick, 2014; Kestenbaum, 2019). Analytical cross-sectional studies are applicable in generating hypotheses for possible associations between the exposures (Pandis, 2014; Kestenbaum, 2019).

In cross-sectional studies, data measurements are carried out once, making it difficult to infer the casual association between identified risk factors and outcomes (Aggarwal and Ranganathan, 2019). These studies may be prone to certain biases (Pandis, 2014; Sedgwick, 2014; Setia, 2016; Aggarwal and Ranganathan, 2019).

3.3   Study Area

Ilorin is the capital of Kwara state which lies between latitude 8° 24'N to 8°34'N and longitude 4°28'E to 4°39'E with an approximate total land area of 105sq. Km (Ajadi *et al.,* 2016). Ilorin is about 500km from Abuja (capital of Nigeria), with an estimated total population of 84,582 cuts across three local governments: Ilorin South, Ilorin East, and Ilorin West (Ahmed, 2013; Europa Technologies Ltd, 2019). Presently, a large population of Ilorin is Yoruba (one of three primary languages in Nigeria) Muslim with a Fulani traditional ruler known as Emir who speaks Yoruba. It comprises education, industrial, commercial centres, and an international airport (Saad, 2013; Encyclopaedia Britannica, 2019). The diagram in figure 3.4 shows the location of Nigeria on an African map, and the Nigeria map indicates the area of Kwara state where the study was carried out. The area map of Ilorin, the capital of Kwara state, showing the three local governments used for the research location, is shown at the bottom right of the diagram.
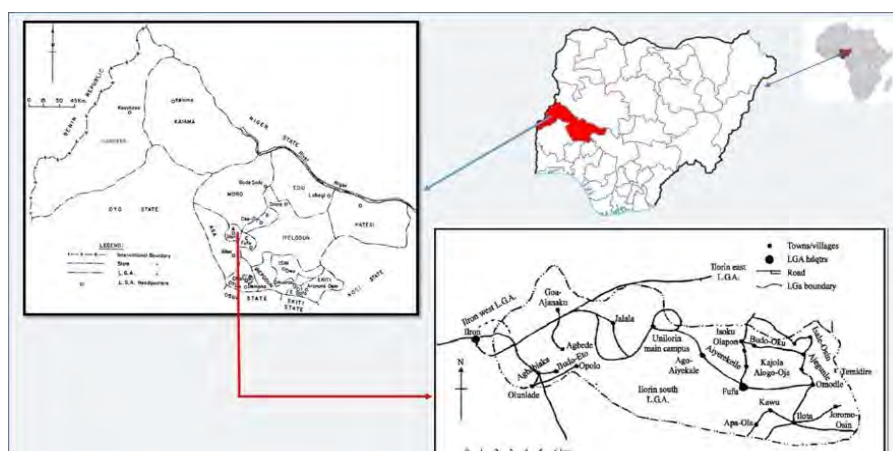
Figure 3.4. Map of Nigeria showing Kwara State and study area (Ilorin)
(Ahmed, 2009; Okeola and Sule, 2011; Wikimedia Commons, 2016b and
AGOA.info, 2019).

The research location was chosen based on the researcher's four years of living experience during her undergraduate studies between the year 2009 to 2013 and the research collaboration with the school of allied health and environmental science at Kwara State University located in Ilorin. The choice of location also helped reduce risk factors associated with carrying out a research project in a region with less available information. The collaboration established with Kwara State University as a recognised higher institution to the general population in Ilorin facilitated easy access to government officials and study participants.

3.4   Study Participants

Study participants are groups of a population selected from a target population (a larger population in which a study result can be generalised) with specific characteristics on which a researcher can base their study interpretations (Orina *et al.,* 2018). The target population was first defined and identified as employees (attendants and managers) and owners of retail petrol stations in Ilorin, final year undergraduate students and academic staff in the school of allied health and environmental science of Kwara State University, and health & environmental government officials in Ilorin. Important information such as the total number of retail petrol stations in Ilorin, identification of government offices in Ilorin related to inspection, functionality and environmental condition of retail petrol stations, the total number of staff and final year undergraduate students in the school of allied health and environmental science of Kwara State University was obtained during the pilot phase. Sampling for the study participants to engage in the main phase of the research was carried out within each target population identified in the pilot phase.

3.4.1   Study Participant in the Research Stages

The research study comprises two major stages: the pilot and the main study phases. The main study phase was further divided into the quantitative and qualitative phases. Each stage of the research comprises a different group of study participants; therefore, different methods of participant selection and criteria were used to select the chosen participants.

3.4.1.1 Pilot Study Phase

A pilot study is a small-scale study that helps plan, test and modifies extensive research protocols, and it is usually carried out first before the primary research (Kinchin *et al.,* 2018). A pilot study can be conducted as an internal pilot study (small-scale study as part of the main study design) and an external pilot study (an independent small-scale study not included as part of the main study) (In, 2017). Literature was used to gather some information on the environmental effects of retail petrol stations and used as a supporting document for designing the pilot study.

3.4.1.1.1   Objectives of the pilot study phase

The main purpose of the pilot study was achieved through the completion of the listed objectives, which are;

- ➢ To confirm if the main study is feasible

- ➢ To collect further background information on the area of study

- ➢ To determine the total number, location, and other characteristics of retail petrol stations in Ilorin

- ➢ To determine the methods of accessibility to selected retail petrol stations

- ➢ To make available arrangements for climate data collection for Ilorin

- ➢ To pilot the questionnaires for the key informants and focus group

- ➢ To identify how to recruit study participants required for the study using the inclusion and exclusion criteria

- ➢ To determine the appropriate ways of administering a questionnaire to selected participants

- ➢ To identify the possible way of contributing in the medium to long term to the community during the research process

- ➢ To obtain ethical approval for the research from appropriate government bodies in Ilorin

- To assess the risk associated with carrying out research in the study area and its risk management

- To foster the collaborative research and academic relationship with the staff and postgraduate students in the School of Allied Health and Environmental Science at Kwara State University to promote further research opportunities and knowledge exchange.

3.4.1.1.2   Inclusion and Exclusion criteria for pilot study participants

The Inclusion criteria are the characteristic that qualifies the selected study participants used in the pilot study. The inclusion criteria are as follows;

- Functioning Retail petrol stations (RPSs) in Ilorin.

- Functioning independent petroleum marketer and major petroleum marketer-owned RPSs

- Male RPS attendants 18 years and above

- Female RPS attendants 18 years and above

- Manager at functioning RPSs in Ilorin

- Male and female residential occupants above 18 years

- Male and female shop occupants above 18 years

- Residential buildings located less than 30 meters from the RPSs

- Shops situated less than 30 meters from the RPSs

- Voluntary and willing study participants.

3.4.1.1.3   Procedure for the pilot study

All the retail petrol station in the three local government in Ilorin was visited by travelling from the beginning of each road to the end using Ilorin Road map as a guide. A stop was made at every retail petrol station along major and minor road in Ilorin to obtain the RPSs coordinates using a handheld GPS (Global Positioning System) device. In addition, an observational checklist to identify ownership type, functionality status, and other properties of each station

was used to gather relevant information. When the total number of retail petrol stations was obtained, the stations were classified as functioning and non-functioning. The locations of each retail petrol station identified were plotted on an Ilorin Road map using the obtained coordinates in geographical information system software. The numbers corresponding to the names of each functioning station were written on pieces of paper, and the researcher used the lottery method (a method of simple random sampling that aids the selection of population by equal chance (Acharya *et al.,* 2013, Cohen *et al.,* 2017; Lohr, 2019) for selecting fifteen per cent of the total number of functioning retail petrol stations through simple random sampling.

The selected functioning retail petrol station was also plotted on the Ilorin Road map using corresponding coordinates to show the distribution pattern of the selected retail petrol station for the pilot study. The selected functioning retail petrol stations were further grouped according to the ownership type (major petroleum marketer (MPM) or independent petroleum marketer (IPM)) to ensure the correct application method for requesting permission to include their stations in the study. Letters requesting accessibility with brief information about the proposed research study were delivered to the retail petrol station managers or owners by the researcher. As were different methods were used to obtain permission. Letter requesting accessibility with brief information about the proposed research study was also submitted to the Independent Petroleum Marketer Association (IPMAN) Ilorin chapter and the Department of Petroleum Resources (DPR) office in Ilorin. Meetings were arranged separately with IPMAN and the DPR director in Ilorin to discuss further information on the study and answer other questions that could help understand the study objectives. After the long process of requesting approval, the researcher visited each of the selected retail petrol stations to confirm their consent and approval to access the station before contacting the manager and attendants at the stations for information.

Shop and residential buildings located less than 30 meters from each selected retail petrol station were also selected as study participants. Some of the selected stations had a shop and residential occupants, while some had shops only or residential buildings only in less than 30 meters from the RPSs. One shop and one residential building closest to some selected station with both shop and residential were selected. One shop or one residential occupant was also chosen from the selected station that had shop only or residential building only in less than 30 meters. Approval was obtained from the IPMAN, DPR, and ministry of environment in Ilorin for the research.

Since permission was obtained, one petrol station attendant was randomly chosen from each selected station, and their consent was obtained. Each of the selected stations had only one manager; therefore, each manager was given a consent form to sign for voluntary participation in the research study. Collected data were analysed using Excel and SPSS.

3.4.1.2   Main Study Phase

The main phase comprises two stages, which are quantitative and qualitative. Data collected during the pilot phase informed the tools and sampling method used to select study participants for both the research's quantitative and qualitative study stages. Three sampling methods, simple random sampling, cluster sampling, and purposive sampling, were used to select participants.

Simple random sampling is classified under probability sample types, and this method allows the selection of individuals with an equal chance in a population sample. Tossing of the coin, lottery method, dice throwing, Tippett's table number, and blindfolded method may be used in choosing data in simple random sampling (Acharya *et al.,* 2013, Cohen *et al.,* 2017; Lohr, 2019). Simple random sampling was used to select the sample retail petrol station and the government official interviewed in this research. Cluster sampling is classified as a type of probability sample that involves selecting an intact group as a whole; it is an economical, easy, highly applicable method and a good representative of the sample population (Sedgwick, 2014b; Sharma, 2017; Saunders *et al.,* 2019).

Cluster sampling was used in a random selection of petrol station employees at each selected retail petrol station. The selected petrol station employees were chosen as a participant group used in this research. Purposive sampling is a non-probability sample in which its selection is made by using an arbitrary method known by the research to produce well-matched groups. This selection method uses sample selection, considering criteria known to be important to this study (Etikan and Bala, 2017; Nardi, 2018). Purposive sampling was used to select the general population (academic staff and final year students).

3.4.1.2.1   Inclusion criteria for the main study

The inclusion criteria show the characteristics adopted by the researcher in selecting study participants (retail petrol stations, attendants, managers, students, staff) used during the main study phase of the research.

The inclusion criteria include;

Retail petrol station study participants

- Functioning retail petrol stations (RPSs) in Ilorin

- Functioning independent petroleum marketer and major petroleum marketer owned RPSs

- Male RPS attendants 18 years and above

- Female RPS attendants 18 years and above

- Manager at functioning RPSs in Ilorin

- Owners of more than one functioning RPSs in Ilorin

University population study participants

- All academic and technical staff in the school of allied health and environmental science (SAHES)

- All undergraduate final year students in SAHES

- All students 18years and above

- Male and female students in SAHES

- Male and female staff in SAHES

3.4.1.2.2   Exclusion criteria for the main study

The exclusion criteria show the characteristics adopted by the researcher in excluding other populations from the study participants (retail petrol stations, attendants, managers, students, staff) during the main study. The exclusion criteria are;

- Non-functioning retail petrol stations (RPSs) in Ilorin

- Owners of non-functioning RPSs

University population study participants

- All non-academic and non-technical staff in the school of allied health and environmental science (SAHES)

> ➢ All students not in their final year of undergraduate study in SAHES

3.4.1.2.3   Procedure for the main study phase

Quantitative stage

In the quantitative stage, the study participants include the petrol station attendants and managers (Retail petrol station employees) and KWASU staff and final year students (University population) in the school of allied health and environmental science. Simple random sampling was used in the selection of the sample retail petrol stations. The same stations selected and used during the pilot study were also used in the main research to avoid the long process of getting accessibility approval and consent of new retail petrol stations to participate in the study research. The manager at each selected retail petrol station was also selected as study participant. The managers who participated during the pilot study were the same managers who participated during the main study. The same retail petrol station attendants selected during the pilot study were also used in the main study. Cluster sampling was used to randomly select petrol station attendants at each selected retail petrol station for administering the Sf-36 questionnaire.

The data of the retail petrol station employees (attendants and managers) collected during the pilot study were used to select a population with similar characteristics as a representative of the general population (i.e., the comparing population -university population). Purposive sampling was used to select the total number of KWASU academic staff and final year students in the school of allied health and environmental science as a comparing population. Consent was obtained from students and staff willing to participate. Also, the accessibility to the staff and student were possible and facilitated through the research collaboration of KWASU school of allied health and environmental science with the researcher.

Qualitative stage

In the qualitative stage, the study participants include retail petrol station attendants, retail petrol station owners, and government officials. A group of retail petrol station attendants was chosen as study participants at one of the retail petrol stations randomly selected from the selected retail petrol stations. The retail petrol station managers who filled the SF-36 questionnaire were also asked to participate in an interview, but only one manager agreed to participate. The manager who accepted was the only manager interviewed in the study. A group of retail petrol station owners who were officials at the IPMAN Ilorin chapter, available and

willing to participate in the study, was selected, and consent was obtained. The Director of public health (public health officer) under the ministry of health Ilorin was also chosen as a study participant using purposive sampling. Purposive sampling was adopted to select a group of environmental health officers in Nigeria who are responsible for environmental inspection around the various household and working environments, including retail petrol stations. Several unsuccessful attempts were made to request an interview/focus group with the Department of Petroleum Resources officers (those directly involved with the regulation of retail petrol stations). The environmental health officer was welcoming and willing to participate in a focus group hence the choice of EHO in place of the DPR officers.

3.5 Data Collection and Analysis

Data collection and analysis are essential in all research methods to evaluate research outcomes (Peersman, 2014). Data collection involves applying systematic procedures in gathering and measuring information relating to the variables of research questions, hypotheses testing, and evaluation of research study outcomes (Kabir, 2016). Data analysis involves integrating, assembling, recombination, combination, and reassembling data in different ways to conclude, interpret the data, and report the research findings (Cohen *et al.,* 2017). Primary and secondary data are the two types of data collected in this research study. Primary data are information gathered for the specific research by the researcher, while secondary data are from existing information gathered by other researchers for other different purposes (Veal, 2017). The field survey and data collection were carried out from July 2017 to August 2019. During the research period, July and August were used for the field survey because of favourable and relatively dry weather conditions.

3.5.1 Pilot study phase

The research collected primary data during the field survey using various tools. The location coordinate of retail petrol stations in Ilorin was obtained using a handheld global positioning system (GPS). Observation notes, checklist, and self-administered questionnaires were used to collect data relating to the RPSs, attendants, managers, residential occupants and shop occupants. The secondary data were extracted from articles, eBooks, journals, and textbooks.

The data collected during the pilot study were descriptively analysed using Microsoft Excel. The summary of the findings was presented in tables, charts, and graphs to aid understanding.

3.5.2   Main study phase

Quantitative stage

The secondary data used for the main study were extracted from government documents, government websites, articles, eBooks, journals, and textbooks. The primary data in the quantitative study were collected using a self-administered questionnaire (SF-36v1 questionnaire (Appendix 3)).

The data from completed questionnaires were entered into Microsoft Excel 365 package, while uncompleted questionnaires were excluded. Once the questionnaires were scored according to the SF-36v1 scoring guidelines (Appendix 3D), the data was rechecked to ensure that it was imputed correctly. The data were then imported into IBM SPSS version 27.0 for descriptive and inferential statistical analysis. The Kolmogorov-Smirnov test with Lilliefors correction was used to test the normality quality of life domain variables between the population groups. The test for means difference of retail petrol station employees and university population QoL domains by gender, age group and marital status using independent sample t-test and one-way ANOVA where appropriate. Mann Whitney U test was used to analyse the distribution between the population groups' QoL domains. The Bivariate Pearson Correlation test was also conducted to test for association between the population group QoL domains and selected sociodemographic factors. Results are presented and discussed in chapter five.

Qualitative stage

The primary data in the qualitative study were collected through focus group discussion and one-to-one interviews with semi-structured questions. The first focus group were selected numbers of retail petrol station attendants (RPSA). Letters were sent to thirty-six retail petrol stations requesting their voluntary participation in the study by sending two RPSA representatives from their station for an hour of discussion on a specific date, but unfortunately, no one showed up on the date with reasons that their employees were too busy and did not have time to attend the meeting. So, a group of retail petrol station

attendants was chosen from one of the stations where the manager and attendants were willing to participate in the study.

The selected retail petrol station for the focus group operated on morning and afternoon shifts, thereby allowing the researcher to conduct a focus group discussion for the group of RPSA at the end of their morning shift. The recruited retail petrol station attendants signed a voluntary consent form and were given a participant information sheet containing details of the study. Focus group discussions were conducted for retail petrol station owners and attendants on a set date, time, and venue convenient for the groups. Each focus group discussion lasted between twenty to thirty minutes. The second focus group consists of some retail petrol station owners. Due to the tight schedules of the owners, the information contained in the letter was passed to all owners to ensure their voluntary participation in the focus group discussion schedule after their monthly meeting at the association office. The focus group interview for the retail petrol station owners was possible after one of their monthly association meetings at the IPMAN secretariat office at an agreed time. The interview lasted for 30 minutes. The discussion was audiotaped with the permission of the participant. The third focus group consists of some environmental health officers from different parts of Nigeria. Identified problems during the research study by the researcher and possible areas of concern were presented to the group of environmental health officers to acquire contribution to other possible interventions and identify other areas of concern omitted by the researcher. All the focus groups consist of both males and females.

A one-to-one interview was conducted with a male government official (director of public health) and the manager of the one station that was willing to participate. All the selected participants for the qualitative study are adults between the age of 18 and 70 years. The semi-structured question guide for interviews and focus groups was developed from the pilot study findings and information from relevant literature. The interview and focus group question guide included an introduction, key questions, and remarks (Appendix 5). The interview was recorded using a passworded audio recorder.

Prior to conducting the qualitative stage of this research, the researcher attended workshops and training sessions to acquire the necessary skills to ensure the effective collection and analysis of qualitative data. An initial analytical coding framework of a prior code based on the research questions and aim of the study was developed first. The researcher adopted a traditional approach where full verbatim transcription of the interview and focus group recordings were carried out manually. The audio recordings were listened to repeatedly for data familiarisation, and note were taken. Using deductive qualitative analysis, the data of

interest and connection between data items and questions are mapped to the prior coding framework of the researcher. Themes and sub-themes were formulated. The finding was then described integrating the results into the study aim and research question. Quotes from participants were used for the narrative description of findings presented in chapter 5. The themes were further discussed using evidence from existing literature to assess the consistency and contrast of this study's findings to results from previous studies. Findings are discussed in chapter six.

The summary of the research method from the pilot study to the main phase, which consisted of the quantitative and qualitative stages, is illustrated in the flow chart in figure 3.5. The quantitative and qualitative stage findings are integrated at the study's interpretation stage to provide a comprehensive understanding of the answers to the research questions. The flow also shows the tools for data collection in the study.
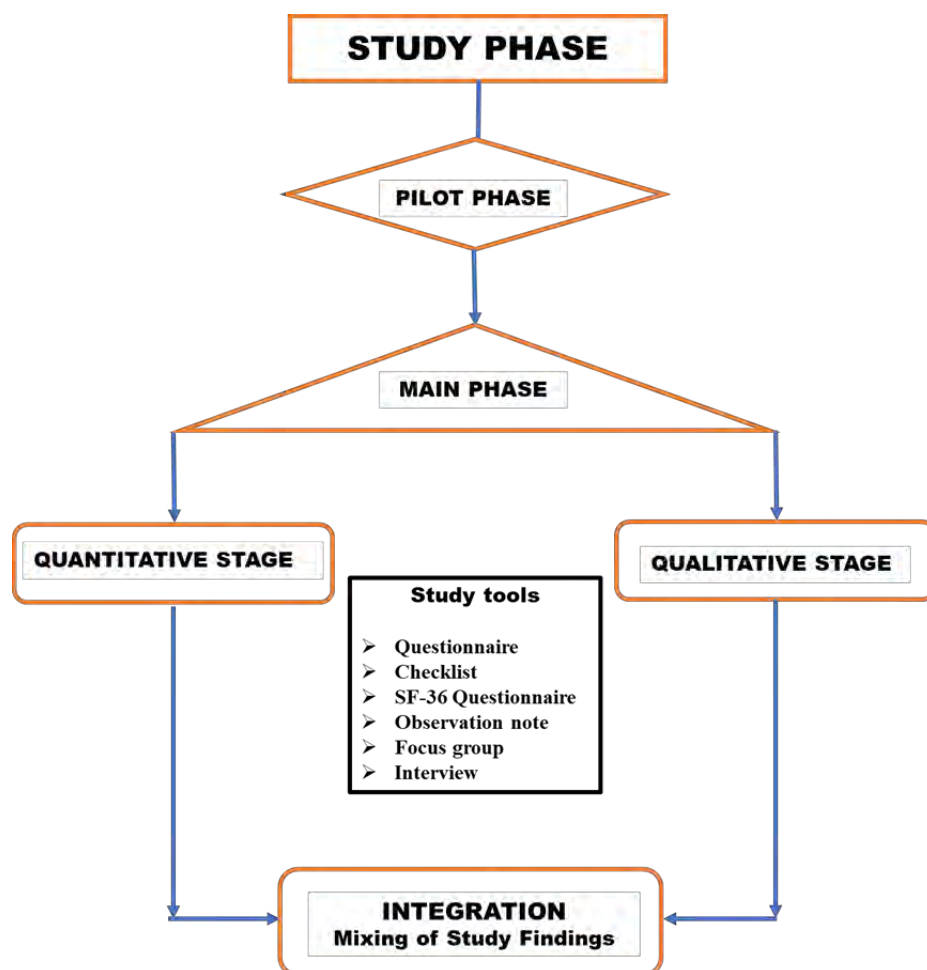
Figure 3.5. Study Design Flow Process

3.6   Ethical Consideration

Ethical approval for the study was obtained from the Cardiff Metropolitan University ethics committee (project reference number 9264) (Appendix 1A) and Kwara State University ethics committee (Appendix 1B). Research accessibility approval was signed by the Kwara State Ministry of Environment and Forestry (Appendix 1D) and the Department of Petroleum Resources, Kwara State (Appendix 1F). Participation in the study was voluntary. Participants were provided written informed consent to sign after explaining brief information of the proposed research, including the anticipated risks and potential benefits before taking part and the opportunity to withdraw from the study at any stage of the study. All participants were over 18 years old.

3.7   Research Study Limitations

Limitations encountered due to self-administer questionnaires include the return of incomplete questionnaires, lack of control over the response rate, and the absence of means of ensuring that the respondents understood the questions in the questionnaire before choosing their answers. The respondent took quite a long time to complete the questionnaire complaining about the total number of questions, thereby limiting the number of questionnaires that could be distributed at each petrol station. The accuracy and validity of the research findings may be reduced since there is no way to ensure complete honesty from study participants. Participants may only choose positive answers to portray themselves in a particular way. The conduction of the attendant's focus group interview at their workplace may limit their honest opinion. During the focus group, full participation of attendants cannot be ensured because the interview was done at the end of their shift with a possible feeling of tiredness and eagerness to go home. The attendants' honest opinions and expressions of concern during the focus group interview may be limited for job security reasons. The accuracy of the research result may be affected due to the inability to ensure the complete honesty of petrol station owners' opinions during the focus group interview. Security issues associated with lone working in the study area also limited the number of retail petrol stations included. Political instability in Nigeria, time and finances available to the researcher also constituted the research scale limit.

3.8   Conclusion

This chapter summarised and described the adopted research methods, rationale for study design, and data collection and analysis. Justification for selection of study area, sample population, and sampling technique was described in this chapter. The method chapter also highlighted the research limitation and the acquisition of ethical approval for the study. The next chapter presents and discusses the results of the pilot study.

CHAPTER FOUR: PILOT STUDY RESULTS AND DISCUSSION

4.0 Introduction

This chapter provides the pilot study results and discussion. The results include findings on the background and descriptive information of retail petrol stations in the Ilorin metropolis, characteristics of sampled retail petrol stations, RPS employees, and residential and shop occupants in close proximity to a retail petrol station in Ilorin. The findings show that less attention is given to occupational health and safety management, which could prevent occupational disease and employee injuries in RPS. In the result discussion, the findings show how characteristics of residential and shop occupants in close proximity to the RPSs could increase the level of hazard within the vicinity of RPS locations. Association of potential risk factors to petrol station employees' health at their workplace is also discussed. Existing literature relating to the research study was used as references to understand and discuss the results. This chapter also highlighted the limitation of the pilot study. In the next chapter, the pilot study's findings provided background information to carry out the main study, such as selecting a representative of the general population as a comparing population in the study and developing an interview and focus group guide.

4.1 Pilot Study Results

The study revealed the total number of retail petrol stations (RPSs) in the three local government areas of Ilorin (Ilorin South, Ilorin East, and Ilorin West) to be two hundred and ninety-seven (297). Picture of RPSs in Ilorin with permission from the station. The coordinates of the 297 retail petrol stations were used to show the distribution pattern on the Ilorin map. Observational data in the study indicates that independent petroleum marketers own more than 50% of retail petrol stations in Ilorin. Also, stations formerly owned by major oil marketers are sold to private owners, making up the independent petroleum marketers due to financial difficulties. Figure 4.1 shows a structure of a retail petrol station in Ilorin. Figure 4.2 shows the distribution pattern of all the identified retail petrol stations in Ilorin stations showing concentrated within the Ilorin metropolis.

Figure 4.1. A Structure of Retail Petrol Station in Ilorin
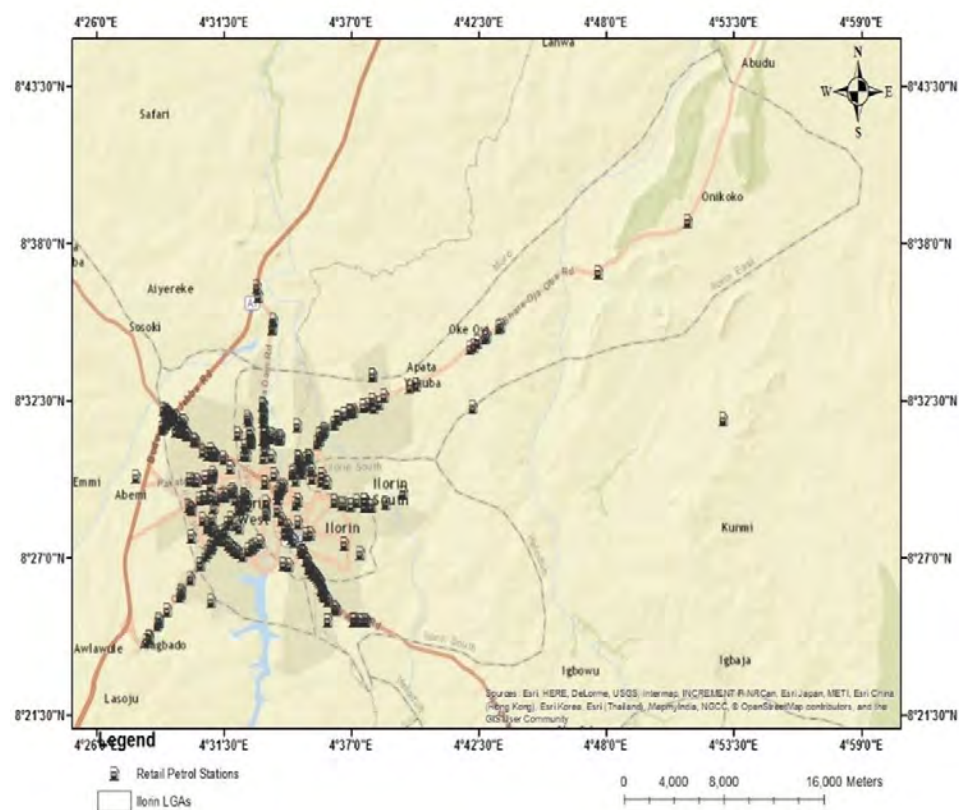
Figure 4.2. Map of Ilorin Showing the Distribution Pattern of Retail Petrol Stations

4.1.1 Functionality Status of Retail Petrol Station in Ilorin

Two hundred and twenty-four (224) stations were classified to be operational (functioning) during the field survey, while seventy-three (73) were non-operational (non-functioning). The functioning and non-functioning RPSs constitute 75% and 25% of the total RPSs, respectively. All retail petrol stations classified as functioning were dispensing and selling either petrol, diesel, kerosene, or a combination of any two or all three products. At the time of the survey, RPSs newly built that had not started selling products; stations under construction; and closed down stations were all classified as non-functioning. Figure 4.3 shows the graphical representation of the functional status of the retail petrol stations in percentage, and the operational stations account for the highest percentage on the chart.

Figure 4.3. Functionality Status of Retail Petrol Stations in Ilorin

4.1.2 Retail Petrol Stations in close proximity to Public Premises

In the survey, RPSs close to less than 30 meters to public premises such as shops, hospitals, schools, and houses (according to government guidelines outlined in 1.2.5 section in chapter 1) were identified. Only 8% (24) of the total RPSs were located within or more than 30 meters, while 92% of the total RPSs in Ilorin were found in less than 30 meters from the highlighted public premises. Table 4.1 shows the total number of RPSs in close proximity to any of the highlighted public premises. The highest number of retail petrol stations (137) is located close to shops and houses, followed by shops (77) and houses (41). The retail petrol stations located

close to schools only, hospitals only and House, School & Hospital only were only one for each group of premises.

Table 4.1: Frequencies of retail petrol stations in Ilorin at less than 30 meters to public premises

Public Premises	Numbers of RPSs in close proximity
Hospital	1
School	1
House	41
Shop	77
House & Hospital	2
Shop & House	137
House, School & Hospital	1
Shop, House & School	5
Shop, House & Hospital	8
Total	**273**

4.1.3 Sampled Retail Petrol Station

During the pilot study, 15% of the total functioning RPSs were randomly selected as the sampled stations for the study to obtain a good maximum sample size of the total functioning retail petrol stations of 297. An additional 1% was added to account for any dropout or close down of station during the study. Therefore, 16% of the 224 functioning RPSs were randomly selected, giving a total number of 36 sampled RPSs. Thirty-six sampled stations were chosen due to financial, time, and accessibility to retail petrol station constraints. The literature review was used to develop a key informant questionnaire relating questions about retail petrol stations and the RPS representatives, which were the manager. The key informant questionnaire comprised 48 questions, and participant consent forms were attached to each questionnaire administered. Thirty-six questionnaires were distributed to the thirty-six sampled retail petrol stations. Some of

the questionnaires were completed on the same day, while some took more than a day. The researcher visited the stations several times before all the thirty-six questionnaires were completed and collected from the managers. Figure 4.4 shows the distribution of the 36 randomly selected RPSs on the map of Ilorin. In the map distribution, the RPSs were more concentrated within the heart of the Ilorin metropolis. It also indicates the country and state of the study with a map of Nigeria and Kwara state.
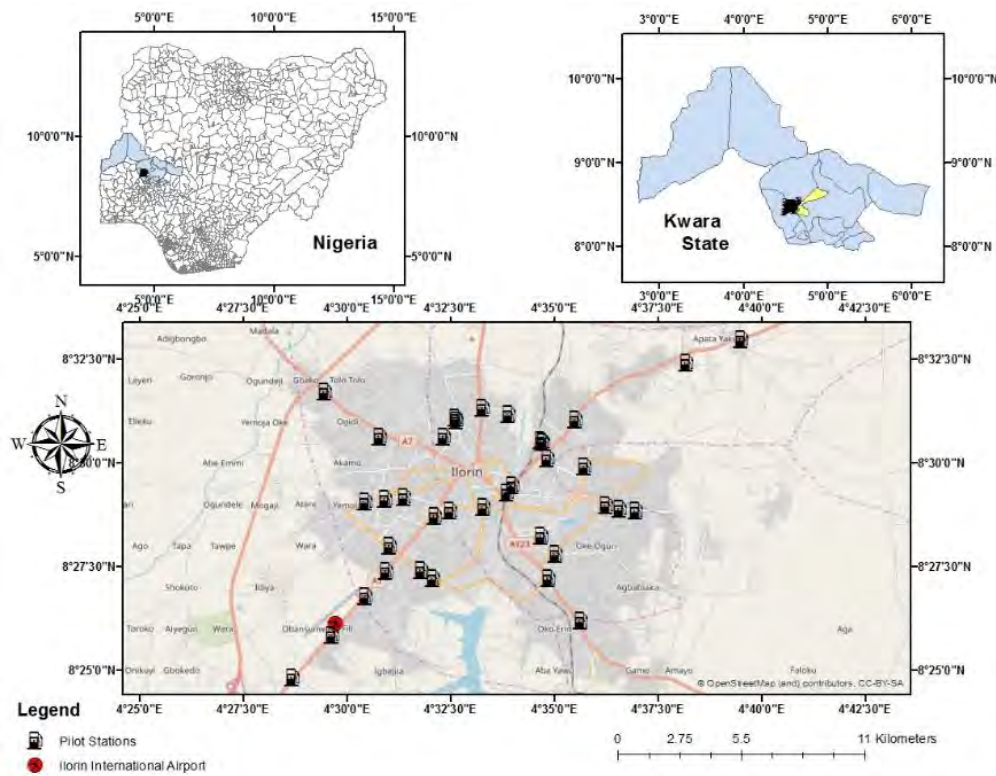
Figure 4.4. Random distribution of thirty-six selected retail petrol stations in Ilorin.

4.1.4 Characteristics of Sampled Retail Petrol Stations

Characteristics discussed include ownership type, number of employees, the product sold, water source, shift pattern, drainage type, and age range of stations. Independent marketers (RPSs owned by indigenous owners) own the highest percentage of functioning RPSs in Ilorin due to the general market value of petroleum products in Nigeria. Half of the sampled RPSs have a total number of six to ten (6-10) employees, 33% RPSs have a total number of one to five employees and 8% RPSs have a total number of eleven to fifteen employees. Retail petrol stations with a total number of 16-20, 21-25, 26-30 and 31-35 accounts for 3%, 3%, 0 and 3%

respectively. The data shows that the maximum number of employees in the sampled RPS is between 31 to 35 people. RPSs with 1 to 10 employees account for 83% of the total sampled RPSs.

The result shows twenty-nine (81%) of the sampled RPSs sell the three major petroleum products (Petrol, Kerosene, and Diesel) sold in Nigeria. Just 3% of the sampled RPSs sell petrol only while 5% sell petrol and diesel, and 11% of sampled RPSs sell the three major petroleum products with cooking gas. All the sampled RPSs operate seven days a week. RPSs established within 5 to 9 years are 14 in number, followed by stations above 15 years with a total number of 10 and stations less than five years with a total number of 8. Sampled RPSs established within 10 to 14 years have the least number, with 4 stations.

Well, and borehole is the primary source of water within the sampled RPS vicinity in Ilorin. Employees of these stations use the water for different purposes such as drinking, ablution, washing, and other form activities within the station. Table 4.2 shows that only one of the RPSs has a tap as their water source, which refers to the government-run water supply, while 51% and 46 % of the RPSs have a Well and borehole, respectively as their water source.

Eighty-three per cent of the sampled RPSs operate in one form of shift patterns such as 1day/2days/ 3dys/4days/5days/6days on & 1day/2days off. Also, some of the stations operate on 6 hours based shift for their employees, while only six (17%) of RPSs do not operate on any shift pattern, which means that their employee works 7days a week and only takes sick absence.

Thirty-one per cent of the sampled RPSs direct all their wastewater to the open gutter without any form of treatment, while 69% of the stations direct their wastewater to soak away. Table 4.2 also shows all the frequency and percentage results of the characteristics of the sampled retail station, such as age range, source of water, shift patterns, number of employees, ownership type, types of petroleum product sold, and drainage type.

Other information about the sampled retail petrol stations, such as the number of storage tanks, repair history, and change of underground storage tanks, were obtained in the survey. The information about the type of storage tank (surface & underground) and time of petrol off-loading from delivery tanks were collected using the key informant questionnaire (Appendix 2A). The result from this information shows that 18 stations off-load petrol from delivery tankers into their storage tank at any time (morning, afternoon, and evening) and only one station off-loads in the afternoon and evening.

Table 4.2: Frequency and percentage of sampled retail petrol stations characteristics

Sampled Retail Petrol Station Characteristics	Frequency (N=36)	Percentage (%)
Source of water		
Well	19	51%
Borehole	17	46%
Tap	1	3%
Employee shift operation pattern		
Operates on a different shift pattern	30	83%
Do not operate on any shift pattern	6	17%
Drainage type		
Soakaway	25	69%
Open gutter	11	31%
Age ranges (years since in operation)		
< 5	8	22%
5 to 9	14	39%
10 to 15	2	11%
>15	10	28%
Ownership type		
Independent petroleum marketers	34	94%
Major petroleum marketers	2	6%
Types of petroleum products sold		
Petrol only	1	3%
Petrol and diesel only	2	5%
Petrol, diesel, kerosene only	29	81%
Petrol, diesel, kerosene, and cooking gas	4	11%
Total number of employees		
1 – 5 employees	12	33%
6 – 10 employees	18	50%
11 – 15 employees	3	8%
16 – 20 employees	1	3%
21 – 25 employees	1	3%
26 – 30 employees	0	0%
31 – 35 employees	1	3%

Figure 4.5 shows the graphical representation of the time the sampled retail petrol stations off-loads petrol from tankers into their storage tanks. Six stations unload in the morning & afternoon while 4, 3, 2, and 2 stations off-load petrol from tankers into their storage tank in the afternoon, evening, morning & evening, and morning, respectively.
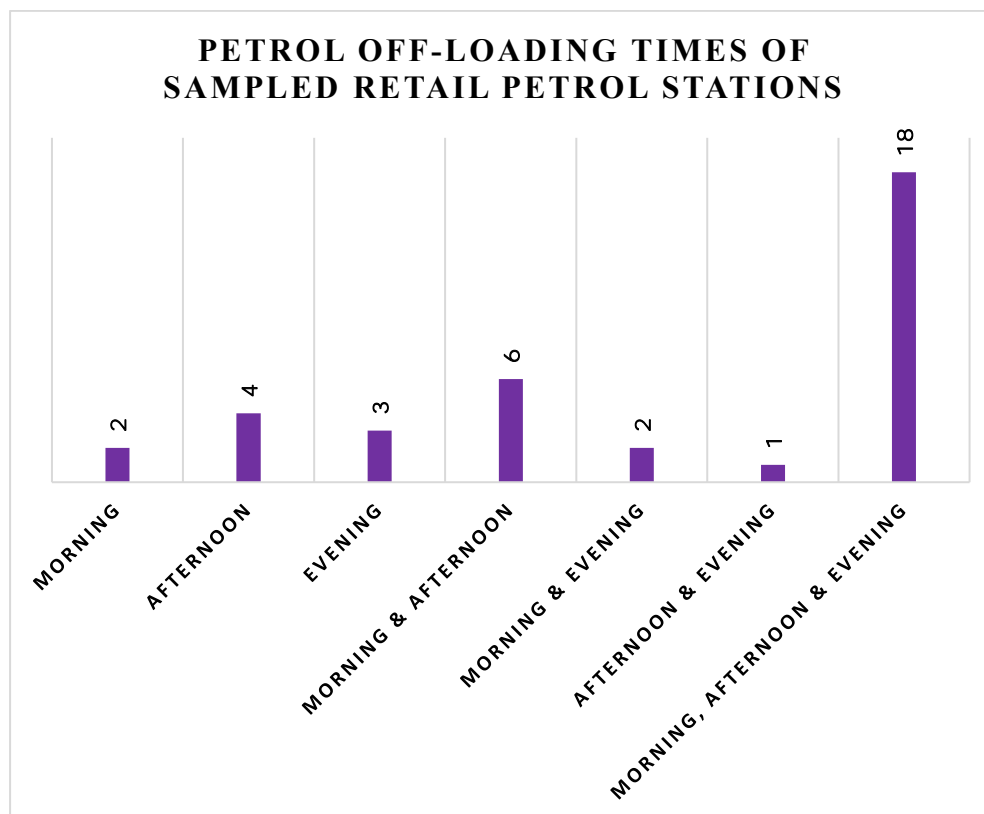
Figure 4.5. Petrol off-loading time from tankers to storage tanks

Table 4.3 shows the frequencies and percentage of sampled RPSs and their repair history of the Fuel pump, pipe networks, and storage tanks. Also, the frequencies and percentage of the sampled retail petrol station and the number of storage tanks used are represented in table 4.3. The dispensing pumps remain inactive during petrol off-loading from tankers in all sampled stations. Figure 4.6 shows the representation of the frequency of RPSs, and the type of storage tank used. Thirty stations have only underground storage tanks, and five stations have surface and underground storage tanks, while one station has surface storage tanks. Products stored in the surface storage tanks are kerosene and cooking gas, while underground storage tanks are used for storing petrol, diesel, and kerosene.

Table 4.3: Frequency of sampled retail petrol stations storage tanks and repair history

Characteristics	Sampled Retail Petrol Station	
	Frequency (N=36)	Percentage (%)
Numbers of Storage Tanks		
3	4	11%
4	14	39%
5	6	16%
6	5	14%
7	1	3%
8	5	14%
9	1	3%
Repair History		
Fuel Pump	21	58%
Fuel Pipe	1	3%
Storage Tank	1	3%
Fuel Pump & Fuel Pipe	3	8%
Fuel Pump & Storage Tank	1	3%
Fuel Pump, Fuel Pipe & Storage Tank	4	11%
No Answer	5	14%
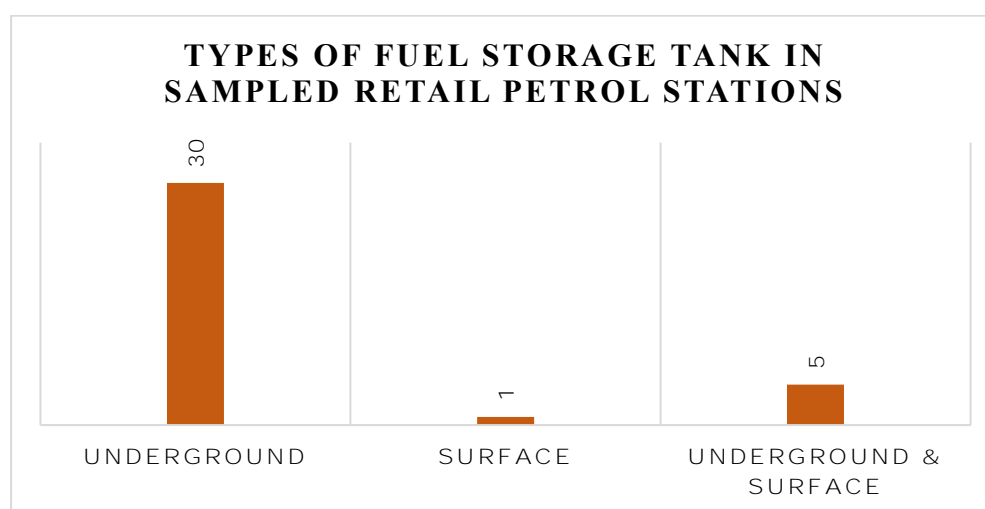
Figure 4.6. Types of storage tanks used in samples retail petrol stations

Five of the seven RPSs with the highest number of storage tanks had 8 storage tanks, and the remaining two had 9 & 7storage tanks each. Fourteen, six, and five other retail petrol stations have 4, 5, and 6 storage tanks, respectively. The remaining four retail petrol stations had the least number of storage tanks with a total number of 3.

Figure 4.7 represents the percentage of sampled RPSs that have changed and not changed storage tanks since they started operating. The result from the key informant questionnaire shows that only two stations have changed their underground storage tank, while 34 stations claimed that none of their underground storage tanks had been changed over the years until the survey. According to the repair history of the sampled retail petrol stations, 21 stations had repaired only fuel pumps. Two stations had repair records of only fuel pipe network and fuel storage tank repaired each. Another had both the fuel pump and storage tank repaired. Three other stations had both the fuel pump and pipe network repaired, and four stations had the fuel pump, pipe network, and storage tank repaired between the time of establishment and the time of the survey. Five stations did not provide an answer to the repair history questions.
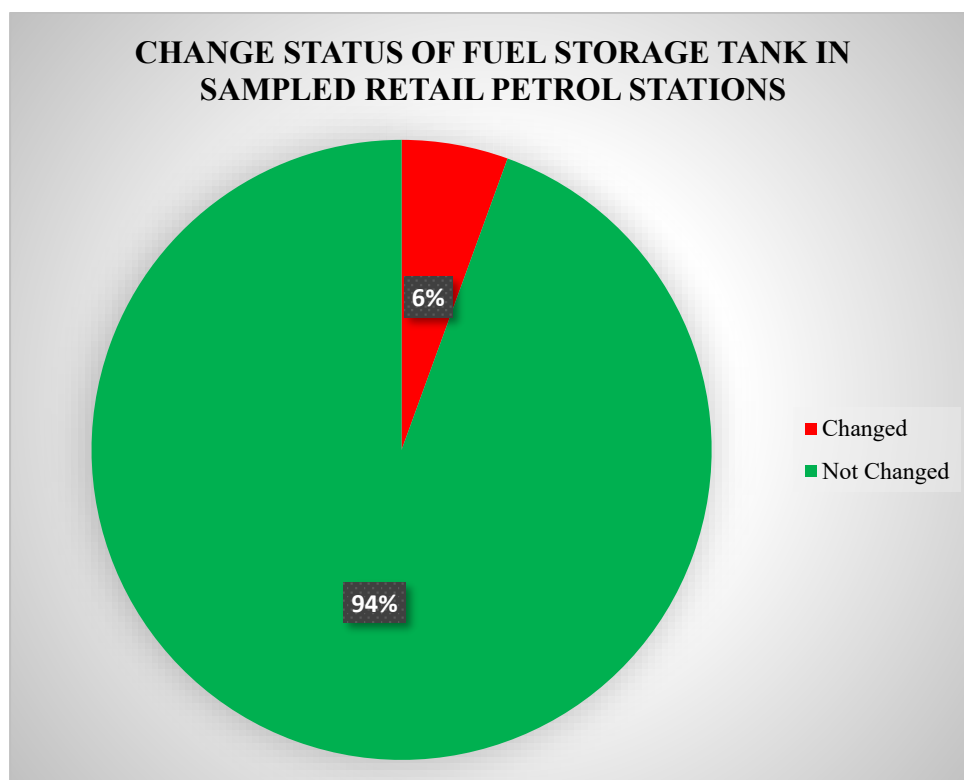
Figure 4.7. Percentage of sample retail stations with and without a changed storage tank

4.1.5 Socio-Demographic Characteristics of the Sampled Retail Petrol Station Employees

The pilot study focused on two groups of retail petrol station staff readily present in the station. The two groups were the managers and attendants. The key informant questionnaire (Appendix 2A) was also used to collect the socio-demographic characteristics of the managers. A questionnaire for employees was the data collection material developed to collect information from retail petrol station attendants during the pilot study. The questionnaire for employees consists of twenty-nine questions with an attached consent form (Appendix 2B). Each sampled RPS has one manager, but the numbers of attendants vary from one station to another. Thirty-six key informant questionnaires were distributed to each manager of the 36 sampled RPSs. A total of 72 questionnaires for the employee were also distributed to the 36 sampled RPSs. Questionnaires for the employee were administered to two voluntary attendants from each sampled station. Completed questionnaires from all the stations were collected within two weeks from the distribution day. There was a 100% response rate from the manager and an 83% (60) rate from the attendants.

4.1.5.1 Characteristics of the Sampled Retail Petrol Station Managers

Each thirty-six sampled retail petrol station has one manager only; therefore, the questionnaires were administered to all the thirty-six managers. The questionnaires were quite difficult to retrieve because of the busy schedule of the managers. So, it took more than a week to collect all the questionnaires from the managers. Table 4.4 shows the socio-demographic characteristic of the managers, such as the age group, gender, educational level, and marital status. The result indicates that males are usually employed for manager positions in Ilorin RPSs, and during the study, all the managers at the sampled RPSs were all male. All the managers work 7days a week because their duties do not permit shift patterns.

Table 4.4: Characteristics of the retail petrol station managers (N=36)

Characteristics	Frequency (N=36)	Percentage (%)
Gender		
Male	36	100%
Female	0	0
Age		
18-24	3	8%
25-31	10	28%
Above 31	23	64%
Educational Level		
Primary	1	3%
Secondary	7	19%
Tertiary	28	78%
Marital Status		
Single	6	17%
Married	30	83%
Widow	0	0
Divorced	0	0

4.1.5.2 Characteristics of the Sampled Retail Petrol Station Attendants

Two (2) voluntary attendants were selected in each of the thirty-six (36) sampled RPSs due to the busy nature of the attendants and to have an equal sample from stations with a total number of 3 employees. A total number of 72 attendants participated in the study. Questionnaires were administered to the 72 attendants, but only 60 attendants completed and returned their questionnaires. The majority of the attendants were male (78%), single (68%), and within the age group of 25 to 31 (47%). Sixty-eight per cent (68%) of the attendants had an educational background to tertiary level. The highest percentage of attendants work 5 days a week while 30% of the attendants work 7days a week. All the attendants indicated the practice of hand hygiene. The study result shows that 62% of the attendants answered no to using any personal protective equipment (PPE), and 38% answered yes to PPE. Only 3% of the attendants were

given any form of training before working. Sixty-two per cent (62%) of the attendants were trained for less than a week. At the same time, 35% of the attendants were trained for more than a week at the start of their employment.

The training was delivered verbally and by physical demonstrations at the RPS. The training was more focused on operational function around the petrol station and less on health and safety. After the training at the start of their employment, only 27% of the attendants were retrained, while 73% were not.

In the study, 86% of the attendants reported that they could operate a fire extinguisher, and 14% of the attendants did not know how to operate a fire extinguisher. Fuel spillage on the skin during work is the most common hazard experienced daily by RPS attendants. Sixty-three per cent of the attendant had experienced fuel spillage on the skin at work, 17% had experienced a fire,13% had experienced motorcycle/car accidents, and 7% had experienced robbery incidents at work.

Furthermore, 58% of the attendants had no work-related health concerns, while 42% of the attendants had a form of work-related health concern. The summary of the characteristics of the RPS attendants, such as the age group, gender, marital status, educational level, length of employment at the station, and the number of working days in a week, are shown in table 4.5.

4.1.6   Characteristics of Residents in Close Proximity to Sampled Retail Petrol Stations

A questionnaire consisting of 17 questions (see appendix 2C) was developed for residential occupants close to the sampled retail petrol station. Only 16 sampled retail petrol stations were close to residential accommodation within a distance of less than 30 meters. The questionnaire collected information on the occupant's position, length of stay, the total number of family members, total number of rooms, type of cooking fuel used, availability of fire extinguishers, environmental issues of concern, and generator use. Seven residential buildings were rented, while the occupants in the other nine residential buildings were the owners. Six residential occupants had lived in their accommodation for more than 10 years, while ten residential occupants had lived in their accommodation for less than 10 years. Figure 4.8 shows the total number of rooms in each residential building and the number of children and adults living in the building. The residential buildings with the highest number of family members are R6, R10, R3, R13, R5, R7, and R11, with 65, 38, 35, 19, 15, 14, and 11 persons, respectively.

Table 4.5: Characteristics of the retail petrol station attendants

Characteristics	Frequency (N=60)	Percentage (%)
Gender		
Male	47	78%
Female	13	22%
Marital Status		
Single	41	68%
Married	19	32%
Widow	0	0
Divorced	0	0
Age		
18-24	21	35%
25-31	28	47%
Above 31	11	18%
Educational Level		
Primary	1	2%
Secondary	18	30%
Tertiary	40	68%
Working Days in a Week		
4day	8	13%
5days	20	34%
6days	14	23%
7days	18	30%
Length of Employment at the station		
< 1 year	15	25%
1-5 years	35	58%
6-10 years	9	15%
>10 years	1	2%

Table 4.6: Characteristics of residents in close proximity to sampled retail petrol stations

S/N Residential building (R)	Length of stay in the accommodation	Total number of family members	Total number of children	Total number of adults
R1	5	6	3	3
R2	1	3	0	3
R3	2	35	7	28
R4	10	6	4	2
R5	16	15	10	5
R6	20	65	40	25
R7	3	14	8	6
R8	4	4	2	2
R9	1	10	6	4
R10	19	38	22	16
R11	30	15	10	5
R12	2	4	2	2
R13	15	19	12	7
R14	7	6	3	3
R15	1	8	4	4
R16	8	5	3	2

Table 4.6 shows the length of stay and total family members consisting of the total number of children and adults of resident 1 (R1) to resident 16 (R16). There were 136 children and 117 adult occupants who lived in the 16 residential buildings. Seven residential buildings used gas as their only source of cooking fuel, five residential buildings used only kerosene, while only two residential buildings used coal as their only source of cooking fuel. One of the residential buildings reported the use of gas, coal, and kerosene also; another residential building reported the use of gas and kerosene as their source of cooking fuel. In terms of fire accidents, none of the residential buildings had experienced fire incidents. Eleven residential buildings owned a fire extinguisher. Only seven occupants claimed to know how to use the fire extinguisher, while the remaining five occupants did not know how to use fire extinguishers. Five residential buildings do not have a fire extinguisher.

Noise pollution, air pollution, and fire outbreak was the major environmental and health concern of all the residential occupants close to the sampled retail petrol station. Eleven residential households reported that the retail petrol station does not cause any form of discomfort, while only five residential households claimed that the retail petrol station causes a state of discomfort to them. Thirteen residential buildings used generators as sources of power, while only three residential buildings did not use generators.
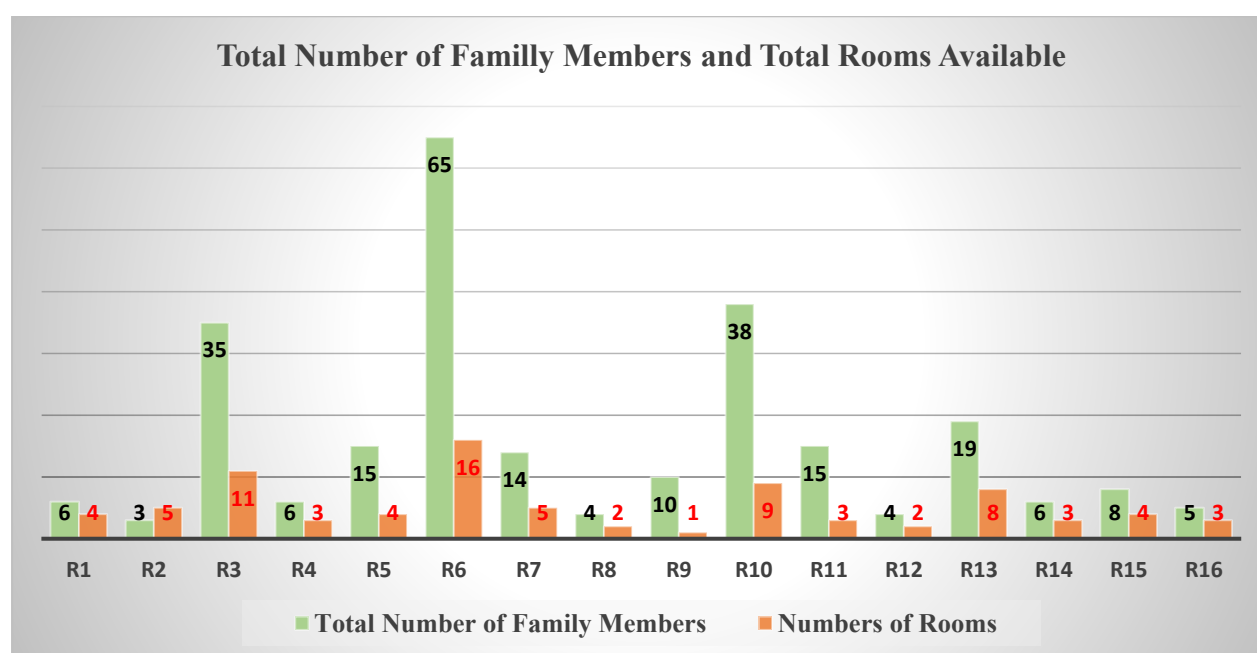
Figure 4.8. Comparison of family members and number of rooms in each residential building

4.1.7 Characteristics of Shops in Close Proximity to Sampled Retail Petrol Stations

A questionnaire with 21 questions was developed and administered to shop occupants in close proximity- i.e., less than 30 meters- to the sampled retail petrol stations. Twenty-five shops were selected for the study. The questionnaire collected information from shop occupants about the days of operation, total operating hours, source of water, the total number of workers, and length of stay at the shop. Information about the products sold/activities rendered, fire incident, availability of fire extinguishers, cooking activities in the shop, use of a generator, method of waste disposal, the discomfort experienced, and environmental issues of concern was also obtained. Figure 4.9 shows the frequency of shops and their water source. The results show that the water source of 10 shops was a borehole, 9 shops had a Well, while the remaining 6 shops had tap water.
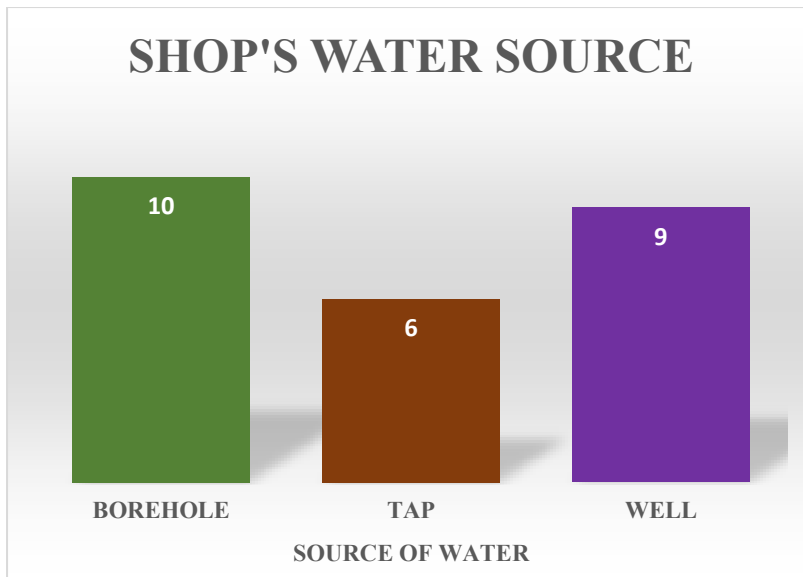
Figure 4.9. Water source for the shops

Table 4.7 shows the shop's length of stay, days of operation per week, total operating hours, the total number of workers, and the product or service rendered. Nine shops operate 7days a week, and 14 shops operate 6days of a week from Monday to Saturday. The remaining two shops operate four and five days of the week. Only four shops have more than five workers, while the remaining 21 shops have no worker apart from the shop owner or had between 1 to 4 workers. Eight shop occupants had been operating in the shop for five years and above, while seventeen shop occupants have been operating for less than five years. Figure 4.10 shows the frequency of the shops with and without fire extinguishers. Only two shops reported having encountered fire in the shop, while twenty-three shops had not experienced fire incidents.

Eighteen shops did not have fire extinguishers, while six shops had fire extinguishers. Figure 4.11 shows the percentage of the shops close to the sampled retail petrol station that carry out any form of cooking activities in the shop. Only 7 shops perform cooking activities in the shop, and the remaining 18 shops do not perform any cooking activities in the shop. Thirteen shops use a generator, and twelve shops do not.

The discomfort experienced by shop occupants includes irritation, noise, petrol fuel smell, sounds, and smoke from vehicles. The environmental issues highlighted by shop occupants are air pollution, noise pollution, and fire outbreak. Only three shops burn their waste close to the shops. Three shops dispose of their waste in the bush, while the remaining nineteen shops use public dump sites and waste disposal trucks.

Table 4.7: Characteristic of shops in close proximity to sampled retail petrol stations

S/N Shop (SH)	Length of stay	Days of operation per week	Total operation time (hours)	Number of workers	Product sold/ service rendered
SH1	8months	7	8	2	Barbecued fish, chicken, gizzard & beef
SH2	3years	6	9	0	Beads Accessories
SH3	2weeks	7	10	0	Beverages, small chops
SH4	6years	6	8	1	Soft drinks
SH5	6months	7	12	0	Raw food stuffs
SH6	1year	7	12	1	Supermarket
SH7	4years	6	11	1	Computer centre
SH8	1month	5	10	4	Food stuff
SH9	2years	6	14	1	Phone accessories
SH10	3years	7	11	2	Provisions
SH11	17years	6	8	1	Clothes
SH12	3years	7	14	8	Petrol
SH13	3years	6	14	10	Petrol
SH14	8months	7	8	0	Chemist
SH15	15years	6	10	20	livestock feeds & ingredient
SH16	3years	6	12	2	Chemist and variety
SH17	5years	6	9	6	Computer training centre
SH18	3years	6	12	3	Cooked food
SH19	3years	6	10	0	Drinks
SH20	10years	7	10	3	Drinks
SH21	5years	4	10	1	Soft drinks and water
SH22	10years	6	10	2	Motor spare parts
SH23	10years	7	12	0	Cements
SH24	2years	6	10	2	Computer service & cyber café
SH25	2years	6	8	2	Supermarket

Figure 4.10. Shops with a fire extinguisher

Figure 4.11. Percentage of shops with any form of cooking activities

4.2   Discussion

According to the study results, the total number of retail petrol stations in Ilorin, including functioning and non-functioning, was 297, which was 72 stations higher than the total number of retail petrol stations of 225 reported by Oloko-oba *et al.* (2016) as cited in Odipe *et al.*

(2018). The increase in the RPSs could be due to the rise in population growth and demand for petroleum products, leading to an increase of RPSs built over the years in Nigeria (Okonkwo *et al.,* 2014; Yunus, 2019). The spatial distribution of the RPSs on the Ilorin map shows a higher concentration of stations along major roads at the heart of the Ilorin metropolis closer to the consumers. Srinivasan (2015), cited in Manneh *et al.* (2020), stated that one of the major determinants of consumer preference is the closeness of RPS to consumers, which could be a contributing factor to why the RPSs in Ilorin are concentrated at the heart of the metropolis. Abdullahi and Adedayo (2017) also stated that marketability and accessibility to the consumer are among determining factors for locating RPS. Most RPSs did not meet the requirement of 400 meters apart from each other from observation according to the department of petroleum resources guidelines, and 92% of RPSs in Ilorin are located close to public premises such as schools, hospitals, shops, and houses. The location of a higher percentage of RPSs in Ilorin close to residential buildings and public places in this study agrees with Mohammed *et al.* (2014); Arokoyu *et al.* (2015); Oloko-Oba *et al.* (2016), and Tah (2017) results in several irregularities in the location of RPSs across different towns in Nigeria.

The randomly selected RPSs show the distribution and representation of RPSs in Ilorin, as indicated in figure 4.4. In the study, 94% of the sampled RPSs were owned by independent petroleum marketers. The high number of independent owned RPSs could be due to the sale of RPSs owned by major marketers to private owners constituting the independent petroleum marketers. In addition, the highest percentage of newly built RPSs in Ilorin is owned by independent petroleum marketers, according to the observational data collected. The RPSs owned by independent petroleum marketers across Nigeria have been increasing since their introduction into the downstream sector of the petroleum industry (Ehinomen and Adeleke, 2012). A high percentage of private independent marketers owned RPSs could result from petrol being a lucrative business in Nigeria, where the primary source of revenue is crude oil (Broni-Bediako *et al.,* 2018).

In this study, no major petroleum marketer's RPSs were new, i.e., between 1 to 9years; they all fell within the age range of 10 to 15years and above. The old age of retail petrol stations owned by major marketers shows that multinational companies predominantly ran most RPSs in Ilorin before the increasing rise of independent petroleum marketers owned RPSs over the last nine years. Although some independent petroleum marketer RPSs are 10 to 15 years old and above, the numbers are small compared to the major petroleum marketers' RPSs.

The studies show that 83% of the sampled RPSs have between 1 to 10 employees; therefore, the average number of retail petrol station employees in Ilorin is between 1 to 10. RPSs with employees between 11 to 35 were only 17%. These stations are classified as mega retail petrol stations due to their large size, the number of employees, and available pumps. The mega stations are mainly located along the major roads. Eighty-one per cent of the RPSs in the study sell petrol, diesel, and kerosene, which are the major petroleum product sold in most standard retail petrol stations in Nigeria.

An additional 11% RPSs sell these three major petroleum products with cooking gas. The additional sale of cooking gas may be due to the gradual replacement of most domestic energy sources such as coal, firewood, and charcoal by cooking gas (Belie *et al.,* 2020). Cooking gas packaged and marketed in Nigeria is also known as liquefied petroleum gas, which contains 70% butane and 30% propane (Belie *et al.,* 2020). The cooking gas is stored in a surfaced storage tank at these RPSs. These will be increasing the effect and threats of fire and explosion associated with RPSs because of the many retail petrol stations located close to residential and public places leading to over-concentration in a small area within the city. Over concentration of RPSs in small areas within the city has been related to various problems like traffic congestion, health risks, fires, and explosions, which led to hampered emergency responses in some cases (Adewuyi, 2020). None of the RPSs in the study has designated fire assembly points or emergency response guidelines. The study shows that most stations sell petrol, diesel, and kerosene, which are highly flammable, making the stations a facility with high fire hazards. All the RPSs in the study do not keep any form of accident or injury record book that could be used for management, safety, and health improvement in the stations to ensure a good working environment for their employees.

Eleven RPSs out of the 36 sampled station directs its wastewater into the open gutter, and no indication of oil/water separator installation. The directed wastewater from RPSs into open drainage is a potential cause of pollution to water sources used by the general public. Although spills of petrol and kerosene at the stations may evaporate within a few hours because they are lighter petroleum products, the mixture of different oil and vehicle spills in the wastewater could also lead to environmental pollution. Oliveira-Martins and Grisolia (2009) reported in their study that the wastewater of retail petrol stations contains toxic compounds even after using an oil/water separation system. Polycyclic aromatic hydrocarbons (PAHs) are samples of toxic compounds present in contaminated water with gasoline residues and other petroleum derivatives (Oliveira-Martins and Grisolia, 2009). Most of the RPSs have only Well as their

source of water supply. In Ayanshola *et al.* (2011) study of "assessment of water consumption pattern in Ilorin, Kwara state, Nigeria," a high number of commercial users, including retail petrol stations, also use Well as the only source of water supply. Water sources in these retail petrol stations can easily be polluted by petrol chemicals and corrosion of underground storage tanks, exposing retail petrol station employees who use it at work to health problems.

A higher number of RPSs in the study unload petrol from a delivery truck at any time of the day. The cooling of the petrol truck from long-distance travelling and the availability of petrol at the station is the main determinant of off-loading time at the RPSs in the study. These determinants show that less consideration is given to the temperature of off-loading time, which determines the evaporation rate of petrol into the atmosphere that constitutes a source of ambient air pollution. Petrol is a highly volatile liquid comprising hundreds of hydrocarbons, and the evaporation of this volatile liquid is a significant anthropogenic source of air pollution (Fakinle *et al.,* 2017). Petrol evaporative emission is invariably increased due to the high volatility characteristics of petrol with increasing ambient temperature. Petrol evaporative emissions occur from different activities such as refuelling vehicles, driving vehicles, loading and unloading petrol, and storing petrol in containers and tanks (Gershon and Asaolu, 2020). Petrol evaporates when its molecules get excited and leave the surface of the liquid. The petrol evaporation escapes as vapour into the atmosphere due to the reduction of vapour pressure above it due to the increase in ambient temperature (Fakinle *et al.,* 2017). Gershon and Asaolu (2020) also state that in addition to petrol evaporation as a source of pollution, evaporation from petrol leakage leads to economic losses. In addition, the increased emission of air pollutants from petrol evaporative also increases the exposure of people within the vicinity of the RPS to those pollutants that may harm human health.

This study shows that most RPSs use underground storage to store petrol, diesel, and kerosene, while only a few use surface storage tanks to store cooking gas. RPSs storage tanks vary from 1 to 9, with most stations having four storage tanks. Through the study observation, tank numbers used by RPSs could be determined by the size of the RPS and the number of pumps. Only 6% of the RPSs have ever changed their underground storage tanks, and 86% of the RPSs had a repair history on their fuel pump, fuel pipe, and storage tank. Leakage from faulty RPS equipment and storage tanks has been associated with land, air, and water pollution, which could have a detrimental effect on human health and the environment. Contamination of underground water with petrochemical compounds was reported by Adeoti *et al.* (2014), Adebiyi and Adeyemi (2015), and Odipe *et al.* (2020), who studied groundwater resources

within the vicinity of the retail petrol station in Nigeria. Petrochemical infiltration from fuel leakage, RPS wastes, and chemical release from corrosion of old underground storage tanks are potential sources of underground water and soil contamination (Nganje *et al.,* 2007; Adeoti *et al.,* 2014).

The retail petrol station employees in the study comprise managers and attendants. All the managers of the RPSs were male. The manager position shows that there is gender inequality despite the fact that some of the stations are owned by females. Men are preferred for the manager position because of the dynamic nature and frequent travelling related to the duties. The manager appoints a supervisor from within attendants who has worked for a long time in the station and are good at their job to oversee the station's activities in the manager's absence. The majority of the manager were aged above 31 years, married, and educated to a tertiary level. The majority of the attendants in the study were male but single, aged 18 to 31 years, and educated to tertiary level. Most of the attendants who had worked 6 to 10 years in the RPS started working after their secondary level education. Therefore, they find it convenient to progress in the same employment because they regard it as stable, require no further educational training, and can progress from being an attendant to supervisor and then to manager based on their job experience and length of employment RPS.

The majority of RPS attendants are trained for less than a week or more at their employment start. The training given is more centred on the operational activities and function with less focus on health and safety information and practices. Although all the attendants reported hand hygiene practice at work, the observational data shows that the attendants only washed their hands with water without soap application. Improper washing of hands still poses a potential health risk because proper hand hygiene cannot be guaranteed with water only due to the nature of their work. The observational data also shows that most retail petrol station staff eat snacks and food sitting close to the pumps, especially during less busy hours at the RPS. These could potentially increase the exposure of attendants through ingestion in addition to inhalation of hydrocarbon components. Most of the time, the nature of RPS attendant work makes them readily available to petroleum hydrocarbon exposure through inhalation, ingestion, or skin contact (Muhsin, 2020). Inhalation of petroleum hydrocarbon in a previous study causes a rise in arterial and mean arterial pressure (Ovuakporaye, 2019). A study on ingestion of petroleum products like petrol in mammals shows that frequent exposure to petrol may be highly harmful to the liver cell (Ubani *et al.,* 2009).

The residential buildings close to the RPSs had more children than adults in all the households, and their primary source of cooking fuel was cooking gas and kerosene. Karakitsios *et al.* (2007) study shows a significant contribution from RPSs to the total benzene concentration observed around the vicinity of RPSs. Also, people living in the vicinity of RPS in an urban location are exposed to an increased risk of leukaemia caused by benzene, depending on their exposure period. The gasoline vapours released during loading, refuelling, and movement of vehicles are sources of volatile organic compounds, which include BTEX (benzene, toluene, ethylbenzene, and xylene) that are potential air pollutants and found in high concentrations in RPSs (Al-Harbi *et al*., 2020). The children in these residential buildings close to retail petrol stations are likely to be susceptible to a higher risk of diseases. Short- and long-term exposure to BTEX is associated with damage to the central nervous system, allergies, leukaemia, headaches, eye and lung irritations. Moreover, children are more sensitive to these air pollutants than adults (Abbasi *et al.,* 2020).

Noise pollution from vehicles refuelling at the stations and generators used by the RPSs is a significant source of noise highlighted by the residential occupants. Fire outbreak is also a significant concern to the residential occupants. These results are similar to the findings of residents' perception of danger associated with RPSs in Mshelia *et al.* (2015) study. A large number of the residential occupants also uses generator as a secondary source of electricity which may also contribute to the level of noise and air pollution within that vicinity. Millions of Nigerians are forced to independently resort to electricity from generators due to the country's energy supply deficit (Ibhadode *et al.,* 2018). Noise levels examined in households using generators in a Nigerian city exceed the WHO noise standard of 50dB for residential areas in the Menkiti and Agunwamba (2015) study.

The study of Ibhadode *et al.* (2018) shows evidence that the majority of the generator used by residents in Nigerian cities poses serious potential risk or danger to the health and general well-being of the residents. Oyedepo and Saadu's (2010) study that evaluated noise pollution levels in the Ilorin metropolis exceeds the recommended limit of 82dB(A). This report indicates that noise pollution in the Ilorin metropolis is a potential source of severe health risk to its residents. The noise level from the residential building and the noise from the RPSs increase the noise level within the vicinity, leading to increased exposure and the effect of noise pollution on people living within that community. Noise pollution has been associated with human physical and mental health problems such as hypertension, increased heart rate, sleep disturbance, violent behaviour, irritability, and lack of concentration (Gupta *et al.,* 2018).

The shop occupants indicated that noise from RPSs, petrol fuel smell, sounds, and smoke from vehicles visiting the RPSs causes discomfort. The discomfort experienced by the shop occupants could contribute to health problems based on their length of exposure. Furthermore, most shop occupants operate more than 9 hours daily between 6 to 7 days a week. Although many shop occupants do not carry out any form of cooking activities in the shop, the few shops that carry out cooking activities increase the risk of fire hazards within the vicinity because of their closeness to RPS. Burning of waste in an open fire within the shop vicinity reported by three shops could also increase fire hazards, and the majority of the shop occupants do not have fire extinguishers. The Borehole and Well are the major water supply source for these shop occupants, exposing them to potential sources of contaminated water. Studies have shown possible contamination of underground water sources in the vicinity close to retail petrol stations (Nganje *et al.,* 2007; Adeoti *et al.,*2014; Adebiyi and Adeyemi, 2015; Odipe *et al.,* 2020)

4.3   Study Limitation

Administration of questionnaires to more than two attendants at each sampled retail petrol station was difficult because the manager believed it would interfere with the busy activities of the attendants. A random sampling of attendants was impossible because of the shift pattern and preference of the manager in the choice of attendants in terms of the RPS image, which could have affected the data collected during the studies. The managers were also cautious in providing data about the RPS because of their thought that the researcher may be working with government organizations that oversee the regulation of RPS. However, this misconception was minimised by explaining that the study is for academic purposes and that all RPS names will be kept anonymised in research publication. The explanation aided the voluntary participation of participants who also signed the consent form.

CHAPTER FIVE: QUANTITATIVE RESULTS AND DISCUSSION

5.0   Introduction

The results of the quantitative phase of the study main phase are presented and discussed in this chapter. Thirty-six functioning retail petrol stations were included in the study. The main study phase consists of the quantitative and qualitative phases. The SF-36 (36 Short-Form) questionnaire was used to assess the quality of life (QoL) of the chosen population group. The SF-36 questionnaire was used for data collection from retail petrol station employees consisting of the attendant and the manager, and a comparing population consisting of students and staff in the same university department.

5.1   Results

SF-36 questionnaires with an additional page of socio-demographic questions (Appendix 3A-3C) were distributed among the university population and the retail petrol station employees. Of the 327 (247 students & 80 staff) questionnaires administered to selected university population (UP), 280 (212 students & 68 staff) returned the questionnaires. Twelve students' questionnaires were excluded as they were incomplete. Therefore, 268 (82%) university population completed the questionnaires. A questionnaire was administered to each manager and a questionnaire to two attendants in each of the 36 RPSs. Of the 108 (36 managers, 72 attendants) retail petrol station employees in the target population, 96 (36 managers, 60 attendants) completed the questionnaire. Therefore, 89% of the retail petrol station employees (RPSE) participated. The socio-demographic data in table 5.1 shows that the retail petrol station employee population and the university population have the lowest number of people aged 18-24 years. The highest number of people in both population groups falls within the 25-31 age group. In the RPSE population, 73% were men, while 27% were women. The university population comprised 53% men and 47% women. A higher number of men were presented in both population groups. None of the RPSE was divorced or a widow, while 51% were married and 49% were single. Of the university population, 56% were married, and 43% were single. Table 5.1 shows the frequency data relative to each group under the university population and retail petrol station employees. Also, the data in table 5.1 show that managers were mostly men

within the age group above 31 years and married, while attendants were mostly single men aged 25 to 31 years.

Table 5.1: Frequency distribution of retail petrol station employees and university population variables

Variables	Retail Petrol Station Employee		University Population	
	Manager (36)	Attendant (60)	Student (200)	Staff (68)
Age				
18-24	3	21	24	8
25-31	10	28	99	25
Above 31	23	11	77	35
Gender				
Male	36	34	106	37
Female	0	26	94	31
Marital status				
Single	6	41	93	22
Married	30	19	105	46
Widow	0	0	1	0
Divorced	0	0	1	0

Furthermore, most university students are male within the age group of 25-31 years and married, while most staff are male within the above 31 years age group and married. Table 5.2 shows the statistical analysis result of an independent t-test comparing the age, gender, and marital status of the retail petrol station employee population and the university population. According to this table, there is a statistically significant difference in the age and gender mean of the two populations with $p = 0.026$ and 0.001, respectively, i.e., the age and gender mean distribution of the two populations are assumed to be unequal. There is no statistically significant difference between the mean of the university population and retail petrol station employees' marital status ($p = 0.613$); therefore, the mean distribution of marital status of the two population groups is assumed to be equal.

Table 5.2: Comparisons of age, gender and marital status between university population and petrol station employees using the test for difference in means

Variables	Occupation	N	Mean ± SD	P-Value
Age	University Population	268	26.57 ± 4.31	0.03
	Petrol station employee	96	25.38 ± 5.01	
Gender	University Population	268	1.47 ± 0.50	0.00
	Petrol station employee	96	1.27 ± 0.45	
Marital Status	University Population	268	1.45 ± 0.53	0.61
	Petrol station employee	96	1.48 ± 0.50	

SD- Standard Deviation

Table 5.3: Normality test of continuous variables (QoL domain)

Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	P-value	Statistic	Df	P-value
PF	.092	364	.000	.947	364	.000
RPF	.182	364	.000	.875	364	.000
REW	.210	364	.000	.840	364	.000
VT	.108	364	.000	.980	364	.000
EW	.084	364	.000	.975	364	.000
SF	.127	364	.000	.954	364	.000
BP	.111	364	.000	.944	364	.000
GH	.107	364	.000	.970	364	.000
PCS	.039	364	.200[*]	.989	364	.009
MCS	.042	364	.192	.989	364	.006

*. This is a lower bound of the true significance. a. Lilliefors Significance Correction

Table 5.3 shows the statistical result of the Kolmogorov-Smirnov test with Lilliefors correction used to test the normality quality of life domain variables between the population groups. The normality test shows a statistically significant p-value of $p<0.001$ for physical functioning (PF), the role of physical functioning (RPF), emotional well—being (EW), the role of emotional well-being (REW), vitality (VT), social functioning (SF), bodily pain (BP), and general health

(GH) therefore, the eight QoL domains are not normally distributed. Physical Component Summary (PCS) and Mental Component Summary (PCS) variables are normally distributed due to the non-statistically significant p-value of p=0.20 and p=0.19, respectively.

5.2 University Population Quality of Life

Table 5.4 shows the result of the test of means difference of university population QoL domains by gender, age group and marital status using independent sample t-test and one-way ANOVA where appropriate. There is no statistically significant difference in the QoL domain, including the Physical Component Summary and Mental Component Summary of the university population by gender. The female university population scored higher than the male population in physical functioning, the role of emotional well-being, emotional well-being, social functioning, bodily pain, general health, physical component summary, and mental component summary. While males only had a higher score than females in the role of physical functioning and vitality QoL domain. The divorced and widowed group under marital status had one participant each, so only the married and single under marital status were involved in the test of means difference. Within the university population, there is statistically no significant difference between the married and single QoL domains. The singles scored higher than the married UP in physical functioning (PF), the role of physical functioning (RPF), the role of emotional well-being (REW), emotional well-being (EW), bodily pain (BP), and general health (GH). The married had a higher score in vitality (VT) and social functioning (SF) QoL domain. Also, the married had a higher score in physical and mental component summary than the singles. The three age groups used in this study are18-24 years, 25-31years and above 31 years. The result in table 5.4 shows statistically no significant result between the age groups QoL domain. When the mean score among the age groups was compared, 18-24 years had a higher score than the other two groups in PF, RPF, REW, EW and SF, 25-31years had a higher score than the other groups in BP and GH, while >31 years had higher score (59.59) than the other groups (57.21 and 59.15) in VT. The 25-31 years age group had the highest score in PCS, followed by 18-24 years and >31years. Table 5.5 shows the test of means difference of staff within the university population QoL domains by gender, age group and marital status using independent sample t-test and One-way ANOVA where appropriate.

Table 5.5 shows no statistically significant difference between the QoL domain, physical and mental component summary of male and female university staff. Female staff scored higher than male staff in PF, REW, EW, GH, PCS and MCS, while the male staff scored higher than female staff in RPF, VT, SF, and BP. There is a statistically significant difference in PF, REW, SF, and MCS with a p-value of p=0.029, p=0.041, p=0.024 and p=0.035, respectively, between the married and single university staff.

There is no statistically significant difference between the married and single staff VT (vitality), RPF (role of physical functioning), EW (emotional well-being), BP (bodily pain), GH (general health) domain, and PCS (physical component summary). The single university staff had a higher mean score for PF (physical functioning), RPF (role of physical functioning), REW (role of emotional well-being), EW (emotional well-being), SF (social functioning), GH (general health), PCS (physical component summary), and MCS (mental component summary). The married staff only scored higher than single staff in VT (Vitality). As shown in table 5.5, there is statistically no significant difference in the QoL domain, PCS and MCS between the three university staff age groups. The 18-24 years age group had a higher score than 25-31 years and >31years in physical functioning, the role of physical functioning, the role of emotional well-being, social functioning, bodily pain, general health, physical component summary, and mental component summary. The 25-31 years age group had a higher score in vitality than the other group, and the>31years age group had a higher score than the other age group in EW. The statistical result of the test of means difference of QoL domain of university students by gender, age group and marital status is shown in table 5.6. Independent sample T-test and One-way ANOVA were used for the statistical analysis were appropriate. The result shows that there is no statistically significant difference between the male and female university students'QoL domain, physical and mental component summary. But the female student had a higher score in PF, REW, EW, SF, BP, GH, PCS and MCS than the male student, while the male students only scored higher than the female student in RPF and VT. There is no statistically significant difference between the married and single university students QoL domain, PCS and MCS. However, the single university student had a higher score than the married student in PF (physical functioning), RPF (role of physical functioning), REW (role of emotional well-being), VT (vitality), SF (social functioning), PCS (physical component summary), and MCS (mental component summary). The married university student only had a higher score in EW and BP than the single university student.

Table 5.4: Test for difference in means for QoL domain score of university population by gender, age group and marital status

QoL Domain	Gender			Age Group					Marital Status			
	Male (N=143) Mean (SD)	Female (N=125) Mean (SD)	P-value	18-24 years (N=34) Mean (SD)	25-31 years (N=124) Mean (SD)	>31 years (N=110) Mean (SD)	F (df)	P-value	Married (N=151) Mean (SD)	Single (N=115) Mean (SD)	F (df)	P-value
PF	58.81 (28.89)	62.04 (24.73)	0.330	61.76 (31.48)	60.77 (27.07)	59.36 (25.70)	0.133 (2, 265)	0.875	57.19 (26.84)	64.04 (26.92)	2.019 (3, 264)	0.112
RPF	60.31 (34.39)	57.00 (36.14)	0.443	66.18 (36.35)	54.84 (35.74)	60.91 (33.95)	1.740 (2, 265)	0.178	56.95 (36.53)	60.65 (33.45)	0.770 (3, 264)	0.512
REW	56.18 (40.04)	60.54 (38.64)	0.366	65.69 (38.04)	52.97 (39.18)	61.82 (39.58)	2.194 (2, 265)	0.114	56.51 (40.55)	60.59 (37.60)	1.342 (3, 264)	0.261
VT	59.58 (16.29)	58.52 (17.45)	0.607	57.21 (15.14)	59.15 (16.67)	59.59 (17.56)	0.262 (2, 265)	0.770	59.64 (17.26)	58.83 (16.04)	1.759 (3, 264)	0.155
EW	59.80 (18.65)	63.78 (18.07)	0.079	64.94 (15.38)	61.07 (18.58)	61.31 (19.21)	0.620 (2, 265)	0.539	61.67 (19.25)	61.77 (17.53)	0.310 (3, 264)	0.818
SF	58.39 (21.59)	61.40 (22.45)	0.265	66.54 (21.26)	58.67 (21.81)	58.98 (22.28)	1.849 (2, 265)	0.159	22.44 (1.83	21.33 (1.99)	1.334 (3, 264)	0.264
BP	72.47 (20.12)	72.64 (20.28)	0.944	21.11 (3.62)	21.15 (1.90)	18.71 (1.78)	0.760 (2, 265)	0.469	20.08 1.63)	20.40 (1.90)	0.490 (3, 264)	0.689
GH	67.80 (16.48)	70.24 (16.74)	0.231	15.23 (2.61)	18.16 (1.63)	15.07 (1.44)	1.307 (2, 265)	0.272	15.83 (1.29)	17.37 (1.62)	2.128 (3, 264)	0.097
PCS	64.85 (16.18)	65.48 (15.99)	0.748	16.43 (2.87)	17.14 (1.54)	14.71 (1.40)	0.494 (2, 265)	0.611	16.20 (1.318)	15.74 (1.47)	1.683 (3, 264)	0.171
MCS	58.49 (16.55)	61.06 (17.71)	0.221	17.30 (2.97)	16.75 (1.50)	17.38 (1.66)	1.625	0.199	17.34 (1.41)	16.77 (1.56)	1.175 (3, 264)	0.320

Table 5.5: Test for difference in means for QoL domain score of university staff by gender, age group and marital status

QoL Domain	Gender			Age Group					Marital Status		
	Male (N=37) Mean (SD)	Female (N=31) Mean (SD)	P-value	18-24 years (N=8) Mean (SD)	25-31 years (N=25) Mean (SD)	>31 years (N=35) Mean (SD)	F (df)	P-value	Married (N=46) Mean (SD)	Single (N=22) Mean (SD)	P-value
PF	53.92 (30.96)	65.65 (23.30)	0.087	65.00 (36.84)	58.60 (25.92)	58.43 (28.28)	0.184 (2, 65)	0.833	54.13 (28.17)	70.00 (25.50)	0.029
RPF	58.11 (34.39)	57.26 (41.43)	0.927	68.75 (32.04)	45.00 (41.46)	64.29 (33.91)	2.423 (2, 65)	0.097	55.98 (37.34)	61.36 (38.36)	0.583
REW	60.36 (42.19)	69.89 (35.85)	0.324	75.00 (29.55)	56.00 (44.85)	68.57 (36.99)	1.052 (2, 65)	0.355	57.97 (40.63)	78.79 (33.41)	0.041
VT	62.16 (18.95)	59.68 (16.12)	0.567	59.38 (16.78)	62.60 (14.73)	60.29 (19.96)	0.161 (2, 65)	0.851	61.85 (19.30)	59.32 (13.74)	0.584
EW	63.46 (18.55)	64.90 (17.52)	0.744	62.00 (11.52)	62.72 (18.71)	65.60 (18.89)	0.245 (2, 65)	0.784	62.87 (18.70)	66.73 (16.44)	0.412
SF	61.82 (23.00)	58.47 (26.30)	0.576	71.88 (14.56)	63.50 (25.50)	55.36 (24.68)	1.877 (2, 65)	0.161	55.71 (25.10)	69.89 (20.29)	0.024
BP	76.08 (19.60)	69.76 (19.02)	0.184	82.81 (19.89)	66.40 (22.79)	75.86 (15.33)	2.999 (2, 65)	0.057	74.95 (17.78)	69.55 (22.58)	0.288
GH	69.73 (16.95)	70.32 (15.16)	0.881	73.75 (14.58)	71.40 (19.07)	68.14 (14.09)	0.541 (2, 65)	0.585	67.50 (14.21)	75.23 (18.61)	0.063
PCS	64.46 (16.69)	65.75 (14.38)	0.737	72.58 (11.46)	60.35 (17.10)	66.68 (14.58)	2.354 (2, 65)	0.103	63.14 (16.23)	69.04 (13.61)	0.146
MCS	61.95 (17.80)	63.24 (15.60)	0.755	67.06 (10.55)	61.21 (19.06)	62.46 (16.29)	0.366 (2, 65)	0.695	59.60 (17.08)	68.68 (14.44)	0.035

Table 5.6: Test for difference in means for QoL domain score of the university student by gender, age group and marital status

QoL Domain	Gender			Age Group					Marital Status		
	Male (N=106) Mean (SD)	Female (N=94) Mean (SD)	P-value	18-24 years (N=26) Mean (SD)	25-31 years (N=99) Mean (SD)	>31 years (N=75) Mean (SD)	F (df)	P-value	Married (N=105) Mean (SD)	Single (N=93) Mean (SD)	P-value
PF	60.52 (28.08)	60.85 (25.18)	0.930	60.77 (30.39)	61.31 (27.45)	59.80 (24.60)	0.068 (2, 197)	0.934	58.53 (26.26)	62.63 (27.18)	0.281
RPF	61.08 (34.52)	56.91 (34.47)	0.395	65.38 (38.13)	57.32 (33.93)	59.33 (34.08)	0.563 (2, 197)	0.571	57.38 (36.35)	60.48 (32.41)	0.529
REW	54.72 (39.36)	57.46 (39.21)	0.623	62.82 (40.36)	52.20 (37.83)	58.67 (40.58)	1.032 (2, 197)	0.358	55.87 (40.69)	56.28 (37.41)	0.941
VT	58.68 (15.25)	58.14 (17.93)	0.818	56.54 (14.88)	58.28 (17.09)	59.27 (16.45)	0.268 (2, 197)	0.765	58.67 (16.29)	58.71 (16.60)	0.985
EW	58.53 (18.60)	63.40 (18.33)	0.064	65.85 16.48	60.65 (18.62)	59.31 (19.15)	1.206 (2, 197)	0.302	61.14 (19.55)	60.60 (17.66)	0.839
SF	57.19 (21.05)	62.37 (21.10)	0.085	64.90 (22.92)	57.45 (20.74)	60.67 (21.03)	1.426 (2, 197)	0.243	58.81 (21.22)	60.22 (21.25)	0.643
BP	71.20 (20.24)	73.59 (20.69)	0.411	72.79 (21.28)	72.17 (20.68)	72.37 (20.10)	0.010 (2, 197)	0.991	73.24 (21.07)	71.26 (19.97)	0.501
GH	67.12 (16.34)	70.21 (17.30)	0.196	63.85 (14.92)	70.40 (18.02)	67.80 (15.60)	1.702 (2, 197)	0.185	67.62 (16.56)	69.46 (16.98)	0.441
PCS	64.98 (16.08)	65.39 (16.55)	0.859	65.70 (17.55)	65.31 (17.10)	64.83 (14.83)	0.033 (2, 197)	0.967	64.19 (16.26)	65.96 (16.22)	0.445
MCS	57.28 (16.00)	60.34 (18.37)	0.209	62.53 (18.94)	57.15 (16.11)	59.48 (17.89)	1.129 (2, 197)	0.325	58.62 (17.53)	58.95 (16.81)	0.893

Also, in table 5.6, there is no statistically significant difference between the QoL domain, PCS and MCS across the three age groups of the university student. The age group 18-24 years scored higher in RPF, REW, EW, SF, BP, PCS, and MCS than the other age group. The age group 25-31 years had a higher score than other age groups in PF and GH, while the>31years age group only had a higher score than other age groups in VT.

Table 5.7 shows the statistical analysis result of an independent t-test comparing the staff and students' age, gender, and marital status within the university population. According to this table, there is no statistically significant p-value in the age and gender mean of the staff and students with p = 1.27 and 0.84, respectively, i.e., the age and gender mean distribution of the two populations are not equal. But there is a statistically significant p-value between university population staff and student marital status mean with p = 0.02; therefore, the mean distribution of marital status between the two population groups is assumed to be equal.

Table 5.7: Comparisons of age, gender and marital status between the university staff and university students using the test for difference in means

Variables	Occupation	N	Mean ± SD	P-Value
Age group	Staff	68	27.26 ± 4.41	1.27
	Student	200	26.34 ± 4.26	
Gender	Staff	68	1.46 ± 0.50	0.84
	Student	200	1.47 ± 0.50	
Marital Status	Staff	68	1.45 ± 0.53	0.02
	Student	200	1.48 ± 0.50	

SD- Standard Deviation

Mann Whitney U test was used to analyse the distribution between the two groups within the university population (UP) in relation to the quality of life domain. Table 5.8 shows the Mann Whitney U test analysis showing the distribution of quality of life domain scores across the staff and student university population. All the quality of life domain and physical components summary shows no statistically significant p-value, which signifies that its distribution is the same across the staff and student UP. Only the mental components summary shows a statistically significant p-value of p=0.04, indicating differences in its distribution across the

staff and student UP. The university staff had higher EW (emotional well-being), REW (role of emotional well-being), VT (vitality), SF (social functioning), and MCS (mental component summary) scores than the university student. The university student had a higher PF (physical functioning), RPF (role of physical functioning), BP (Bodily pain), and PCS (physical component summary) score than the university staff.

Table 5.8: Mann Whitney U test analysis of quality of life domain and physical and mental component summary between the student and staff university population

Quality of Life Domains	Student (N=200)	Staff (N=68)	P-value (P<0.05)
	Mean (SD)	Mean (SD)	
Physical functioning (PF)	60.68 (26.69)	59.26 (28.16)	0.69
Role Physical functioning (RPF)	59.13 (34.47)	57.72 (37.47)	0.85
Bodily pain (BP)	72.33 (20.44)	73.20 (19.46)	0.75
General Health (GH),	68.58 (16.83)	70.00 (16.05)	0.49
Emotional well-being (EW)	60.82 (18.59)	64.12 (17.97)	0.19
Role emotional well-being (REW)	56.00 (39.22)	64.71 (39.43)	0.11
Vitality (VT)	58.43 (16.52)	61.03 (17.63)	0.26
Social Functioning (SF)	59.63 (21.18)	60.29 (24.43)	0.50
Physical Component Summary (PCS)	65.18 (16.26)	65.05 (15.58)	0.95
Mental Component Summary (MCS)	58.72 (17.18)	62.54 (16.72)	0.04

SD- Standard Deviation

5.3   Retail Petrol Station Employee Quality of Life

The result of the independent sampled T-test for the difference in the QoL domain of retail petrol station employees by gender is shown in table 5.9. There is a statistically significant difference in vitality (p=0.002), general health (0.016), and physical components summary (0.016) between the male and female retail petrol station employees (RPSEs). The male RPSEs had a higher score than the female RPSEs in all the QoL domains, including the physical and mental component summary.

Table 5.9: Test for difference in means for QoL domain of retail petrol station employees by gender

Quality of Life Domains	Gender		P-value (P<0.05)
	Male (N=70)	Female (N=26)	
	Mean (SD)	Mean (SD)	
Physical functioning (PF)	67.50 (28.32)	63.65 (22.70)	0.536
Role Physical functioning (RPF)	64.64 (33.38)	50.00 (31.62)	0.056
Bodily pain (BP)	65.25 (23.66)	56.25 (30.73)	0.131
General Health (GH)	72.43 (13.92)	64.23 (16.29)	0.016
Emotional well-being (EW)	59.79 (17.45)	56.92 (11.99)	0.44
Role emotional well-being (REW)	50.48 (33.93)	43.59 (33.69)	0.378
Vitality (VT)	64.71 (15.01)	53.85 (15.19)	0.002
Social Functioning (SF)	64.09 (18.53)	59.62 (22.99)	0.328
Physical Component Summary (PCS)	67.46 (14.95)	58.54 (18.09)	0.016
Mental Component Summary (MCS)	59.77 (13.76)	53.50 (12.28)	0.052

SD- Standard Deviation

Table 5.10 shows the result of the independent sampled T-test for means difference in the QoL domain of retail petrol station employees by marital status. There is a statistically significant p-value of p=0.028 for the emotional well-being of married and single retail petrol station employees. A higher score in PF(physical functioning), RPF (role of physical functioning), GH (general health), REW (role of emotional well-being), SF (social functioning), PCS (physical component summary), and MCS (mental component summary) was shown in married RPSEs. Single RPSEs had a higher BP (bodily pain), EW (emotional well-being), and VT (vitality) score than married RPSEs. The ANOVA statistical analysis results that test for a significant difference in QoL domains of retail petrol station employees by age group are shown in table 5.11. Emotional well-being (EW) and the role of emotional well-being (REW) show a statistically significant p-value of p=0.04 each. There are statically no significant differences in the quality of life domain (PF, RPF, GH, VT, BP SF), PCS, and MCS of RPSE by age group. The >31 years age group had a higher score than other age groups in PF (physical functioning), RPF (role of physical functioning), GH (general health), REW (role of emotional well-being),

VT (vitality), PCS (physical component summary) and MCS (mental component summary). The 25-31 years age group had a higher score than other age groups in BP (bodily pain) and SF (social functioning), while the 18-24 years age group had a higher score only in EW (emotional well-being) than other age groups. Table 5.12 shows the test results of difference in means for the manager QoL domain by age group and marital status using independent sample T-test and One-way ANOVA where appropriate. All the managers are male. There is a statistically significant difference in PCS (p=0.026) between the married and single retail petrol station managers.

Table 5.10: Test for difference in means for QoL domain of retail petrol station employees by marital status

Quality of Life Domains	Marital Status		P-value (P<0.05)
	Married (N=50)	Single (N=46)	
	Mean (SD)	Mean (SD)	
Physical functioning (PF)	68.60 (28.25)	63.13 (25.35)	0.418
Role Physical functioning (RPF)	66.00 (34.41)	54.89 (32.75)	0.104
Bodily pain (BP)	60.80 (27.71)	65.00 (23.90)	0.430
General Health (GH)	72.40 (13.30)	67.83 (16.42)	0.136
Emotional well-being (EW)	55.55 (16.67)	62.78 (14.82)	0.028
Role emotional well-being (REW)	54.67 (34.84)	42.03 (31.77)	0.067
Vitality (VT)	61.30 (17.23)	62.28 (14.13)	0.762
Social Functioning (SF)	63.25 (20.42)	62.48 (19.35)	0.850
Physical Component Summary (PCS)	66.95 (17.20)	62.96 (15.07)	0.232
Mental Component Summary (MCS)	58.69 (15.36)	57.39 (12.72)	0.654

SD- Standard Deviation

Table 5.11: Test for difference in means for QoL domain of retail petrol station employees by age group

| Quality of Life Domains | Age Group | | | F (df) | P-value (P<0.05) |
| | 18-24 years (N=24) | 25-31years (N=38) | >31years (N=34) | | |
	Mean (SD)	Mean (SD)	Mean (SD)		
Physical functioning (PF)	62.29 (28.24)	63.68 (24.49)	72.50 (28.05)	1.36 (2, 93)	0.26
Role Physical functioning (RPF)	58.33 (34.32)	60.92 (33.65)	69.85 (31.25)	2.17 (2, 93)	0.12
Bodily pain (BP)	70.63 (19.91)	73.20 (26.95)	59.41 (27.94)	1.50 (2, 93)	0.23
General Health (GH)	68.75 (16.37)	69.61 (14.81)	71.91 (14.41)	0.36 (2, 93)	0.70
Emotional well-being (EW)	66.00 (15.74)	57.98 (14.96)	55.25 (16.59)	3.42 (2, 93)	0.04
Role emotional well-being (REW)	38.89 (34.98)	44.74 (30.29)	59.80 (34.60)	3.25 (2, 93)	0.04
Vitality (VT)	61.88 (14.20)	60.13 (15.40)	63.53 (17.34)	0.41 (2, 93)	0.66
Social Functioning (SF)	62.98 (18.21)	64.47 (18.95)	61.03 (22.14)	0.27 (2, 93)	0.76
Physical Component Summary (PCS)	65.00 (17.11)	62.04 (15.92)	68.42 (15.82)	1.39 (2, 93)	0.25
Mental Component Summary (MCS)	57.44 (13.53)	56.83 (12.28)	59.90 (16.44)	0.45 (2, 93)	0.64

SD- Standard Deviation, df- degree of freedom, One-way ANOVA

Table 5.12: Test for difference in means for QoL domain score of retail petrol station manager by age group and marital status

QoL Domain	Age Group					Marital Status		
	18-24 years (N=3) Mean (SD)	25-31 years (N=10) Mean (SD)	>31 years (N=23) Mean (SD)	F (df)	P-value	Married (N=30) Mean (SD)	Single (N=6) Mean (SD)	P-value
PF	45.00 (10.00)	72.50 (26.27)	73.26 (30.32)	1.341 (2, 33)	0.276	71.67 (29.66)	65.83 (24.98)	0.656
RPF	33.33 (14.43)	77.50 (24.86)	73.91 (28.68)	3.333 (2, 33)	0.048	75.00 (27.85)	54.17 (29.23)	0.106
REW	66.67 (33.34)	63.34 (29.19)	60.87 (32.80)	0.055 (2, 33)	0.946	63.33 (30.76)	55.56 (34.43)	0.582
VT	60.00 (17.32)	63.50 (11.32)	66.30 (18.72)	0.238 (2, 33)	0.789	66.50 (16.82)	57.50 (14.05)	0.229
EW	50.67 (18.48)	53.92 (16.45)	50.89 (15.91)	0.129 (2, 33)	0.880	51.25 (16.36)	54.00 (13.80)	0.704
SF	62.17 (21.37)	68.75 (18.87)	59.78 (16.84)	0.894 (2, 33)	0.419	63.33 (18.26)	58.17 (14.92)	0.521
BP	58.33 (8.78)	62.50 (26.14)	63.37 (24.08)	0.059 (2, 33)	0.943	65.00 (23.42)	51.25 (21.37)	0.193
GH	46.67 (10.41)	72.50 (6.77)	72.39 (14.21)	5.935 (2, 33)	0.006	72.17 (12.91)	60.83 (16.86)	0.070
PCS	45.84 (5.46)	71.25 (11.45)	70.74 (11.97)	6.491 (2, 33)	0.004	70.96 (12.03)	58.02 (14.72)	0.026
MCS	59.87 (18.95)	62.38 (11.87)	(59.46) (14.86)	0.144 (2, 33)	0.866	61.11 (13.73)	56.31 (16.25)	0.453

SD- Standard Deviation

Table 5.12 shows that the married managers had a higher score than single managers in physical component summary (PCS), mental component summary (MCS), and all QoL domains except emotional well-being (EW). There is a statistically significant difference in the role of physical functioning (RPF) (p=0.048), general health (GH) (0.006), and physical component summary (PCS) (0.004) between the managers by age group. The 25-31 years age group had a higher score than 18-24 years and >31 years in RPF, EW, SF, GH, PCS, and MCS. The >31years age group had a higher score than the other age group in PF, VT, and BP, while the 18-24years age group only had a higher score than the other age group in REW. The bivariate Pearson correlation test result between the quality of life domain with age, gender, and marital status of

retail petrol station attendants is shown in table 5.13. The result shows a significant negative correlation for BP with age group, GH, EW, and VT with gender, while VT shows a significant positive correlation with marital status.

Table 5.13: Bivariate correlations between the quality of life domains with age, gender, and marital status of petrol station attendant

Quality of Life Domains	Statistics	Gender	Age group	Marital status
Physical functioning (PF)	Correlation	-0.009	0.047	-0.002
	P-value	0.945	0.720	0.986
Role Physical functioning (RPF)	Correlation	-0.107	-0.069	0.034
	P-value	0.418	0.601	0.794
Bodily pain (BP)	Correlation	-0.212	-0.283*	0.217
	P-value	0.103	0.028	0.096
General Health (GH)	Correlation	-0.335**	-0.047	-0.118
	P-value	0.009	0.719	0.370
Emotional well-being (EW)	Correlation	-0.386**	-0.155	0.067
	P-value	0.002	0.236	0.609
Role emotional well-being (REW)	Correlation	0.081	0.212	-0.024
	P-value	0.539	0.105	0.856
Vitality (VT)	Correlation	-0.351**	-0.114	0.300*
	P-value	0.006	0.385	0.020
Social Functioning (SF)	Correlation	-0.146	0.006	0.000
	P-value	0.264	0.961	1.000
Physical Component Summary (PCS)	Correlation	-0.213	-0.138	0.075
	P-value	0.101	0.292	0.569
Mental Component Summary (MCS)	Correlation	-0.203	0.055	0.084
	P-value	0.121	0.674	0.534

*P<0.001 according to the Pearson correlation test. **P<0.05 according to the Pearson correlation test.

Table 5.14 shows the results for the test of difference in means for the QoL domain of retail petrol station attendants by gender, age group, and marital status. The male attendant had a higher score than the female attendant in all the QoL domains, including PCS and MCS, except in the REW domain. Also, the result shows a statistically significant difference between the male and female attendants in VT, EW, and GH QoL domains.

Table 5.14: Test of difference in means for QoL domain score of retail station attendants by gender, age group and marital status

	Gender			Age Group					Marital Status		
QoL Domain	Male (N=34) Mean (SD)	Female (N=26) Mean (SD)	P-value	18-24 years (N=21) Mean (SD)	25-31 years (N=28) Mean (SD)	>31 years (N=11) Mean (SD)	F (df)	P-value	Married (N=20) Mean (SD)	Single (N=40) Mean (SD)	P-value
PF	64.12 (27.95)	63.65 (22.70)	0.945	64.76 (29.26)	60.54 (23.50)	70.91 (23.96)	0.658	0.522	64.00 (26.04)	63.88 (25.71)	0.986
RPF	57.35 (36.69)	50.00 (31.62)	0.418	61.90 (35.02)	45.54 (32.67)	61.36 (35.99)	1.682	0.195	52.50 (37.08)	55.00 (33.59)	0.794
REW	38.23 (32.96)	43.59 (33.69)	0.539	34.92 (34.12)	38.09 (28.28)	57.58 (39.70)	1.891	0.160	41.67 (37.27)	39.99 (31.31)	0.856
VT	64.41 (13.41)	53.85 (15.19)	0.006	62.14 (14.19)	58.93 (16.63)	57.73 (12.92)	0.398	0.674	53.50 (15.05)	63.00 (14.18)	0.020
EW	68.35 (14.98)	56.92 (11.99)	0.002	68.19 (14.50)	59.43 (14.43)	64.36 (14.69)	2.220	0.118	62.00 (15.33)	64.10 (14.68)	0.609
SF	65.81 (19.54)	59.62 (22.99)	0.264	63.10 (18.32)	62.95 (19.09)	63.64 (31.35)	0.004	0.996	63.13 (23.81)	63.12 (20.01)	1.000
BP	67.94 (23.99)	56.25 (30.73)	0.103	72.38 (20.55)	60.36 (27.69)	51.14 (34.48)	2.494	0.092	54.50 (32.77)	67.06 (23.81)	0.096
GH	74.71 (13.65)	64.23 (16.29)	0.009	71.90 (14.62)	68.57 (16.77)	70.91 (15.46)	0.281	0.756	72.75 (14.19)	68.88 (16.31)	0.370
PCS	66.03 (16.66)	58.54 (18.09)	0.101	67.74 (16.45)	58.75 (16.16)	63.58 (21.74)	1.622	0.207	60.94 (21.88)	63.71 (15.16)	0.569
MCS	59.20 (13.64)	53.50 (14.25)	0.121	57.09 (13.17)	54.85 (12.01)	60.83 (20.13)	0.715	0.494	55.07 (17.26)	57.56 (12.36)	0.520

Also, table 5.14 shows that the single attendant scored higher than the married attendant in the role of physical functioning (RPF), vitality (VT), emotional well-being (EW), bodily pain (BP), physical component summary (PCS), and mental component summary (MCS). The married attendant had a higher score than the single in physical functioning (PF), the role of emotional well-being (REW), social functioning (SF), and general health (GH) QoL domain. There is also a statistically significant difference between the vitality QoL domain of married and single attendants. In terms of the attendant age group, the 18-24 years age group had a higher score than 25-31years and >31 years age group in RPF, VT, EW, BP, GH, and PCS. The >31 years age group scored higher than the other age groups in PF, REW, SF, and MCS, while the 25-31years scored lower than other age groups in all QoL domains, including PCS and MCS.

Because all the managers were male, only the QoL domain results for the male attendant and manager within the retail petrol station employee were compared during the statistical analysis shown in table 5.15. There was a statistically significant p-value between the manager and attendant EW (p= 0.000) and REW (p=0.002). The male retail petrol station manager scored higher in the physical component summary and mental component summary than the male retail petrol station attendant. The manager had a higher score than the attendant in PF, RPF, REW, and VT, while the attendant had a higher score than the manager in BP, GH, EW, and SF.

Table 5.15: Mann Whitney U test analysis of quality of life domains and the group classification of the QoL domains (physical component summary and mental component summary) of attendants and managers within the retail petrol station employees

Quality of Life Domains	Attendant (N=34)	Manager (N=36)	P-value (P<0.05)
	Mean (SD)	Mean (SD)	
Physical Functioning (PF)	64.12 (27.95)	70.69 (28.69)	0.195
Role Physical Functioning (RPF)	57.35 (36.69)	71.53 (28.76)	0.112
Bodily Pain (BP)	67.94 (23.99)	62.71 (23.38)	0.432
General Health (GH),	74.71 (13.65)	70.28 (14.04)	0.329
Emotional Well-being (EW)	68.35 (14.98)	51.71 (15.81)	0.000
Role Emotional Well-being (REW)	38.23 (32.96)	62.04 (31.02)	0.002
Vitality (VT)	64.41 (13.41)	65.00 (16.56)	0.772
Social Functioning (SF)	65.81 (19.54)	62.47 (17.66)	0.335
Physical Component Summary (PCS)	66.03 (16.66)	68.80 (13.22)	0.338
Mental Component Summary (MCS)	59.20 (13.64)	60.31 (14.04)	0.428

5.4 Comparison Between University Population and Retail Petrol Station Employees' Quality of Life

The Mann-Whitney U test was used to analyse the distribution between the two occupational populations in relation to the quality of life domain. The statistical results of the analysis are shown in table 5.16. The role of emotional well-being (p=0.02), vitality(p=0.03), and bodily pain (0.00) show a statistically significant p-value showing the difference in the listed quality of life domain between the petrol station employee and the university population. There is no statistically significant difference between the university population (UP) and retail petrol station employees'(RPSE) physical functioning, the role of physical functioning, emotional well-being, social functioning, general health, physical and mental component summary QoL domain. The physical and mental component summary also shows no statistically significant difference, with its p>0.05 showing the same distribution across the two populations. The RPSE had a higher score than UP in physical functioning (PF), the role of physical functioning (RPF), vitality (VT), social functioning (SF), and general health (GH), while UP had a higher score than RPSE in the role of emotional well-being (REW), emotional well-being (EW), bodily pain (BP), physical component summary (PCS), and mental component summary (MCS). Table 5.17 shows the Mann Whitney U test result for comparing the QoL domain of the university student and retail petrol station attendant (RPSA). Comparing the student and the retail petrol station attendant population, only bodily pain and role of emotional well-being are statistically significantly different, with a p-value of p=0.03 and p=0.01, respectively. Other quality of life domains (PF, RPF, GH, EW, VT, and SF) had no statistically significant p-value. The student scored higher than the attendant in RPF, BP, REW, PCS, and MCS, while the attendant scored higher than the student in PF, GH, EW, SF, and VT.

Because all the managers were male, only the quality of life domain for the male university staff and the retail petrol station manager were compared in the results shown in table 5.18. The Mann-Whitney U test analysis showing the distribution of quality of life domain score across the staff and manager population shows a statistically significant result in physical functioning, bodily pain, and emotional well-being.

Table 5.16: Mann Whitney U Test analysis of quality of life domains, physical component summary and mental component summary of the university population and petrol station employee

Quality of Life Domain	Occupation	N	Mean ± SD	P-Value
Physical Functioning (PF)	University Population	268	60.32 ± 27.02	0.08
	Petrol station employee	96	66.46 ± 26.85	
Role of Physical Functioning (RPF)	University Population	268	58.77 ± 35.19	0.69
	Petrol station employee	96	60.68 ± 33.39	
Role of Emotional Well-being (REW)	University Population	268	58.21 ± 39.38	0.02
	Petrol station employee	96	48.61 ± 33.83	
Vitality (VT)	University Population	268	59.09 ± 16.82	0.03
	Petrol station employee	96	61.77 ± 15.74	
Emotional Well-being (mental health) (EW)	University Population	268	61.66 ± 18.45	0.43
	Petrol station employee	96	59.02 ± 16.14	
Social Functioning (SF)	University Population	268	59.79 ± 22.01	0.16
	Petrol station employee	96	62.88 ± 19.82	
Bodily Pain (BP)	University Population	268	72.55 ± 20.16	0.00
	Petrol station employee	96	62.81 ± 25.91	
General Health (GH)	University Population	268	68.94 ± 16.62	0.27
	Petrol station employee	96	70.21 ± 14.97	
Physical Component Summary (PCS)	University Population	268	65.14 ± 16.06	0.80
	Petrol station employee	96	65.04 ± 16.25	
Mental Component Summary (MCS)	University Population	268	59.69 ± 17.12	0.58
	Petrol station employee	96	58.07 ± 14.10	

SD- Standard Deviation

Table 5.17: Mann Whitney U test analysis of quality of life domains and physical component summary and mental component summary of attendant and student sampled population

Quality of Life Domains	Student (N=200)	Attendant (N=60)	P-value (P<0.05)
	Mean (SD)	Mean (SD)	
Physical Functioning (PF)	60.68 (26.69)	63.92 (25.60)	0.50
Role Physical Functioning (RPF)	59.13 (34.47)	54.17 (54.17)	0.32
Bodily Pain (BP)	72.33 (20.44)	62.88 (27.50)	0.03
General Health (GH)	68.58 (16.83)	70.17 (15.63)	0.23
Emotional Well-being (EW)	60.82 (18.59)	63.40 (14.80)	0.20
Role Emotional Well-being (REW)	56.00 (39.22)	40.55 (33.10)	0.01
Vitality (VT)	58.43 (16.52)	59.83 (15.04)	0.19
Social Functioning (SF)	59.63 (21.18)	63.13 (21.15)	0.11
Physical Component Summary (PCS)	65.18 (16.26)	62.78 (17.55)	0.45
Mental Component Summary (MCS)	58.72 (17.18)	56.73 (14.08)	0.52

SD- Standard Deviation

Table 5.18: Mann Whitney U Test analysis of quality of life domains physical component summary and mental component summary of manager and staff sampled population

Quality of Life Domains	Manager (N=36)	Staff (N=37)	P-value (P<0.05)
	Mean (SD)	Mean (SD)	
Physical functioning (PF)	70.69 (28.69)	53.91 (30.96)	0.027
Role Physical functioning (RPF)	71.53 (28.76)	58.11 (34.39)	0.092
Bodily Pain (BP)	62.71 (23.38)	76.08 (19.60)	0.011
General Health (GH)	70.28 (14.04)	69.73 (16.95)	0.920
Emotional Well-being (EW)	51.71 (15.81)	63.46 (18.55)	0.023
Role Emotional Well-being (REW)	62.04 (31.02)	60.36 (42.19)	0.800
Vitality (VT)	65.00 (16.56)	62.16 (18.95)	0.340
Social Functioning (SF)	62.47 (17.66)	61.82 (23.00)	0.924
Physical Component Summary (PCS)	68.80 (13.22)	64.46 (16.69)	0.200
Mental Component Summary (MCS)	60.31 (14.04)	61.95 (17.80)	0.675

SD- Standard Deviation

There is no statistically significant difference between the manager and staff's role in physical functioning, general health, role emotional well-being, vitality, social functioning, and physical and mental component summary. The retail petrol station manager had a higher mean score than the university staff in physical functioning, role physical functioning, general health, role emotional well-being, vitality, social functioning, and physical component summary, while the staff only had a higher mean score than the manager in bodily pain, emotional well-being, and mental component summary.

5.5 Discussion

The quality of life of retail petrol station employees and a university employee population in the Ilorin metropolis was evaluated using the SF-36 questionnaire. The demographic result shows that more than fifty per cent of both the retail petrol station employees and the university population are male and married. The age and gender were equally distributed, while the marital status was unequally distributed between retail petrol station employees and the university population. The manager roles within the retail petrol stations are occupied by men only, showing evidence of gender inequality in Nigeria and the manager role within retail petrol stations. Gender inequality is a common trait of the patriarchy embedded deeply in the values, norms, and culture of sub-Saharan African countries like Nigeria. There is gender role differentiation, and the societal expectation of females as subservient is a commonly accepted phenomenon (Ademiluka, 2018).

Furthermore, Ademiluka (2018) states the London Feminist Network notion of patriarchy as a "*term used to describe the society in which we live today, characterised by current and historic unequal power relations between women and men whereby women are systematically disadvantaged and oppressed. It is particularly noticeable in women's under-representation in key state institutions, in decision-making positions and employment and industry*". Religious or cultural practices, the ability of men to work long hours than women, the peculiar needs of women, and the disapproval of gender inequality as a problem to be solved are reasons that contribute to gender disparity (Sanni *et al.,* 2016). The research showed different results when the quality of life domain of groups within the two occupational populations was compared. The quality of life domain of staff and the student group was compared within and between-group. Also, the quality of life domain of the attendant and manager groups were compared

within and across the groups. The quality of life domain of the sampled population group was compared by age group, gender, and marital status.

The quality of life domain is analysed among each population group because the perception of health and decision-making across different countries and cultures are greatly influenced by gender, according to Lee *et al.* (2020). In addition, gender difference is identified as an important factor in the quality of life in low-and middle-income countries (Lee *et al.,* 2020). Furthermore, the health-related quality of life for women was reported to be worse than that of men in the general population, according to Colillas-Malet *et al*. (2020). The quality of life domain of the population group between age groups was compared because age is identified as a factor that can affect an individual's health-related quality of life (Bolton *et al.,* 2014). Also, the quality of life domain between the married and single was compared between the groups because evidence of a significant association between marital status and quality of life and health has been reported by research studies (Caputo and Simon, 2013; Han *et al.,* 2014; Dabiran *et al.,* 2018; Kim *et al*., 2018; Wang *et al*., 2020).

Although there is statistically no significant difference between the quality of life domain, the physical and mental component summary between the male and female university population, the female university population showed better quality of life than the male university population. So, this study does not agree with Colillas-Malet *et al*. (2020), that reported worse HRQoL for women than men. The married university population (UP) showed better quality of life than the single university population despite statistically no significant difference in the quality of life domain, physical and mental component summary between the married and single university population. Married UP had a higher score in both the physical and mental component summary of the quality of life domain. The results of this study support the literature that married people are healthier and have a higher level of mental well-being than other marital status groups, including the singles (Kim and McKenry, 2002; Wilson and Oswald, 2005; Hsu and Barrett, 2020). There is statically no significant difference in the quality of life domain between the university population age group, but the 25-31 years age group had a higher physical component summary score than other age groups. The above 31 years age group had a higher score than other age groups in mental component summary and vitality. The higher score in vitality/energy/ fatigue of the older age group allies with studies that report that the fatigue of an individual is influenced by age (Engberg *et al.,* 2017; Åkerstedt *et al.,* 2018).

In terms of the university staff population, there is a statistically no significant difference in the quality of life domain between the male and female university staff, but the female staff had a higher score than the male staff in the physical and mental component summary. Also, there is statistically no significant difference in the quality of life domain between the university staff age groups, but the 18-24 years age group shows a better quality of life than other age groups. There is a statistically significant difference between the married and single university staff in physical functioning, the role of emotional well-being, social functioning, and mental component summary. In addition, the single university staff scored higher than the married staff in all quality of life domains except vitality. The study results show that the single university staff has a better quality of life than the married university staff. Within the university student population, there is no statistically significant difference between the quality of life domain of the male and female students, but the study result shows that the female student has a better quality of life than the male student. Also, the female student scored higher in more quality of life domains than male university students; therefore, it does not agree with Biswas *et al.* (2019) and NUR *et al.* (2017) findings. The better quality of life of the female students in this study allied with Boladale *et al.* (2015) findings. There is also statically no significant difference between the quality of life domain of the married and single university students, which is similar to the findings in Alkallabi *et al.* (2019). The single university students showed better quality of life than the married students, which contrasts with Alkallabi *et al.* (2019) findings. There is statically no significant difference in the quality of life across the three student age groups used in this study. Among the university student age group, students who fell within the 18-24 years of age group showed higher physical and mental component summary scores.

The university staff and student quality of life domain were compared in this study because the equal variance in marital status was assumed in the two groups according to the test in the difference of means statistical analysis result. The comparison result shows a statistically significant difference between the university staff and student mental component summary. Academic workload and stress affect undergraduate students' mental health (Thuraiselvam and Thang, 2015). Nigerian university lecturers are significantly affected by job stress caused by stressors such as job demand, organisational work environment, and role expectation (Ubangari and Bako, 2014). The mental health of people with a job is significantly affected by occupational stress (Moreno Fortes *et al.,* 2020). Work-life balance is a determining factor for mental health among the working population (Kotera *et al.,* 2020). Therefore, academic stress

and workload experienced by the student and job stress and work-life balance experienced by the university staff, among other factors, could be the reason for the statistically significant difference between the staff and student mental component summary in this study. The staff had a higher mean score than the student in six out of eight quality of life domains. Therefore, the university staff shows a better quality of life than the university students.

Regarding the retail petrol station employee population, there is a statistically significant difference between the male and female general health, vitality, and physical component summary. This study shows that male retail petrol station employees have a better quality of life than female retail petrol station employees. The male retail petrol station employees had a higher mean score than the female retail petrol station employees in all quality of life domains, and women have worse HRQoL than men (Colillas-Malet *et al*., 2020). Also, there is a statistically significant difference between the married and single RPSE's emotional well-being. There is an association between emotional well-being and marital status, according to Hsu and Barrett (2020). In addition, the married retail petrol station employees scored higher than the single retail petrol station employees in physical and mental component summary. There is a statistically significant difference in emotional well-being and the role of emotional well-being between the age group of the retail petrol station employees (RPSEs). A higher level of emotional well-being is reported among older people than in the younger age group (Charles and Leger, 2016). Among the RPSEs age group, the >31 years age group showed a better quality of life than the other age group.

The retail petrol station managers' quality of life domain was compared by age group and marital status because all respondents were male. The result showed a statistically significant difference between the manager's age group in the role of physical functioning, general health, and physical component summary. Between the manager's age group, the 25-31 years age group has a higher mean score in physical and mental component summary than the other age group. Furthermore, there is a statically significant difference between the married and single manager's physical component summary. The married manager also has a higher mean score in physical and mental component summary than the single manager indicating that the married manager has a better quality of life than the single manager. The bivariate correlation analysis result shows a significant correlation between the retail petrol station attendant's general health, emotional well-being, and vitality with gender. Also, there is a significant correlation between the attendant's age group and their bodily pain.

In addition, there is a significant correlation between retail attendants' marital status and their vitality. There is a statistically significant difference between the male and female attendants' general health, emotional well-being, and vitality. This study shows that male attendants have a better quality of life than female attendants in the retail petrol station. There is no statistically significant difference in all the quality of life domains between the attendant's age group despite a significant correlation between the attendant's bodily pain and age group. The 18-24 years attendant's age group has a higher score than other age groups in the physical component summary, while the >31 years age group has a higher mean score in the mental component summary than the other age group. Furthermore, there is a statistically significant difference between the married and single retail petrol station attendant's vitality. The single retail petrol station attendant scored higher in physical and mental component summary than the married retail petrol station attendant.

Within the retail petrol station employees, only the male attendant quality of life domain was compared to the male manager. The result shows a statistically significant difference between their emotional well-being and the role of emotional well-being. Also, the manager scored higher in the physical and mental component summary than the attendant. This study shows that retail petrol station manager scores are higher than retail petrol station attendants in physical functioning, the role of physical functioning, the role of emotional well-being, and vitality. In contrast, the attendant scored higher in bodily pain, general health, emotional well-being, and social functioning. This result could be related to the difference in job function, activities, and workload despite working in the same retail petrol station. Pommerehn *et al.* (2016) reported scholars' affirmation of the interference of different working areas and activities on different areas of quality of life.

The university population has a mean score higher than the retail petrol station employee in the physical and mental component summary. Poor quality of life in the physical and mental health of petrol pump workers compared to the general population was reported in Gaikwad *et al.* (2020) study conducted in India. Mahirah *et al.* (2020) also reported less physical component summary scores for non-desk jobs. Daily occupational engagement and occupational psychosocial factors such as working environment, job control, work-life balance, and workload have a significant impact on an individual's physical and mental health. And different occupational groups' health-related quality of life is affected differently because of the varying physical and psychological demands relating to various job scopes (Hultqvist *et al.,* 2019; Mahirah *et al.,* 2020; Sjöberg *et al.,* 2020). Retail petrol station employees scored higher than

the university population in physical functioning, the role of physical functioning, vitality, social functioning, and general health. The retail petrol station employees are active and perform their duties in standing positions for an extended time, thereby engaging in continuous physical activities daily. Studies have reported a positive association between HRQoL and physical activities (Anokye *et al.,* 2012; Xu *et al.,* 2018; Blom *et al.,* 2019; Blom *et al.,* 2020; Slimani *et al.,* 2020). The retail petrol station employees also meet and interact with different people from various life works, which helps their social functioning. The job demand and job scope of working in the retail petrol station could have contributed to their better quality of life score in physical functioning, the role of physical functioning, vitality, social functioning, and general health than the university population. The retail petrol station employees had lower than the university population in the role of emotional well-being, emotional well-being, and bodily pain. The engaging physical activities, energy, and social functioning could have contributed to the high score by retail petrol station employees in general health. Physical activity could prevent disease development, and engaging in physical activity brings benefits to health, thereby contributing to better health of an individual (Warburton *et al.,* 2006; Reiner *et al.,* 2013; Bull *et al.,* 2020; Leme *et al.,* 2020).

The higher score in retail petrol station employees than the university population in vitality could have also contributed to their higher score in physical functioning, the role of physical functioning, social functioning, and general health. Vitality improves an individual's physical functioning, psychological and physiological well-being, and ability to carry on. Vitality is also strongly related to an individual's general health (Lavrusheva, 2020). In addition, vitality makes an individual have a better mood and feel happier (Lavrusheva, 2020), so vitality helps an individual's social functioning, given that emotional regulation is an essential condition for relevant social functioning (Sanmartín *et al.,* 2018). Retail petrol station employees had a lower score than the university population in bodily pain, emotional well-being, and role of emotional well-being domains. The use of energy to produce any bodily movement by human skeletal muscles defines the term physical activity. It could occur during work, exercise, play, active transportation, and leisure activities (Søgaard and Sjøgaard, 2017). A physical activity carried out purposely concerning an individual's work is referred to as occupational physical activity (Byambasukh *et al*., 2020). Retail petrol station employees are physically active at work. According to Aktürk *et al.* (2019), occupational factors such as repetitive work and extended static muscle load could be the source of pain development. Therefore, the high score in

physical functioning of retail petrol station employees, which involves occupational physical activity, could be associated with the low score in their bodily pain domain.

Between the retail petrol station employee and the university population, there is a statistically significant difference in the role of emotional well-being, vitality, and bodily pain quality of life domains. Although, there is no statistically significant difference between the physical functioning and role of physical functioning between the retail petrol station employees and the university population. The mean score shows that retail petrol station employee engages in more physical activities at work than the university population, justifying the statistically significant difference in their vitality and bodily pain quality of life domain. The university population has a better quality of life in terms of emotional well-being and role of emotional well-being. Only the role of emotional well-being shows a statistically significant difference between the retail petrol station employees and the university population.

This study assumed unequal variance in age and gender and equal variance in the marital status of retail petrol station employees and the university population distribution when their socio-demographic data is compared. The statistically significant difference in the role of emotional well-being between retail petrol station employees and the university population could be due to the assumed equal variance in age and gender and unequal variance in the marital status distribution in the two population groups. Studies have shown that gender and age are crucial social determinants of an individual's psychological well-being (Charles *et al.,* 2016; Manandhar *et al.,* 2018; Matud *et al.,* 2020). The difference in job demand of the two occupation groups could also be responsible for the statically significant difference in emotional well-being, vitality, and bodily between the retail petrol station employee and the university population. According to Onyishi *et al*. (2018), employees are exposed to poor psychological health by excessive work demand, which is a feature of the work environment. Job type, work time duration, working positions, job shift pattern, and workload are associated with neck and back pain (Chen *et al.,* 2018; Shariat *et al.,* 2018; Dave *et al.,* 2019).

The university student population was compared to their working peers, the retail petrol station attendant in this study. The findings showed a statistically significant difference between the student and attendants' bodily pain and the role of emotional well-being. The university student scored higher than the attendant in the physical and mental component summary. Therefore, the quality of life of the retail petrol station attendants is lower than that of university students. It could have been due to several factors such as working environment, work-life

balance, occupational stress, job demand, etc. Comparing the male retail petrol station manager and the male university staff shows a statistically significant difference in physical functioning, bodily pain, and emotional well-being. As expected in this study, the manager has a higher mean score in the physical component summary of the quality of life domain. In the mental component summary of the quality of life domain, the university staff scored higher than the retail petrol station manager despite being the same gender. This study finding shows that occupation type could affect the quality of life of an individual even within the same gender.

5.6   Study Limitations

In this quantitative phase of the main study, occupational stress is not used as a predictor for the university population's quality of life and retail petrol station employees. Occupational stress is present in every occupation, and it is a significant health risk factor for psychological, behavioural, and diseases among the occupational population (Quick and Henderson, 2016; Wang *et al*., 2017). Educational level is not used as a predictor of the quality of life of the retail petrol station employee, manager, and attendant in this study. While according to Sabbah *et al.* (2013), education is a strong predictor of quality of life in various settings, times, and populations. Also, lifestyle is not a determining factor for the university population (staff, students) and retail petrol station employees (attendants and managers) quality of life. There is an association between lifestyle and different aspects of the quality of life of an individual (Tol *et al.,* 2013). The dynamic nature of the retail petrol station employee makes it challenging to administer the questionnaire to a larger sample size. The retail petrol station and employees were randomly selected, so this allows generalisation of the research findings. There were delays in getting a response, but there was a high completion rate for the questionnaire. In addition, the research findings mainly were inconsistent with previous studies on the difference between the quality of life of retail petrol station employees and the compared occupational group selected.

5.7   Conclusion

This quantitative study has provided valuable findings concerning the difference in the quality of life of retail petrol station employees and another occupation group in Ilorin, Nigeria. Concerning the difference in retail petrol station employees' quality of life based on their job position, the retail petrol station managers had a better quality of life than the university staff.

Retail petrol station attendants have a lower quality of life than their comparing population (500 level undergraduate students). Overall, the retail petrol station employee's quality of life was not statistically significantly different from the general population representative (university population) used as a comparison.

CHAPTER SIX: QUALITATIVE FINDINGS AND DISCUSSION

6.0   Introduction

The main study phase comprises quantitative and qualitative studies. The results and discussion of the qualitative study in the main study phase are discussed in this chapter. A theoretical framework for a thematic approach was used in designing this study and for collecting data that could not be obtained through quantitative study (Mays and Pope, 1995; Tobin and Begley, 2004; Gale *et al.,* 2013; Collins and Stockton, 2018; Aspers and Corte, 2019). The methodology framework and methods adopted for this qualitative study are described in chapter two and chapter three. The data obtained during the qualitative study provided information that enhances understanding of the retail petrol station owner, manager & manager, public health, and environmental health officer's risk awareness and perspective about risks associated with working in a retail petrol station (RPS). Focus groups and interviews were used for data collection, and the questions were centred around areas such as:

- ➢ Risk awareness

- ➢ Perspective on the use of personal protective equipment (PPE) among retail petrol station employees

- ➢ Perspective on the need for health promotion among retail petrol station employees

The interview and focus group questions were developed from information from literature and the data from the pilot study on the characteristics of RPS and the RPS employees. The information obtained through observation and field checklist (Appendix 4A) were also used in developing interview and focus group question guides.

Three focus groups were conducted, and each group had more than five participants. The focus groups comprise the retail petrol station owners, retail petrol station attendants, and the environmental health officers' group. Getting the retail petrol station owners to participate in the focus group discussion was challenging. But this was achieved by attending one of the quarterly meetings for retail petrol station owners in their association headquarters office. The president of the association granted permission to ask for voluntary participants after their meeting. Some retail petrol station owners volunteered to participate in the study, and the focus group discussion was conducted immediately using one of the association's available offices.

Letters were sent out to 36 retail petrol stations inviting their manager for focus group discussion, but none honoured the invitation, claiming they were busy and could not leave their retail petrol station; therefore, only one manager who volunteered was interviewed at his place of work. Also, none of the attendants invited from 36 different retail petrol stations for focus group discussion attended after assuring their attendance when the invitation was delivered to each retail petrol station. Therefore, permission was gotten from one retail petrol station that their attendants operate on a morning (6 am-2 pm) and afternoon shift (2 pm-10 pm). The focus group discussion was conducted among their attendants working the morning shift because the afternoon shift finishes late at night. The RPSA focus group was carried out in an office within the retail petrol station fifteen minutes after the end of their shift. The retail petrol station owner and environmental health officers' conversation was conducted in English, audio-recorded, and transcribed. The retail petrol station attendant's focus group conversation was conducted in English, audio-recorded, and transcribed.

During the focus group, some words were spoken in Yoruba (one of the major native languages of Nigeria). Information in Yoruba was translated to English during transcription. A third party was not sought to translate the Yoruba language to English as the words to be translated were few. The researcher speaks the native language with formal education for six years in Yoruba language study with grade A1 in the West African Senior School Certificate Examination. Additionally, the researcher has more than three years of experience in interpreting spoken Yoruba language to the English language in large religious congregations such as churches. Hence, the research has the capability to translate the few words spoken in Yoruba during the focus groups. The manager and the public health officer interview were conducted in English, audio-recorded, and transcribed. In addition, before the start of each interview and focus group, informed consent was asked from participants and recorded, and they were reminded that they could choose not to answer a question if they felt uncomfortable and they could withdraw at any time during the interview or focus group. At the end of each session, the researcher appreciated the participants for their contribution and time. Drink refreshments were offered to all participants at the end of the interview and focus groups.

6.1   Findings and Discussion

Identified themes in the finding of each group interview are discussed in this section. Firstly, to identify the themes, the researcher familiarised herself with the data by carrying out a

verbatim transcription of the recordings. Read through the data and field notes repeatedly to ensure accurate reporting and understanding. The researcher used a deductive approach - developed an initial analytical coding framework of a prior code based on the research questions and the aim of the qualitative study. Themes and sub-themes were generated researcher using data of interest, the connection between data items, and questions, with the prior code framework drafted. The data were coded, adding additional codes as sub-themes arose. The themes were reviewed to ensure that there were adequate supporting data. Definition and description of each theme identified were used to create a coherent narrative of how the themes provide insight and contribute to the overall understanding of the research questions. The findings were finally reported using narrative description and representative data extract, such as using direct quotes from participants. The discussion was broadened by referencing related literature to support the findings. The emergent theme and subthemes from the interview and focus group are presented in table 6.1.

Table 6.1: Themes and sub-themes

Focus Group	Emergent Themes	Sub-Themes
Retail petrol station owners	• Health risk awareness • Employee health and safety	• Financial difficulties
Retail petrol station attendants	• Health risk awareness • Awareness and perception on the use of PPE	• Career prospect
Environmental health officers	• Risk awareness about RPS • Intervention and recommendation for health improvement	
Interview	Emergent Themes	Sub-Themes
Retail petrol station manager	• Health risk awareness • Awareness and perception on the use of PPE	
Public health officer	• Risk awareness about RPS • Intervention and recommendation for health improvement	

The emergent themes of the retail petrol station attendants and manager were similar; therefore, it was discussed together. The emergent themes of the public health officer and environmental health officers were also similar; consequently, it was discussed together. The key summary in the focus group discussion and face to face interview includes the following:

➢ Poor health risk awareness among retail petrol station owners on health risks associated with working in the retail petrol station.

➢ Good health risk awareness among retail petrol station employees on health risks associated with their job

➢ Lack of risk assessment in the retail petrol station

➢ Lack of appropriate personal protective equipment for retail petrol station employees

➢ Poor and lack of the use of personal protective equipment among retail petrol station employees

➢ Employee's career prospect in the retail petrol station

➢ Good awareness of health and environmental risks associated with retail petrol stations among public health and environmental health officer in the state

➢ The environmental health officer recommended policy amendment, public awareness and education of risks, and enforcement of policies to ensure adherence among retail petrol station owners

➢ Both the public health and environmental health officer recommended a collaborative approach among stakeholders in tackling health and environmental risks related to the retail petrol station

6.1.1 Retail Petrol Station Owners: The focus group session consisted of six retail petrol station owners, and the discussion lasted for thirty minutes. The focus group guide is attached in appendix 5A. All participants had 12years of education and were between the age of 40 and 70 years. The participants had more than one retail petrol station each, and they had owned a retail petrol station for 5 to 10 years. They all speak and understand English. The main purpose of the focus group was to assess the risk awareness and perception of retail petrol station owners

on the risk associated with working in the retail petrol station. Two themes and one sub-theme were identified in the focus group discussion.

THEME 1: HEALTH RISK AWARENESS: The identification of hazards in a business system is the starting point of any process of assessing or identifying risks that highlight vital factors that may or may not cause failure or harmful effects on people, assets, or the environment (Islam and Tedford, 2012). In addition, risk perceptions of an individual are reported to be an important component of health behaviour change theories (Ferrer & Klein, 2015). The risk perception of an individual varies significantly depending on their current understanding and circumstances, which are not dependent on the environment but based on beliefs about the possibility of the operational danger and how people could be affected by its occurrence (Adeyele and Osemene, 2018). In this study, the findings show that the retail petrol station owner lacks risk awareness about the associated health risks that retail petrol station employees are exposed to as a result of working in the retail petrol station. The retail petrol station owners' risk perception of associated health risks of working in the retail petrol station shows that employees are not exposed to any health hazard based on the narratives described below.

> "*There is no health hazard in the business as long as you don't drink the petrol, only the fumes inhale cannot cause effect, and anyone can inhale fumes on the road even without selling petrol.*" (RPS owner 2,)

> "*There is no health issue in this business and no risk whatsoever because the products are stored underground.*" (RPS owner 1)

Different health risk factors relating to working in the retail petrol station and health problems in people working in retail petrol stations have been reported by several studies (Maciel *et al.,* 2019; Moro *et al.,* 2019; Alhaj, 2020; Asefaw *et al.,* 2020; Gaikwad *et al.,* 2020; Jaiswal, 2020; Ramadhany *et al*., 2020; Ufelle *et al.,* 2020). The finding in the Gwangwava *et al.* (2014) study that assessed the risk management practises in SMEs in Zimbabwe shows that most SMEs operator in the study expressed a lack of understanding or knowledge of risk and the concept of risk management. The finding in this study agrees with the idea that small-medium enterprises (SMEs) worldwide, especially in developing countries, lack strong risk management, cultures for crisis management, and business continuity (Asgary *et al.,* 2020). In addition, one of the big problems in SMEs is often the ignorance of managers or business owners in risk management (Belás *et al.,* 2015). Also, lack of awareness in risk identification,

laws, and policies was identified as one of the biggest problems of companies irrespective of their size in a survey of 3600 companies by a European agency for safety and health at work (Nyirendaavwil *et al.,* 2015). Risk management comprising four concepts: identification of risk, risk assessment, risk response, and risk monitoring and control, is suggested to be less developed in small and medium enterprises (Naude and Chiweshe, 2017). The main purpose of SMEs may be maximising profit (Belás *et al.,* 2015); however, SMEs should consider the interests of all stakeholders in the business, including employees, without focusing solely on profitability (Esterhuyzen and Louw, 2019). Unfortunately, some business owners are focused more on keeping their business going and making profits with less concern for their employees' risk management and health improvement.

THEME 2: EMPLOYEE HEALTH AND SAFETY: Employers have the responsibility to provide a safe place of work, a working system and means of access to work, and provision of a competent co-worker (Akpan, 2011). The employer is also responsible for the provision of adequate and appropriate protective clothing, material, and protective equipment for the safe execution of work by the employee and a duty of care to ensure that the employee is not exposed to any unreasonable risks at work (Akpan, 2011, International Labour Organisation (ILO), 2021a). This study shows that retail petrol station owners have poor knowledge of employee health and safety regarding the need for personal protective equipment (PPE). The retail petrol station owners believed that the retail petrol station employee does not require any form of PPE.

> "*There is nothing necessary on PPE in petrol stations because product doesn't spill down and even abroad, they don't use gloves and safety shoes for selling fuel. But when you go to the depot, you can be asking of PPE because there may be issue on fuel spilling, but in filling station there is nothing necessary on that, and if there is going to be spillage, it will be from the car buying petrol, so there is no need in providing personal protective equipment.*" (RPS owner 3)

> "*Buying gloves or safety boots for attendants, there no need for something like that at all.*" (RPS owner 5)

The perception and poor knowledge of retail petrol station owners about the use of PPE by their employees in this study could be one of the factors responsible for the lack and poor use of PPE by retail petrol station employees reported in several studies (Rocha *et al*., 2014; Monney *et al.,* 2015; Okafoagu *et al.,* 2017; Johnson and Umoren, 2018; Maciel *et al.,* 2019;

Alhaj, 2020; Ramadhany *et al*., 2020). Another possible contributing factor to the lack and poor use of PPE among retail petrol station employees could be the absence or near absence of BTEX control around retail petrol station pump despite the presence of specification for maximum allowable exposure level for BTEX compounds by an organisation such as National Institute of Industrial Safety and Health, African Refiners Association and the Occupational Safety and Health act (Emokpae *et al*., 2020).

Regarding health emergency response, the retail petrol station owners all agreed with one owner's response that:

"*We always have a first aid box if it is a minor issue, headaches, cold and small injuries.*" *(RPS owner 6)*

Although the retail petrol station owners indicated the availability of first aid boxes in the retail petrol stations, there is no evidence to support the presence of a trained first aider within the retail petrol station in Ilorin. Also, no hospital or ambulance information was provided for retail petrol station employees in case of emergency. Employers are shouldered with the responsibility of promoting the health and well-being of their employees at their workplace. But not every employer sees the importance of carrying out risk assessment and management at their workplace or even the necessity to plan for the general well-being of their employees.

Sub-theme - Financial difficulties: Small Medium enterprise such as retail petrol station in developed and developing countries faces financial gaps as limited external funding are received by SME owners compared to large businesses (Abraham and Schmukler, 2017). One of the major important factors cited for the thriving and survival of small and medium businesses is access to finance. The SMEs have to depend on eternal financial resources, unlike the large firms that can internalise a large percentage of their financial needs through capital allocation (Goswami, 2019; Bakhtiari *et al.,* 2020). The data range between 2005 and 2016 was used by the World Bank Enterprises Survey to assess the use of formal credit by firm sizes (small, medium and large). The result shows that compared to large companies or organisations, Small Medium Enterprise is less likely to have formal bank loans and other forms of credits, according to the World Bank enterprise survey (Abraham and Schmukler, 2017). Figure 6.1 shows the graphical representation of the cross-country average of the

percentage of an organisation that had a form of credit or loan from a financial institution according to the size of the organisation.
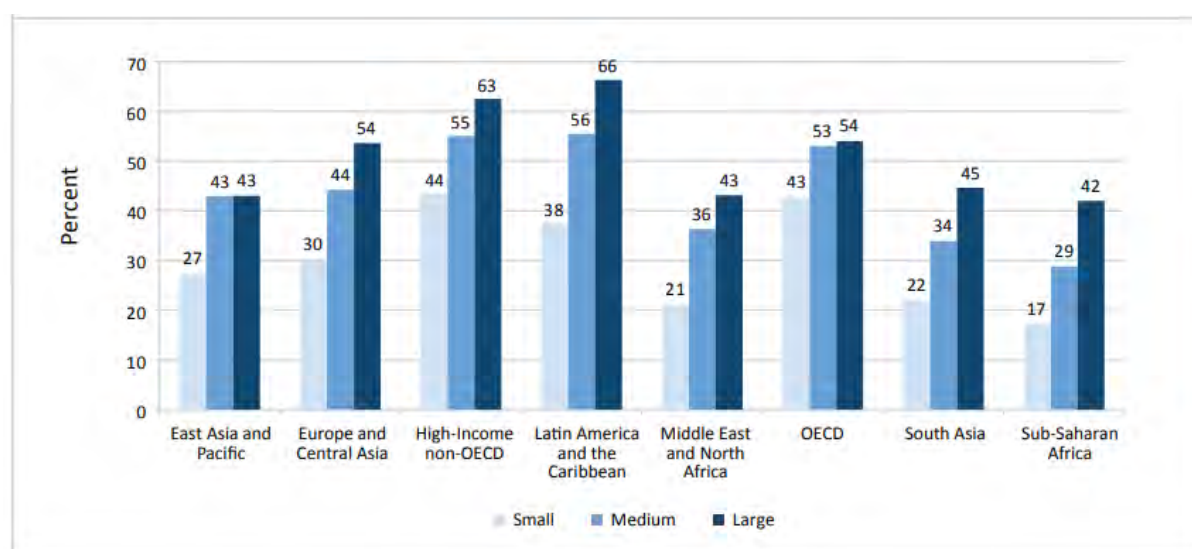
Figure 6.1. Use of formal loan or credit according to organisation size (Abraham and Schmukler, 2017).

The retail petrol station owners identified financial difficulties in their business which affect the operation of their retail petrol stations. The impossible collateral request by commercial banks in Nigeria was highlighted as a factor making it difficult for RPS owners to access loans or any form of credit.

"Petroleum business is a regulated business that governments tell you how much you sell your product. They give us the price to sell the product, and they include our margin within the price. Unfortunately, the government has increased the price of petroleum products four times already, and they did not increase our margin. Our margin remains static. The amount of money keeps on increasing without increasing the profit margin. Definitely, if there is increase in the money without increasing margin, that means you have to go to the bank to get additional money to do your business. You pay bank interest on the price increment and the same static profit margin given already." **(RPS owner 1)**

"When you finish building filling station, you have an agreement with NNPC to be giving you the petroleum product. We have specific place to be picking the product within Ilorin environment, which is the Ogiri depot. For four to five years, we have not received any product in the Ogiri depot, so we are going to Lagos to bring the product. From the little margin, we transport the product reducing our margin further." **(RPS owner 1)**

180

"As…as spoken, for example, if the profit margin is 20,000 naira, as petrol is a regulated product that you can't sell above a certain price. The government have increased the price of the product three to four times. Then your profit margin have been errored to something like 10,000 naira. Definitely, it will affect how you operate your station, pay your staff, pay tax, and so many things will be affected that why you see many stations are not working." **(RPS owner 3)**

"Also, in getting financial support, you know the situation in the country. The financial banks are terrible. If you want to borrow money in Nigeria commercial bank, they will even ask you to bring your grandmother and the musician that sang on her wedding day. They will request for almost everything. They will ask for so many things that will make it impossible for them to accept the loan request. Even when you access the loan, the interest is high, and the profit margin on the business is not enough to pay." **(RPS owner 1)**

In Nigeria, the banks insist on collateral as a must for SMEs due to the deficiency in record keeping of small and medium business owners. Financial strength, management quality, track record, relations and payment records with other banks, business prospects, business risks, collateral securities, profitability, and network are some of the standard criteria used by the financial institution to assess the creditworthiness of borrowers. Hence why, SMEs face challenges in accessing credit because all these criteria cannot be properly assessed without adequate accounting and records (Ezeagba, 2017). There has been a heated argument in accessing loans between small and medium business owners and banks as SMEs owner claims that Banks request stringent requirements for terms of approval. In contrast, the Bank claims that owners of SMEs do not present bankable projects eligible to access loans (Fatai, 2011). The inability of retail petrol station owners to access formal loans and having poor profit margin, as indicated in the quote above, could be a potential contributing factor that determines the investment of RPS owners towards their employee's health and safety.

6.1.2   Retail petrol station manager and attendants: A male manager was interviewed face-to-face, and the focus group session consisted of seven attendants. The interview guide for the manager is attached in appendix 5C. The discussion lasted for 20 minutes. The manager interviewed has over four years of experience working as a retail petrol station attendant and two years of experience working in a manager position at the time of the interview. The manager had an education level of an undergraduate degree. The attendants' focus group

discussion lasted for 30 minutes. The focus group guide is attached in appendix 5B. The majority of the attendants have been working the retail petrol station for more than a year and working at the retail petrol station is their first job. All the attendants have no previous experience working in the retail petrol station. Among the attendants, the highest degree holder has Higher National Diploma (HND) certificate from a Nigerian Institution, while the lowest degree holder has a secondary school certificate.

THEME 1: HEALTH RISK AWARENESS: the findings in this study shows that the manager and attendant are aware of health risks associated with their jobs and their impact on health.

"There are risks associated with working in this field and going back to when I was working as an attendant, I am aware that continuous inhaling of fume and vapour from the petroleum product could damage the lung function and affect our health, but we take precautions against that" (**Manager 1**)

"The job is risky generally even apart from the health-related risk" (**Attendant 3**)

"As for me, when I finish from this job, I will go directly to the hospital for proper check-up" (**Attendant 1**)

"This job can definitely affect our health" (**Attendant 6**)

"*The stress of this work is too much"* (**Attendant 2**)

"I know it will affect my health and life, but I need the money from the job" (**Attendant 3**)

"It not an easy job as we all know it, standing for hours is not easy and even considering the inhaling of the petrol vapour which is not good for our health during the job" (**Attendant 5**)

The findings in this study allies with Cezar-Vaz *et al.* (2012) and Okafoagu *et al.* (2017) that retail petrol station employees are aware of the risk factors that they are exposed to at their workplace. A small percentage of retail petrol station attendants in the Emokpae *et al.* (2020) study were reported to be aware of health hazards relating to their workplace. But Ahmed *et al.* (2014) reported good but narrow safety measures awareness among retail petrol station attendants in their study.

Despite Nigeria having the largest economy in Africa with high economic potential, the unemployment rate among the working-age population was as high as 7.96% in 2020 (ILO, 2016; Plecher, 2020). Unemployment in Nigeria is caused by a series of major developmental issues, and the rate of unemployment in Nigeria is increasing significantly in all parts of the country (Muhammad *et al.,* 2011). One of the critical socio-economic issues confronting Nigeria is the high level of unemployment (Adelowokan *et al.,* 2019). The problem of low income and various responsibilities faced by most Nigerians and the increase in the rate of unemployment leave the youth population with less choice of jobs. Therefore, they engage in any available occupation despite the associated risks. As stated by the attendant, working in the retail petrol station is solely for financial purposes and overlooks associated risk to the occupation. The retail petrol stations also provide an attractive offer of recruiting people without any job experience for the attendant position. People are thereby given the opportunity to gain job experience as indicated by the attendants in the focus group that their work at the retail petrol station is their first job. The retail petrol station attendants are paid between NGN 10,000-15,000 ($26.25-39.37) per month, which is lower than the national minimum monthly wage of NGN 18 000 in Nigeria ($47.24) (Azubuike *et al.,* 2018). Also, among the unemployed youth population in Nigeria, the fortunate are still likely to be underpaid, underemployed while working for longer hours, and engaging in hazardous jobs (Adelowokan *et al.,* 2019).

THEME 2: AWARENESS AND PERCEPTION ON THE USE OF PPE: Poor awareness of PPE use, and hand hygiene practice was reported among retail petrol station attendants in the Johnson and Umoren (2018) study. Also, Monney *et al.* (2015), Okafoagu *et al. (*2017), and Ramadhany *et al*. (2020) reported the lack and poor use of PPE among retail petrol station attendants. However, more than 90% of retail petrol station attendants in the Emokpae *et al.* (2020) study were aware of one or more types of PPE, but only 18.8% of the retail petrol station attendants used one type of PPE or another at work. Furthermore, workers' perception is an influencing factor for implementing risk-mitigation approaches within a working environment (Che Huei *et al.,* 2020). In this study, the retail petrol station attendants were also aware of one or more PPE types and were willing to use them if the retail petrol station provided them. But they cannot pay or would not buy the PPE themselves because they believe it is the employer's responsibility. Occupational health and safety and compliance with the occupational health and safety obligations in accordance with national laws and regulations are the duty and responsibility of the employer (ILO, 2021b). The discussion of the retail petrol

station attendant below shows that they believe that the provision of PPE is the responsibility of their employer, but they are willing to use PPE if provided by the employer.

"*There is a fault in what I wear to do my job.*" (**Attendant 6**)

"*We will wear the PPE if it is provided; we also wear the raincoat provided by the retail petrol station*" (**Attendant 3**)

"*It is a good idea if the management provide the PPE*" (**Attendant 7**)

"*We cannot buy the PPE ourselves because you could come tomorrow and not meet us at the retail petrol station*" (**Attendant 2**)

The retail petrol station attendant does not use another form of PPE at work apart from the uniform because the PPE is not available within the retail petrol station or not provided by their employer, which allies with finding from Okafoagu *et al.* (2017). There is a need for retail petrol station employers to identify risks and hazards associated with working in the retail petrol station to put up safety measures, give required training to employees, and provide PPE for employees' daily use (Okafoagu *et al.,* 2017).

Sub-theme - Career prospect of attendant in retail petrol station: An individual's career prospects often depend on an individual perception of their work and industry, which is often assessed based on several factors like promotions, rewards, and possibility for a promising career. Therefore, the perceived nature of work is also linked to career prospects (Wan *et al.,* 2014). Job satisfaction, defined as an individual's feeling and attitude about their work arising from an individual's experiences at a particular job position through their appreciation and evaluation of their encounter at work, affects their emotional and mental state (Ramhit, 2019). A career prospect is identified to be linked with job satisfaction. Belias *et al.* (2014), cited in Ramhit (2019), identified that employees that do not have the possibility of a better career prospect to demonstrate their competencies are dissatisfied with their job. In addition, job satisfaction decreases when employees are aware of limited career prospects (Ramhit, 2019). Attendant job has low social status, and there is reduced job satisfaction among the attendant because of the experiences such as harassment and violence) faced at work. Social status is also important in an individual's career prospect because it is a social system that relates to the community, such as friends, family, and social media perception about an individual's occupation (Sihite *et al.,* 2020). A person's social status relates to their occupation, responsibility, personal characteristics, and the behavioural attitude of those working in the

occupation within the community (Sihite *et al.*, 2020). A person's social status can be evaluated by assessing an individual's pride in their career, pride of family members towards the occupation, and if the job is perceived as an important and respected occupation in the community (Wan *et al.*, 2014).

Retail petrol station attendants are faced with job insecurity, and job insecurity has been identified as one of the major stressors within the work environment (Schreurs *et al.*, 2010). Job insecurity may also promote negative job and organisational behaviours among employees, leading to decreased job commitment, effort, and performance (Schreurs *et al.*, 2010; Darvishmotevali and Ali, 2020). Evidence shows that job insecurity has a strong negative impact on job satisfaction, employee-employer trust, and employee well-being (Sverke *et al.*, 2002; Caroli and Godard, 2016; Richter and Näswall, 2019). Job insecurity as an objective phenomenon is defined as the probability that an employee will have the same job likely in the future (Sverke *et al.*, 2002). Also, it refers to the reflection of the threat to the stability and continuity of employment in the future (Shoss, 2017; Darvishmotevali and Ali, 2020). During the focus group, the attendant's discussion showed that they perceived insecurity about their job, lack of career prospects, and poor job satisfaction.

> *"The funny thing about this work is that you may come tomorrow and not meet one of us here because they may stop coming for many reasons such as being sacked"* (**Attendant 5**)

> *"This job is a temporary job, for some time and to earn money for independent living"* (**Attendant 3**)

> *"Me working here is not permanent; I want to further my education"* (**Attendant 2**)

> *"We are just doing this job not to be idle at home"* (**Attendant 1**)

> *"Am doing this job to be independent"* (**Attendant 1**)

> *"I want to use the money earned to start my own business"* (**Attendant 6**)

> *"Not that I am willing to do this work but earning money is important"* (**Attendant 4**)

> *"I will continue to do this work for some years before getting other good job if am not sacked because we are sacked based on late coming too"* (**Attendant 7**)

> *"The embarrassment we face from customers are too much with statements such as "guy did you sell my fuel complete" implying theft and when the fuel is mistakenly spilt*

185

*the customer give comment such as "guy, are you okay or crazy? I won't pay for you for my fuel completely" (**Attendant 4**)*

*"It is quite embarrassing, especially when customers harass us in different ways despite the little amount of fuel they want to buy" (**Attendant 2**)*

6.1.3   Public Health Officer and Environmental Health Officers: The director of the public health department in Kwara state ministry of health in Ilorin was interviewed at the time of the survey. The interview guide is attached in appendix 5D, and the interview lasted for 20 minutes. The director was a man; he had been working in the Kwara State Ministry of Health for five years and had been the public health department director for a year. The public health department in Kwara focuses its action on preventing diseases, promoting the health of the population, especially the people living in Kwara state, and creating health awareness through health education that encourages people to practice good health behaviours. A focus group discussion was also conducted among 20 environmental officers. The focus group discussion with the environmental officers lasted an hour. The focus group question guide is attached in appendix 5E. The researcher presented the summary of the finding of the research study and the drafted recommendation to be made for 30 minutes. The rest 30 minutes of the discussion were open to questions and contributions about the presented recommendations by the researcher. All the EHOs appreciated the work of the researcher with no further comment. However, there were five active speakers in the group that shared their ideas on the project and made contributions to the first draft of the researcher's recommendations. Most of the EHOs also clapped to signify their agreement with the points raised by the active speakers. The main aim of the focus group is to assess their awareness of the risks associated with the retail petrol station and retail petrol station employees and possible interventions to tackle identified health risks.

THEME 1: RISK AWARENESS OF PUBLIC HEALTH AND ENVIRONMENTAL OFFICERS ON HEALTH RISKS ASSOCIATED WITH RETAIL PETROL STATION: The public health department and the environmental health officer (EHO) are aware of the health and environmental risks associated with retail petrol station. The discussion below shows their experience and concern about health and environmental risk related to the retail petrol station.

*"We are also concerned about the health challenges that people may have or may be exposed to in the filling station but no ongoing intervention for this" (**Public health officer**)*

"During the course of my practice as an environmental health officer, there were cases of underground pollution from a retail petrol station noticed in water sources that are 100 meters apart" (**EHO 1**)

"My area also had a problem of underground spillage from a petrol station where the people in communities were scoping diesel fuel from a well close to the station before the interference of the government" (**EHO 2**)

The public health department is aware of the health and environmental risk associated with retail petrol stations, and this aids the recommendation of a health awareness program and health promotion program for the retail petrol station owner, retail petrol station employees, and retail petrol station customers. For an effective change in health and environmental policies relating to retail petrol stations, the right government organisation must be involved. The adherence of policies within a state also needs to be enforced by the relevant government organisation. The ministry of health is also ready to collaborate with researchers to bring about effective health change in the communities.

THEME 2: INTERVENTION AND RECOMMENDATION FOR HEALTH IMPROVEMENT: During the interview and focus group discussion, the public health specialist and environmental health officers recommended possible solutions and suggested interventions that could help in tackling health and environmental risk associated with retail petrol stations. The discussion below shows that amendment of policies, a collaboration between related government bodies such as the ministry of health and ministry of labour, increased awareness among retail petrol station owners and their employees, and enforcement of policies by the government is vital in promoting the population's health.

To ensure the safety of people around the retail petrol station, we work with other government organisations such as the ministry of work, ministry of environment, educational institutions and others" (**Public health officer**)

"The operators who do the scaling of the sector need to be very careful, and they need to do a second examination to determine the effect of the sector on the investor, human factors and other factors" (**EHO 2**)

"Environmental officers are the closest to the people, and there should be a synergy between the DPR and the local government to prevent reoccurrence of an environmental problem from retail petrol station" (**EHO 2**)

Premedical examination and post medical examination not done in these retail petrol station because they just engage anyone, and they commence their service" (**EHO 3**)

"People need awareness; it is not everything that needs to do with force" (**EHO 4**)

"We need to enlighten our people; the fact that you are getting the job does not mean you should not know what to do" (**EHO 1**)

"The employer needs to subject the staff to premedication test before offering them a job, and I think by doing these it will help the health of the people" (**EHO 1**)

"The retail petrol station is located in the grassroots of the community, and the environmental health officer works are the grassroots. if it is possible for the regulator to cooperate with the environmental health officers at the grassroots, we can be able to checkmate most of these menial problems going on around" (**EHO 4**)

The environmental health officers have a lot to do, especially when we go out for inspection in this filling station. We have to enforce the use of PPE and ensure that it is always worn and sanction owner of the station if not used" (**EHO 3**)

"We have to ask about worker premedical examination information when we go out for inspection in these filling stations" (**EHO 3**)

"What I see the workers wear are just customised uniform which cannot protect them from petrol splash, I think they should have a kind of overall wear and gloves that can protect them from petrol splash" (**EHO 2**)

We should emphasise more on seeing the environmental impact assessment report, and I believe this will also help with the issue" (**EHO 1**)

"To the policymakers, something tangible needs to be put in place for the workers' health. There should be an enforcement that will inculcate incentive and health insurance in case of any health problem, fire accident and robbery incident" (**EHO 5**)

"The petrol station owner is aware of the risk associated to the work of retail petrol station" (**EHO 5**)

"The intervention has to start with the DPR because their major concern mostly during their inspection is about checking the meter regulation and price overlooking other areas" (**EHO 5**)

"The environmental health officers are not equipped to check leakage and emission problem in the filling station which is not supposed to be" (**EHO 5**)

"We should decide now to start advocating for a professional environmentalist to take care of the environment rather than looking for any politician" (**EHO 1**)

"Another key area is bringing to the consciousness of our leader that the environment is key and that there are people who are professional in this area. It may just be that the authorises are unaware" (**EHO 3**)

"We are not opposed to any researcher, partner who want to work with us to ensure the improvement in the health of the people" (**Public health officer**)

The collaborative approaches suggested by the public health and environmental health officer are often suggested as an applicable method of managing the environment (Bodin *et al.,* 2020). Therefore, the adoption of collaborative environmental management has been an increasingly popular institution for tackling environmental issues (Koontz, 2006). A collaborative approach is described as a process where parties and stakeholders with different perspectives on a problem are jointly involved in managing or finding solutions to a particular problem. These approaches have been adopted in the context of environmental management, sustainability, and so on (Bodin *et al.,* 2020; Fobbe, 2020). Furthermore, a collaboration between employers and occupational health service providers is vital for an effective occupational health service that supports the health and workability of employees in various work settings (Halonen *et al.,* 2017). Most importantly, authorities and policymakers involved in occupational health and safety intervention must carefully consider interventions that allow the use of limited available resources (Teufer *et al.,* 2019).

6.2   Research limitations

Participant bias could not be entirely eliminated during the focus group discussion. The researcher believes that conducting the retail petrol station attendants focus group within the vicinity of the retail petrol station where they work could have influenced or restricted the answers provided by the retail petrol station attendant in fear of the management hearing the conversation. Conducting the retail petrol station attendant focus group among those working in the same retail petrol station is also seen as a limiting factor that may have affected the attendant in answering the questions honestly and truthfully. Some of the attendants are closer

to the management than others, and attendants who are not close to the management are scared of losing their job if the other attendants report their answers to the management. This bias could have been eliminated entirely if the invitation sent to the 36 retail petrol stations requesting an attendant representative was honoured. Unfortunately, no attendants were sent by the retail petrol station to attend the meeting after accepting the invitation from the researcher. The president of the Independent Petroleum Marketer Association of Nigeria (IPMAN), Ilorin branch, was part of the retail petrol station owner in the focus group of retail petrol station owners. His position as the president may have influenced the honest and truthful answers of other retail petrol station owners in the focus group. Other retail petrol station owners sometimes just agree with the president in any questions he answers to show loyalty and respect. Interviewing retail petrol station owners separately despite the time consumption helped eliminate bias encountered during the focus group discussion.

The researcher conducted the interview and focus group personally, which guarantees the assurance of efficiency and consistency during the interview and focus group discussion. Research bias was limited by considering potential bias during the construction of interview questions and asking general questions before moving to specific questions. All data collected were analysed without unbiased thought. Most importantly, the researcher considered and addressed every potential bias at every stage of the study design.

6.3 Conclusion

There was poor awareness of health risks associated with working in the retail petrol station among the owners of the retail petrol station in Ilorin. Although, the environmental health officer believes that the retail petrol station owners in Nigeria are aware of the health risk but deny its knowledge and presence. The retail petrol station attendants are aware of their exposure to health risks at the retail petrol station, but they are willing to do the job because of the lack of employment in Nigeria. Also, the job serves as means to their independence and household responsibility. The study shows a lack of risk assessment and management among retail petrol stations in Ilorin.

The findings in this study emphasise the need for reviewing and updating the health and safety policies relating to the retail petrol station and their employee. Also, it emphasises the need for collaboration among relevant stakeholders in tackling both the environmental and health risk

factors associated with retail petrol stations that could impact the quality of life of the retail petrol station employee and the general population.

Interventions including education programmes and health education materials to promote awareness of environmental and health risks associated with a retail petrol station in English and the local language in Ilorin will be beneficial. Because it is essential for the practice of good health behaviours and aids informed health decision making among the population. Intervention addressing the identified problems should be tailored towards the specific need and available resources in Ilorin, considering possible practical traditional and indigenous approaches too. The intervention should not be solely based on practice in developed and high-income countries. This study provides increased knowledge, new understanding, and ideas for future studies relating to a retail petrol station in Nigeria that other African countries can use.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATION

7.0   Introduction

The concluding chapter of this thesis summarises the research methods, findings, contributions to knowledge, recommendations, and future studies. The experience of the researcher towards the success of the research studies is also shared in this chapter. The chapter describes how the study design and methods addressed the research questions, aim, and objectives. In addition, it also provides recommendations for interventions for any public health problems identified. Furthermore, chapter seven highlights the significance of the different processes used in achieving the study's findings that contribute to improving the quality of life of the general population.

The processes employed in this study ensure the effective completion of the project. The pilot study provided preliminary evidence and information to compare and contrast with evidence and information from searched literature. Evidence from searched literature was used to gather information about the area of study and the targeted occupation and participants. However, this information was not sufficient for the researcher to determine the challenges and risks associated with conducting research in the study area, the possibility of getting accessibility to RPSs and obtaining approval from government offices that could interfere with the successful completion of the study. In addition, there was limited information in the existing literature about the retail petrol stations and retail petrol station employees within the chosen study area. The pilot study helped gather vital information through questionnaires, observation, and a checklist. The pilot study also provided the opportunity to test and obtain key data that helped in the development of the research tools used in the main study. Essential information from the pilot study assisted the researcher in reducing the main study from being lengthy and time-consuming by excluding residential and shop occupants due to the unwillingness of participants and challenges encountered during the administration of questionnaires in the pilot study. The pilot study findings discussed in chapter four show that the retail petrol stations in Ilorin are workplace settings that are likely to pose health risks to the people in and around their vicinity.

The successful administration of the SF-36 questionnaires used in collecting the participants' quality of life data was possible because of the first evidence obtained from the pilot study that shows their educational level and understanding of the questionnaire when tested. The time used for administering the SF-36 questionnaire was reduced because the time for seeking

accessibility approval from retail petrol station owners and employees was excluded by using the same selected retail petrol stations, and employees willing to participate in the research during the pilot study. However, consent was obtained again from participants to ensure that they were voluntarily willing to continue participating in the study. The findings of the quality of life survey presented and discussed in chapter five show no statistical difference between the quality of life of retail petrol station employees and the selected representative of the general population (university population). These results could be associated with the result of the pilot study that indicated 83% of the employees had just worked for less than a year to five years while only 17% had worked between six to ten years. The potential reasons why more employees had worked in the RPS between the period of less than a year to five years could be associated with the findings in the qualitative study. The findings show that RPSA regards their job as temporary and an alternative occupation for gaining experience and earning money to start their own business or further their education. Also, RPSA considers working in the RPS as an occupation with job insecurity and without career prospects.

The poor use of PPE and limited health and safety training of RPSE reported in the pilot study could be associated with the poor health risk awareness of retail petrol station owners and the lack of provision of PPE in RPS reported in the qualitative study findings. In addition, the retail petrol station owners stated that one of the reasons for being unable to support and promote occupational health and safety within their stations was financial difficulties, as they find it challenging to access loan or any form of credit from financial institutions to fund their business. Also, RPS owners regard the opportunities given to RPSA to work in the petrol station as a favour because the experience requirement was not requested in the job application. They are trained when employed, thereby giving fresh graduates the opportunity to gain working experience. Furthermore, the findings from the qualitative study emphasise that a collaborative effort among government officials, business owners, employees and the general population is needed to tackle the health risks posed by the retail petrol station to its employees, the general population, and the environment. The research method and findings are summarised in sections 7.1 and 7.2.

7.1   Summary of Research Method

The research adopted a mixed-method design using both quantitative and qualitative methods. The study was conducted as cross-sectional research over a given time. Ethical approval and accessibility approval was crucial, and these were obtained from the relevant bodies. Ethical approval was obtained from the Cardiff Metropolitan University ethics committee and Kwara State University (KWASU) ethics committee (Appendix 1A and 1B). Accessibility and notification of the research study were approved by the Department of Petroleum Resources (DPR), Independent Petroleum marketer Association of Nigeria (IPMAN), and Major Oil Marketer Association of Nigeria (MOMAN)) even before the commencement of the pilot study (see appendix 1C to 1G). The pilot study explored the background information of the research and the feasibility of the study within speculated time and available resources. The pilot study findings directly fed into the quantitative stage of the main study. Also, the quantitative results directly fed into the interview and focus group discussions. Quantitative research was conducted with managers, attendants, students, and staff from selected retail petrol stations and a university. The qualitative study was conducted with retail petrol station owners, attendants, managers, public health officers, and environmental health officers in service at the time of the research study. Interview and focus group discussions were conducted face to face by the researcher. Figure 7.1 shows the visual summary of the research method from the pilot study to the main study stage, comprising both quantitative and qualitative stages.
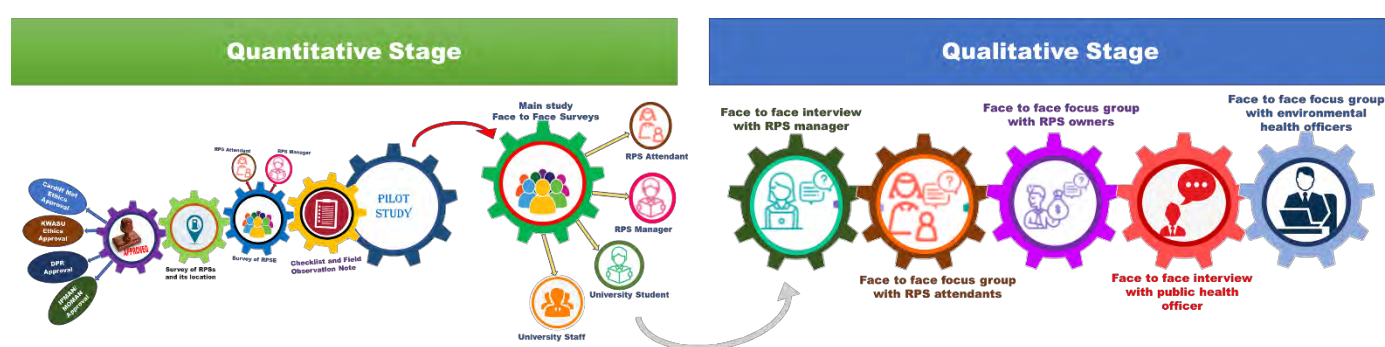

Figure 7.1. Visual summary of research methods

7.2   Summary of Research Findings

Summary of the pilot study stage and the main study stages findings are briefly discussed to give an overview of the research findings. The discussion shows how some of the findings in the main study addressed issues identified in the pilot study. Furthermore, the insightful qualitative findings also provided a further explanation of the main study's quantitative findings.

7.2.1   Summary of pilot study findings

The results were discussed and presented in chapter four of this thesis concerning the pilot study. In summary, the retail petrol stations in Ilorin and their location were surveyed at the time of the field study. The obtained coordinates were used to create a map in fig 4.2 in chapter four, showing the distribution pattern of retail petrol stations in Ilorin. Within the three local governments in Ilorin, a total number of 297 retail petrol stations were identified at the time of the survey comprising both functioning and non-functioning stations. Regarding the ownership of the retail petrol stations identified, less than 50% were owned by MOMAN, and IPMAN owned more than 50%. Petrol, kerosene, and diesel were the three major petroleum products sold at the retail petrol stations in Ilorin, but at some of the stations' sales of cooking gas had been added.

The retail petrol stations operate 7days of a week from 5 am to 10 pm or 12 am-midnight. An estimated percentage of 83% of the retail petrol station in the study had between one to 10 employees. About 92% of the identified retail petrol stations were located in close proximity to shops, hospitals, schools, and houses, i.e., less than 30 meters to listed premises, while only 8% were located within or more than 30 meters to shops, hospitals, schools, and houses per the DPR regulation for retail petrol stations. The two major reasons why more than 90% of the retail petrol stations were located in close proximity to public premises are due to retail petrol stations not adhering to government policies and building its station close to a large population as a potential market strategy, or the public is not adhering to government town planning and development policies thereby erecting buildings close to existing retail petrol stations.

The dominant male gender was found in the position of retail petrol station manager; therefore, the managers in the study were all male. The majority of the retail petrol station manager in the study were aged 30 years and above, married, and had a higher educational degree. Also, the highest percentage of the attendants were male. The majority of the retail petrol station

attendants were educated with a degree from polytechnics or university, single and aged 25 to 31 years. Only 30% of the attendants in the studies claimed to work 7days a week, while others claimed to work 5 days a week, having two days off. Furthermore, about 83% of the retail petrol station attendants have only worked for less than a year to 5years. Poor use of personal protective equipment and poor hand hygiene were observed among retail petrol station attendants.

Noise pollution from vehicles refuelling at the stations and generators used by the retail petrol stations, fire outbreaks, and air pollution associated with retail petrol stations was the major concern highlighted by residential and shop occupants close to the retail petrol station. In conclusion, the retail petrol stations in the study were identified as potential contributors to environmental pollution through the air, water, land, noise pollution, health risk factors, and fire hazards. Poor safety management was also observed among the retail petrol stations in the study.

7.2.2 Summary of main study findings

The main tool used in the quantitative stage was the short form-36 (SF-36) questionnaire. The SF-36 questionnaire was used to collect quality of life related information from the retail petrol station employees (attendant and manager) and a comparison population comprising university students and staff. This comparison group were selected based on the findings from the pilot that the retail petrol station employees were educated in higher education. 89 % of the selected participants returned their SF-36 questionnaire completed, and only 11% of the participants returned their SF-36 questionnaire incomplete. Regarding the findings in the quantitative stage of the main study, the quality of life of the retail petrol station employees (RPSE) was compared to the population of a university with similar socio-demographic characteristics. The participant's quality of life was scored according to the eight domains in the SF-36. However, the average score difference between retail petrol station employees and the university population (university population) was small. The retail petrol station employees scored higher in five quality of life domains (physical functioning (PF), role of physical functioning (RPF), vitality (VT), social functioning (SF), and general health (GH)), showing that the retail petrol station employees had a better quality of life in those domains than the university population. The retail petrol station employees had a lower average score than the university population in three quality of life domains (emotional well-being (EW), role of emotional well-being (REW),

and bodily pain (BP)), thereby indicating that the retail petrol station employee had poor quality of life in those three domains than the university population. But only in the domain of REW, VT, and BP were the scores of retail petrol station employees statistically significantly different from the university population. The average scores of the eight quality of life domains comparing the retail petrol station employee to the university population are shown in the quality of life domain chart in figure 7.2.

In the physical component summary (PCS) and mental component summary (MCS) of the quality of life domain, the difference in the average score of the retail petrol station employees and the university population is very little, but the retail petrol station employees scored the same as the university population in PCS while retail petrol station employees scored lower than university population in MCS. The study results show no difference between the quality of life PCS of retail petrol station employees and the university population, and the retail petrol station employees had poor MCS quality of life than the university population. The average score of the PCS and MCS of the retail petrol station employees and the university population are compared in figure 7.3. In conclusion, there was statistically no significant difference between the retail petrol station employees and the university population's physical and mental component summary quality of life.
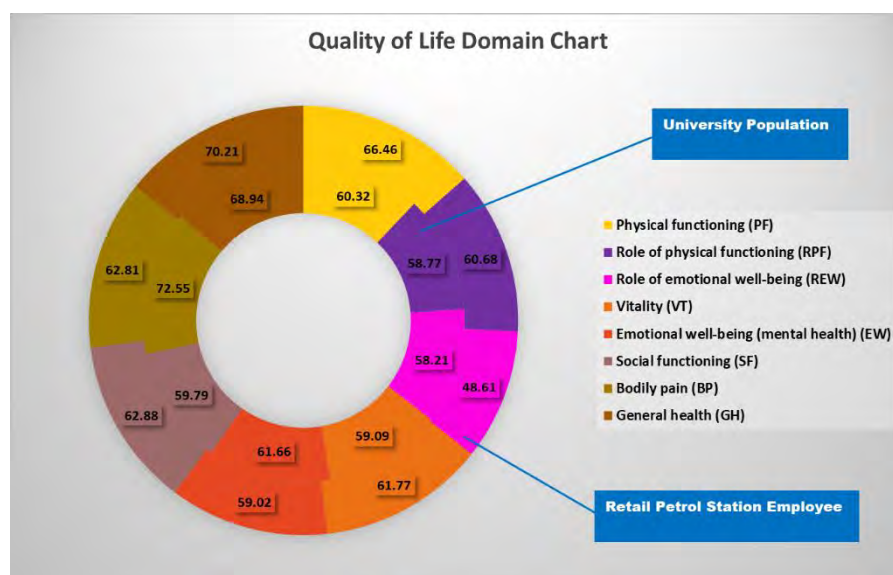

Figure 7.2. Visual representation of retail petrol station employee and university population quality of life domain average scores
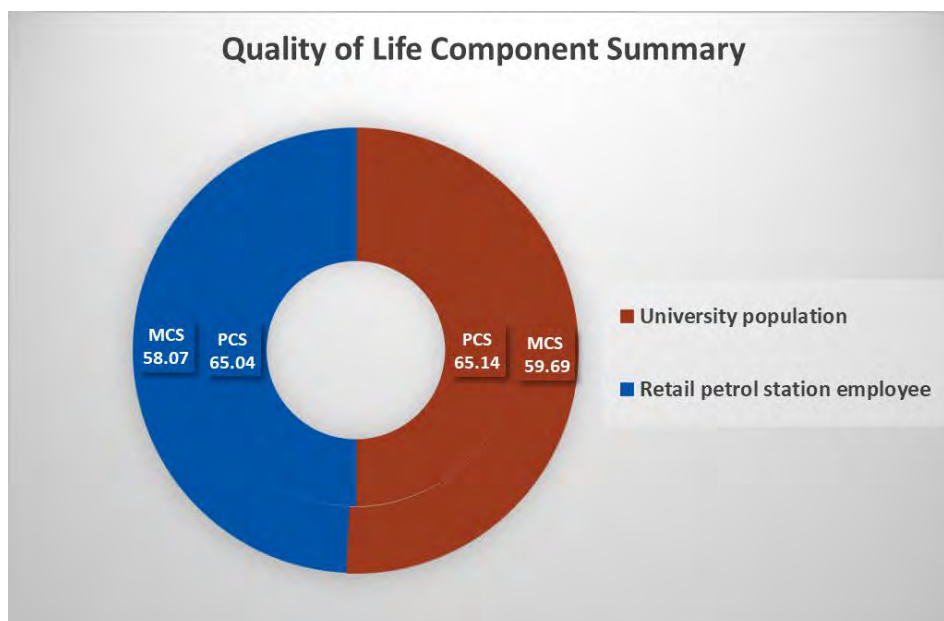
Figure 7.3. Visual representation of retail petrol station employee and university population physical and mental component summary of the quality life domain average scores

Regarding the qualitative stage of the research study, the findings show that the awareness of health risks related to working in a retail petrol station is poor among the retail petrol station owners. Due to poor safety awareness and knowledge among the retail petrol station owner, there was poor safety management practice, an absence of appropriate PPE for staff, and less concern for retail petrol station employees' health and safety at work. In addition, these identified issues explain why poor use of PPE and poor safety management were observed and reported in the pilot study findings.

The retail petrol station employees have a good awareness of health risks related to working in the retail petrol station. Despite being aware of the potential dangers of working in the retail petrol station, most employees engage in the job as a potential source of daily living and lack of employment in Nigeria. The majority of the retail petrol station employees work in the retail petrol station to work for a short period to look for better employment opportunities, earn money for further education, and start their own business. The lack of considering a job in a retail petrol station as a prospective career among the retail petrol station employees clarifies why more than 80% of the retail petrol station employees in the study were reported to have only worked for less than a year to 5years. The fewer years the retail petrol station employees had worked could be the reason for the statistically non-significant difference in the physical and mental component summary between retail petrol station employees and university

population quality of life domain in the quantitative finding. Retail petrol station employees recognise the need for appropriate PPE when carrying out their duties, but they believe that the provision of this PPE is the responsibility of the employer rather than their responsibility.

The public health officer and environmental health officers interviewed in the study have good knowledge of health risks associated with working in the retail petrol station and the environmental risks associated with the operation of retail petrol stations. The officers also believe that retail petrol station owners are aware of health and environmental risk factors associated with operating retail petrol stations but feign ignorance to avoid further financial-related responsibilities. The public health and environmental officers agreed that there is inadequate adherence to government regulations, guidelines, and policies among retail petrol stations. So, they suggested the need to improve enforcement of related government regulations and policies to reduce retail petrol stations' associated risks. The environmental health officer suggested collaboration among relevant organisations and retail petrol stations in tackling environmental issues related to retail petrol stations. Most importantly, the officers ensure that they are ready to support and participate in interventions, health, and environmental improvement programs to reduce potential risk factors associated with the operation of the retail petrol station.

7.3. Summary of research findings regarding the research aim, objectives, questions, and hypothesis

In this study, four research hypotheses were tested. The findings in this study provide evidence to either accept the null hypothesis or accept the alternative hypothesis. Figure 7.3 in the conclusion chapter shows that the retail petrol station employee has the same quality of life physical component as their peer in the university population; therefore, the null hypothesis was accepted, and the alternative hypothesis was rejected in hypothesis 1. Regarding hypothesis 2, figure 7.3 shows that the university population had a higher average score in the quality of life mental component summary. The null hypothesis stating that "retail petrol station employee quality of life mental component is the same as their peers in other occupation (university population)" was rejected, and the alternative hypothesis was accepted based on the summary in figure 7.3. Figure 7.4 shows the summary of the findings that provide results to accept the alternative hypothesis in hypotheses 3 and 4, stating that "retail petrol station manager quality of life physical and mental component is better than the retail petrol station attendant."

Figure 7.5 shows the visual representation of both the physical and mental component summary of the quality of life domain for male and female retail petrol station employees. i.e., the male retail petrol station employee's quality of life physical and mental component is better than the female retail petrol station employee. Figure 7.6 shows a visual representation of the average score for both physical and mental component summary of the quality of life domain for married and single retail petrol station employees. The married retail petrol station employee's quality of life physical and mental component is better than the single retail petrol station employees.
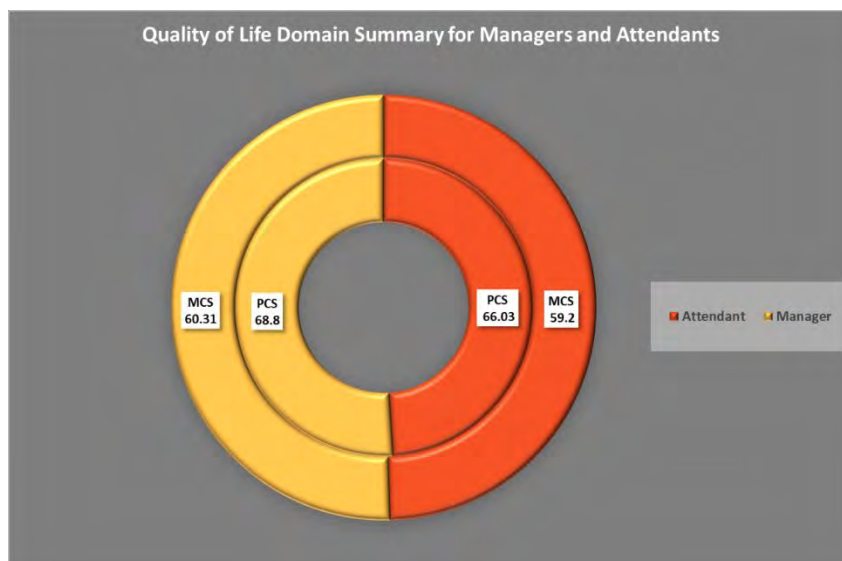

Figure 7.4. Visual representation of retail petrol station manager and attendants' physical and mental component summary of the quality life domain average scores
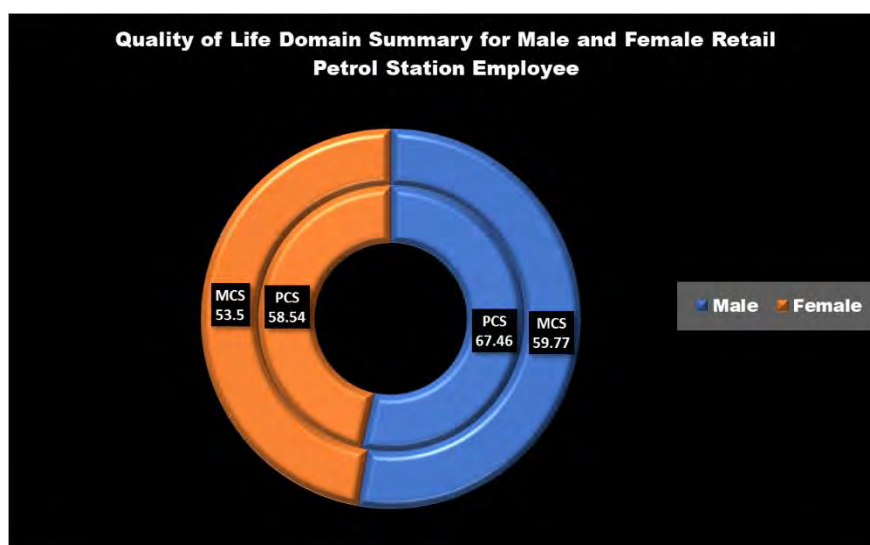

Figure 7.5. Visual representation of retail petrol station employee male and female physical and mental component summary of quality life domain average scores
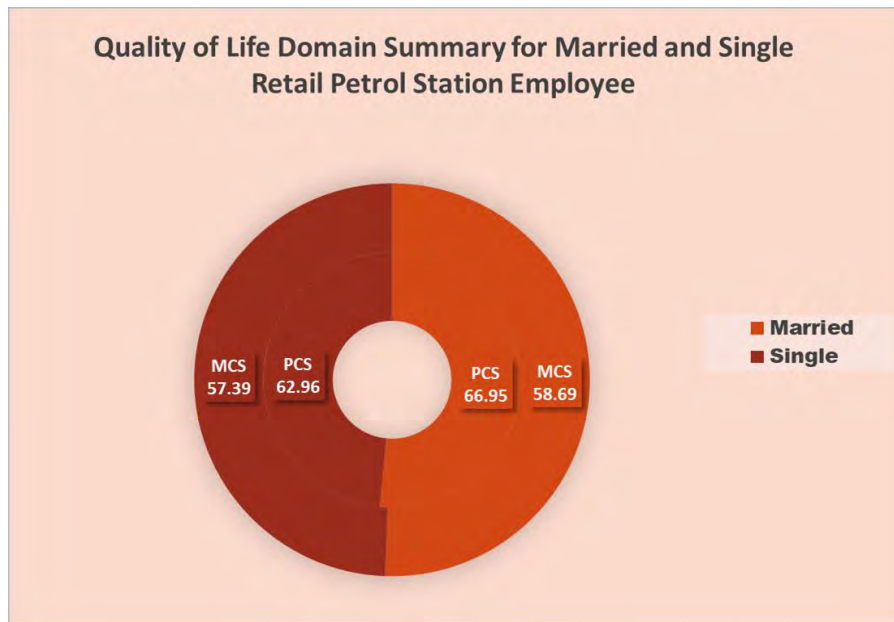
Figure 7.6. Visual representation of married and single retail petrol station employees' physical and mental component summary of the quality life domain average scores

The research met all its study objectives by conducting an in-depth literature review identifying knowledge for translational prospects and the methodology and methods used in this study narrated in chapters two and three of this thesis. In addition, the total number of retail petrol stations and their location in the study area were identified, and the information was used to create a geographical location of the retail petrol stations on the Ilorin map. The map for the distribution of retail petrol stations in Ilorin can be found in figure 4.2 in chapter four of this thesis. Retail petrol stations close to public, residential, and commercial centres were noted.

The researcher developed the questionnaire to assess and obtain information about the characteristics, environmental, and health risk concerns of residential and shop occupants in close proximity to the retail petrol stations used in the study. All the findings for the study objectives were reported in chapter four and under the summary for the pilot study in this chapter. Safety measures and occupational health and safety practices were observed using an observational checklist and field notes, and the findings were also reported in chapter four.

Furthermore, SF-36 was used to collect quality of life data for retail petrol station employees, and their quality of life was compared to a similar group from a university population. The findings for the quality of life of the retail petrol station employee and the university population are reported in chapters five and seven. Focus group discussion and an interview were conducted with retail petrol station owners and employees, environmental health officers and

public health officers to assess their risk awareness and perception of health risks associated with operating and working in the retail petrol station. The interview and focus group findings reported in chapter six provided more enlightenment on issues identified during the study. All the research results were integrated to provide beneficial information relating to the general body of knowledge.

All the eight study objectives highlighted in chapter one were achieved, contributing to the provision of answers to the five research questions and achieving the study's aim. The study aimed "to assess the practice of safety measure, perception & awareness of health hazards related to working in retail petrol station among retail petrol station employee and the quality of life of retail petrol station employees in Ilorin. It also aimed to assess the awareness and perception of retail petrol station owners, environmental and public health government officers, and determine the health risks concern of population sub-groups living and working in close proximity to the retail petrol stations in Ilorin".

7.4   Researcher Experience and Challenges Encountered During the Study

The study was an exploratory learning experience that led to the acquisition of knowledge. Although developing literature for this study was challenging because of the limited published article relating to the research area in Nigeria. Information from published studies conducted in different developing countries with limited literature from Nigeria was translated into knowledge that was used for this study. The literature helped to give an overall understanding of issues associated with retail petrol stations.

Obtaining approval from retail petrol station owners to access their employees and gain access to their stations was a daunting task because some owners were well-respected elderly individuals. So, a home visit with colleagues was made to get approval from selected retail petrol station owners. Also, it was challenging to recruit retail station owners for the focus group, and the invitation sent to attendants and managers for focus group discussion was received, but none of them honoured the invitation. Furthermore, the retail petrol station owner and manager had to be appropriately briefed to assure them that all information obtained would be used solely for research purposes. Their station's names will be anonymous, and their opinions will not be reported to the government to be used against them. With this assurance, the participant was confident and relaxed to participate in the research.

Cultural and societal practice for the research location was observed for the success of the study. Working with a local university in Ilorin was very helpful in accessing the stakeholders. The majority of the stakeholders were welcoming after making an introduction as a PhD student at the local university (KWASU). Because the majority of their children or relatives also attend the university. Also, some of the stakeholders were impressed to see a young female researcher doing her PhD, so they offered help contacting stakeholders who were hard to reach for the researcher.

The researcher wore appropriate dressing and used appropriate language, late working in the evening was excluded, and no valuables were carried during field activities to ensure safety as a lone worker. Although, some risks related to lone working as a female researcher, such as unwanted sexual advances, were experienced. But the assistance and prompt suggestions from the supervisory team and the collaborating local university helped manage and eliminate potential risks identified or experienced.

Overall, the study was filled with exciting and knowledgeable experiences. The researcher worked with students and lecturers at the collaborating university, thereby educating and sharing knowledge with students in different fields of study. The researcher was also able to contribute to community development activities during the study.

7.5 Conclusion

In Nigeria, the number of retail petrol stations keeps increasing due to the lucrative petroleum market as a major fuel and economic capital source in the country. Therefore, assessing how the retail petrol station contributes to the health and environmental risks within the country is vital in ensuring the safety and well-being of Nigeria's population. Also, there is limited in-depth research about related health risks associated with working in the retail petrol station, knowledge of risk awareness among owners and employees of the retail petrol station, and the quality of life of people working in the retail petrol station. This study has provided findings to inform related health risks associated with working at retail petrol stations, risk awareness knowledge in the retail petrol station, quality of life of retail petrol station employees, and government officers' views and recommendations towards improving health and environmental risk factors concerning retail petrol stations. The set study aim & objectives were achieved, the research question was answered, and the study hypothesis was proven.

The findings from the study were able to identify that majority of retail petrol station attendants in Ilorin were young male adults, unmarried, and had more than twelve years of education. Indigenous private owners owned many retail petrol stations in Ilorin with poor occupational health and safety practices due to the lack of knowledge about risks associated with working in a retail petrol station. The retail petrol station attendants had no career prospects working retail petrol stations because most were engaged in the job due to lack of employment in the desired occupation. Also, the knowledge of retail petrol station related health risks and job insecurity of working in retail petrol stations contributed to the discouragement of career prospects. There is a higher rate of non-adherence to government policy and regulation among retail petrol stations in the study. The study identified that policies and regulations related to retail petrol stations need to be reviewed and updated to address identified problems. Furthermore, the government officers in the study recommended collaborative partnerships among retail petrol station owners, policymakers, retail petrol station employees, environmental health officers, and other NGOs to address issues related to retail petrol stations.

The findings from this study support the improvement of quality of life among retail petrol station employees and the general public and guide intervention to address problems related to the retail petrol stations. In addition, the study promotes the need for and importance of good occupational health and safety practices. Also, it highlights the need to define and refine policies and guidelines related to retail petrol stations operation in Nigeria.

7.6　Recommendation

The following recommendations are made for petrol station owners, petrol station attendants, government officers and the university population.

Classification of Recommendations based on Stakeholders

Retail Petrol Station Owner

❖ The use of soundproofing material in building retail petrol station generator houses should be introduced to retail petrol station owners. The use of sound-reducing material will help address noise pollution reported by retail petrol station workers, residential occupants and shop occupants close to the retail petrol station.

❖ Provision of appropriate PPE for employees at the retail petrol station.

- ❖ Provision of career progression opportunities for employees in retail petrol stations.

Petrol Station Attendants

- ❖ Posters with fire-resistant material outlining the procedure for using fire extinguishers should be placed at each retail petrol station to constantly remind and educate retail petrol station employees on fire safety.

- ❖ The use of PPE and practice of hand hygiene should be promoted among retail petrol station employees.

- ❖ Increase awareness of good safety practices among retail petrol station attendants.

- ❖ Raise awareness to increase understanding of health risk factors associated with working in a retail petrol station

Government Officers

- ❖ Raise awareness and train residential and shop occupants close to the retail petrol station to own and use fire extinguishers in case of fire hazards to reduce the potential of fire spreading to the nearby retail petrol stations.

- ❖ Increase safety awareness for customers visiting retail petrol stations through radio, television adverts, billboards, and posters.

- ❖ There should be educative intervention targeted at retail petrol station owners to increase their awareness of risks associated with working in the retail petrol station and educate them on occupational health safety management.

- ❖ Governmental officers working close to retail petrol stations should collaborate with retail petrol stations, educational institutions, research organisations, and non-governmental organisations to promote general well-being and address health and environmental problems associated with retail petrol stations.

- ❖ Pre-medical assessment for retail petrol station employees should be encouraged before they are employed to avoid the aggravation of any current medical conditions by health risks associated with working in the retail petrol station.

- ❖ Government policies and guidelines need to be refined to promote effective occupational health and safety practices and management among retail petrol stations.

- ❖ Information from refined and updated policies should be disseminated appropriately to retail petrol stations and government organisations working closely with retail petrol stations.

University population

- ❖ The Kwara State University should create more programs within the university that encourage good health and well-being among the university population.
- ❖ Health and well-being educative materials should be provided to increase the awareness of the university population on the benefit and importance of good health and well-being.
- ❖ Research initiatives should be encouraged within the university to monitor students' quality of life in different departments from the first year to the final year.
- ❖ Sports and exercise centres should be built within the university with subsidised membership fees for staff and students to promote health and well-being among the university population.

Classification based on Short and Long Term Achievable Recommendations

Short Term Achievable Recommendations

- ❖ The use of PPE and practice of hand hygiene should be promoted among retail petrol station employees.

- ❖ Increase awareness of good safety practices among retail petrol station attendants.

- ❖ Provision of appropriate PPE for employees at the retail petrol station.

- ❖ Raise awareness and train residential and shop occupants close to the retail petrol station to own and use fire extinguishers in case of fire hazards to reduce the potential of fire spreading to the nearby retail petrol stations.

- ❖ Increase safety awareness for customers visiting retail petrol stations through radio, television adverts, billboards, and posters.

- ❖ Posters with fire-resistant material outlining the procedure for using fire extinguishers should be placed at each retail petrol station to constantly remind and educate retail petrol station employees on fire safety.

- ❖ The Kwara State University should create more programs within the university that encourage good health and well-being among the university population.

- ❖ Health and well-being educative materials should be provided to increase the awareness of the university population on the benefit and importance of good health and well-being.

Long Term Achievable Recommendations

- ❖ The use of soundproofing material in building retail petrol station generator houses should be introduced to retail petrol station owners. The use of sound-reducing material will help address noise pollution reported by retail petrol station workers, residential occupants and shop occupants close to the retail petrol station.

- ❖ There should be educative intervention targeted at retail petrol station owners to increase their awareness of risks associated with working in the retail petrol station and educate them on occupational health safety management.

- ❖ Governmental officers working close to retail petrol stations should collaborate with retail petrol stations, educational institutions, research organisations, and non-governmental organisations to promote general well-being and address health and environmental problems associated with retail petrol stations.

- ❖ Pre-medical assessment for retail petrol station employees should be encouraged before they are employed to avoid the aggravation of any current medical conditions by health risks associated with working in the retail petrol station.

- ❖ Government policies and guidelines need to be refined to promote effective occupational health and safety practices and management among retail petrol stations.

- ❖ Information from refined and updated policies should be disseminated appropriately to retail petrol stations and government organisations working closely with retail petrol stations.

- ❖ Research initiatives should be encouraged within the university to monitor students' quality of life in different departments from the first year to the final year.
- ❖ Sports and exercise centres should be built within the university with subsidised membership fees for staff and students to promote health and well-being among the university population.

7.7 Future Studies

- ❖ Studies could be conducted to assess the quality of life of retail petrol station employees who have worked in a retail petrol station in Ilorin for three years and above.

- ❖ A study to assess the effect of physical activities on the quality of life of retail petrol station employees should be carried out.

- ❖ A study to assess stress and its effect on retail petrol station employees in different states in Nigeria could be conducted.

- ❖ Studies with intervention on occupational health and safety management in retail and promotion of well-being among retail petrol station employees should be carried out.

- ❖ Studies could be conducted to assess the quality of work life for retail petrol station employees.

- ❖ A study could be carried out to investigate changes in the health condition of retail petrol station employees in Ilorin at different intervals of their employment.

- ❖ A study assessing the quality of life of retail petrol station employees in other countries could be conducted.

- ❖ Studies could be conducted to explore the perception and risk awareness of retail petrol stations in other countries.

- ❖ Studies could be carried out to explore career progression opportunities for retail petrol stations in other countries.

REFERENCES

Aalsalem, M.Y., Khan, W.Z., Gharibi, W., Khan, M.K. and Arshad, Q., 2018. Wireless Sensor Networks in oil and gas industry: Recent advances, taxonomy, requirements, and open challenges. *Journal of Network and Computer Applications*, *113*, pp.87-97.

Abbasi, F., Pasalari, H., Delgado-Saborit, J.M., Rafiee, A., Abbasi, A. and Hoseini, M., 2020. Characterization and risk assessment of BTEX in ambient air of a Middle Eastern City. *Process Safety and Environmental Protection,* 139, pp.98-105.

Abdullahi, A.P. and Adedayo, O.F., 2017. Application of sustainable environmental design requirements in filling stations in Niger State Nigeria. *Conflu. J. Environ. Stud,* 11(1), pp.104-116.

Abeh, O., 2017. The problems and prospects of small and medium scale enterprises (SMEs) growth and development in Nigeria: A study of selected SMEs in Delta State. *International Journal of Scientific Research in Education*, 10(3), pp.278-294.

Abouee-Mehrizi, A., Rasoulzadeh, Y., Mesgari-Abbasi, M., Mehdipour, A. and Ebrahimi-Kalan, A., 2020. Nephrotoxic effects caused by co-exposure to noise and toluene in New Zealand white rabbits: A biochemical and histopathological study. *Life Sciences*, *259*, p.118254.

Abou-ElWafa, H.S., Albadry, A.A., El-Gilany, A.H. and Bazeed, F.B., 2015. Some biochemical and hematological parameters among petrol station attendants: a comparative study. *BioMed Research International.* Article ID 418724, http://dx.doi.org/10.1155/2015/418724.

Abowitz, D.A. and Toole, T.M., 2009. Mixed method research: Fundamental issues of design, validity, and reliability in construction research. *Journal of Construction Engineering and Management*, *136*(1), pp.108-116.

Abraham, F. and Schmukler, S.L., 2017. Addressing the SME finance problem. *World Bank Research and Policy Briefs*, (120333), pp.1-4.

AbuAlRub, R., El-Jardali, F., Jamal, D. and Al-Rub, N.A., 2016. Exploring the relationship between work environment, job satisfaction, and intent to stay of Jordanian nurses in underserved areas. *Applied Nursing Research*, *31*, pp.19-23.

Abubakar, U., 2015. An overview of the occupational safety and health systems of Nigeria, UK, USA, Australia and China: Nigeria being the reference case study. *American Journal of Educational Research,* 3(11), pp.1350-1358.

Abuhashesh, M., Al-Dmour, R. and Masa'deh, R., 2019. Factors that affect employees job satisfaction and performance to increase customers'satisfactions. *Journal of Human Resources Management Research*, *2019*, pp.1-23.

Abutabenjeh, S. and Jaradat, R., 2018. Clarification of research design, research methods, and research methodology: A guide for public administration researchers and practitioners. *Teaching Public Administration*, *36*(3), pp.237-258.

Acharya, A.S., Prakash, A., Saxena, P. and Nigam, A., 2013. Sampling: Why and how of it. *Indian Journal of Medical Specialties*, *4*(2), pp.330-333.

Adagba, D.T. and Shakpande, C., 2017. Effect Of Environmental Factors on Business Performance. *Nigerian Journal of Management Sciences, 6 (1), 17*, *23*.

Adamcová, D., Vaverková, M.D., Bartoň, S., Havlíček, Z. and Břoušková, E., 2016. Soil contamination in landfills: a case study of a landfill in Czech Republic. *Solid Earth,* 7(1), pp.239-247.

Adebiyi, F.M. and Adeyemi, A.F., 2015. Determination of the contamination profile of groundwater in the vicinity of petroleum products retailing stations in Nigeria. *Management of Environmental Quality: An International Journal*, 25(2), pp. 250-269.

Adelowokan, O.A., Maku, O.E., Babasanya, A.O. and Adesoye, A.B., 2019. Unemployment, poverty and economic growth in Nigeria. *Journal of Economics & Management*, *35*, pp.5-17.

Ademiluka, S.O., 2018. Patriarchy and women abuse: perspectives from ancient Israel and Africa. *Old Testament Essays*, *31*(2), pp.339-362.

Adeoti, O.F., Akinluyi, F.O., Isimekhai, K.A., Anifowose, A.Y.B. and Komolafe, A., 2014. Application of GIS in the Mapping of Petrochemical–Induced Groundwater Contamination from Underground Fuel Storage Tank Leakages in Ile-Ife, Southwestern Nigeria. *International Geoinformatics Research and Development Journal,* 5(4), pp.10-20.

Adeoye, S.A., Awotunde, M.J., Arowolo, O.O., Sogunle, M.O., Adebayo, M.R. And Popoola, O.T., 2015. Occupational health problems confronting poultry farm workers in ogun and oyo state, Nigeria. *Journal of Sustainable Development,* 12(1), pp.28-35.

Adesola, B., Onwuegbuna, G.N. and Abodunrin, O., 2021. Impact of Occupational Safety and Health Regulations on Labour Productivity in Nigeria: A Study of Slabmark Nigeria Limited. *Sapientia Global Journal of Arts, Humanities and Development Studies,* 4(1), pp. 177-188.

Adewale, B.A., Olalekan, A.J. and Olawale, A.M., 2020. Physical Work Environment and Modern Farm Performance: Employees'perspectives. *Ilorin Journal of Human Resource Management*, *4*(1), pp.35-46.

Adewusi, V.A., 1998. Development of Petroleum Resources in Nigeria-Advances, Challenges and Opportunities. *Petroleum Science and Technology,* 16(7-8), pp.685-695.

Adewuyi, G.K., 2020. Assessment of Fire Service Station Response to Filling Stations Fire Outbreak and Vulnerable Healthcare Centers to Filling Stations in Urban Settlement. *International Journal of Research and Review*, *7*(3), pp.10-30.

Adeyele, J.S. and Osemene, O.F., 2018. Small and Medium Enterprises'Risk Exposures and Mitigation Approaches in Nigeria. *The Journal of Entrepreneurial Finance*, *20*(1), pp. 21-42.

Adeyemo, O. and Smallwood, J., 2017. Impact of occupational health and safety legislation on performance improvement in the Nigerian construction industry. *Procedia engineering*, 196, pp.785-791.

Adeyeye, B.A. and Ighorojeh, B., 2019. Education and Gender Disparity in West African Countries: The Nigeria Scenario. *European Scientific Journal,* 15(28).

Adkins, C.L. and Premeaux, S.F., 2019. A cybernetic model of work-life balance through time. *Human Resource Management Review*, *29*(4), p.100680.

Ado, A., Tukur, A.I., Ladan, M., Gumel, S.M., Muhammad, A.A., Habibu, S. and Koki, I.B., 2015. A Review on Industrial Effluents as Major Sources of Water Pollution in Nigeria. *Chemistry Journal,* 1(5), pp.159-164.

Afandi, A.T. and Ardiana, A., 2021. Exploration of the Non-Physical Work Environment and Burnout Syndrome for Nurses at the Jember Regional Hospital. *Pakistan Journal of Medical & Health Sciences* 15(1), pp.256-259.

Afolabi, O.T., 2011. Assessment of safety practices in filling stations in Ile-Ife, South Western Nigeria. *Journal of Community Medicine and Primary Health Care,* 23(1-2), pp.9-15.

Afonina, T.E. and Oshirova, M.A., 2020, August. Assessment of the current state of agricultural land pollution with heavy metals. In *IOP Conference Series: Earth and Environmental Science* 548(2) p. 022062.

African Growth and opportunity Act (AGOA).info, 2019. Country Info: Nigeria. Available at< *https://agoa.info/profiles/nigeria.html>*.[Accessed 2 September 2020].

African Union Development Agency (AUDA-NEPAD), 2020. First continental report on the implementation of agenda 2063. [pdf] Available at < https://www.nepad.org/publication/first-continental-report-implementation-of-agenda-2063> [Accessed 30 May 2022].

Afroz, R., Masud, M.M., Akhtar, R. and Duasa, J.B., 2014. Water pollution: Challenges and future direction for water resource management policies in Malaysia. *Environment and Urbanization ASIA,* 5(1), pp.63-81.

Agathokleous, E., Carrari, E. and Sicard, P., 2020. SI: Air Pollution and Plant Ecosystems. *Climate,* 8(8), p.91.

Agbozo, G.K., Owusu, I.S., Hoedoafia, M.A. and Atakorah, Y.B., 2017. The effect of work environment on job satisfaction: Evidence from the banking sector in Ghana. *Journal of Human Resource Management*, *5*(1), p.12.

Agency for Toxic Substances and Disease Registry (ATSDR), 2019. Case Studies in Environmental Medicine (CSEM): Lead Toxicity. [pdf] Available at < https://www.atsdr.cdc.gov/csem/lead/docs/CSEM-Lead_toxicity_508.pdf> [Accessed 6 August 2020].

Aggarwal, R. & Ranganathan, P. 2019. "Study designs: Part 2 – Descriptive studies". *Perspectives in Clinical Research,* 10 (1) pp. 34-36.

Aguwa, E.N, Arinze-Onyia, S.U. and Asuzu, M.C., 2014. Assessment of Workplace Accidents and Risk Reduction Mechanisms among Filling Station Pump Operators in Aba, Southeast Nigeria. *Occupational and Environmental Health Journal,* 3(1) p.17.

Agwu, P.E., 2018. Analysis of the impact of strategic management on the business performance of SMEs in Nigeria. *Academy of Strategic Management,* 17(1), pp.1-20.

Ahmad S.S., 2015. Research and its importance. *Ophthalmol Open J.,* 1(1), pp.e1-e2.

Ahmed, F. and Fakhruddin, A.N.M., 2018. A review on environmental contamination of petroleum hydrocarbons and its biodegradation. *International Journal of Environmental Sciences & Natural Resources*, *11*(3), pp.1-7.

Ahmed, J., Wong, L.P., Chua, Y.P., Channa, N., Mahar, R.B., Yasmin, A., VanDerslice, J.A. and Garn, J.V., 2020. Quantitative Microbial Risk Assessment of Drinking Water Quality to Predict the Risk of Waterborne Diseases in Primary-School Children. *International Journal of Environmental Research and Public Health*, *17*(8), p.2774.

Ahmed, S., Abdulrahman, A.S., Kovo, A.S., Ibrahim, S., Okoro, E.O. and Agbo, A.A., 2014. Health, risk and safety of petrol stations in Minna town: An overview. *World Appl Sci J,* 32(4), pp.655-666.

Ahmed, Y.A., 2009. Settlements pattern and functional distribution in an emerging communities: a case of a local government area of Kwara State, Nigeria. *The Social Sciences,* 4(3), pp.256-263.

Ahmed, Y.A., 2013. Urban Traffic Dilemma and Potential Remedy: Example from Ilorin City, Nigeria. *African Research Review*, *7*(1), pp.261-270.

Aigbedion, I. and Iyayi, S.E., 2007. Diversifying Nigeria's petroleum industry. *Economic and Policy Review*, 13(4), pp. 41-49.

Aigboduwa, J.E. and Oisamoje, M.D., 2013. Promoting small and medium enterprises in the Nigerian oil and gas industry. *European Scientific Journal*, 9(1), pp.244-261.

Aisyah, S., Deswindi, L. and Indrajaya, D., 2020, August. Are Physical and Non-Physical Working Environment Effect Employees Productivity with Motivation as an Intervening

Factor?. In *3rd Asia Pacific Management Research Conference (APMRC 2019)* (pp. 242-247). Atlantis Press.

Ajadi, B.S., Adaramola, M.A., Adeniyi, A. and Abubakar, M.I., 2016. Effect of effluents discharge on public health in Ilorin Metropolis, Nigeria. *Ethiopian Journal of Environmental Studies and Management,* 9(4), pp.389-404.

Ajibade, F.O., Adelodun, B., Lasisi, K.H., Fadare, O.O., Ajibade, T.F., Nwogwu, N.A., Sulaymon, I.D., Ugya, A.Y., Wang, H.C. and Wang, A., 2021. Environmental pollution and their socioeconomic impacts. In *Microbe Mediated Remediation of Environmental Contaminants* (pp. 321-354). Woodhead Publishing.

Ajzen, I. and Kruglanski, A.W., 2019. Reasoned action in the service of goal pursuit. *Psychological Review,* 126(5), p.774.

Akankali, J.A. and Elenwo, E.I., 2015. Sources of marine pollution on Nigerian coastal resources: an overview. *Open Journal of Marine Science,* 5(02), p.226.

Akar, H., 2018. The relationships between quality of work life, school alienation, burnout, affective commitment and organizational citizenship: A study on teachers. *European Journal of Educational Research*, 7(2), pp.169-180.

Åkerstedt, T., Discacciati, A., Miley-Åkerstedt, A. and Westerlund, H., 2018. Aging and the change in fatigue and sleep–a longitudinal study across 8 years in three age groups. *Frontiers in Psychology*, 9, p.234.

Akinloye, I.A., 2018. Towards the implementation of sustainable development goals in Nigeria: Maximizing the influence of religious leaders. *Stellenbosch Theological Journal,* 4(1), pp.39-60.

Akinsanya, B., Ayanda, I.O., Onwuka, B. and Saliu, J.K., 2020. Bioaccumulation of BTEX and PAHs in Heterotis niloticus (Actinopterygii) from the Epe Lagoon, Lagos, Nigeria. *Heliyon*, 6(1), p.e03272.

Akintunde, E.A., Bayei, J.Y. and Akintunde, J.A., 2020. Noise level mapping in University of Jos, Nigeria. *Geo Journal*, pp.1-13. https://doi.org/10.1007/s10708-019-10135-w.

Akitsu, T., 2018. *Environmental Science: Society, Nature, and Technology*. CRC Press. New York.

Akopyan, A.V., Polikarpova, P.D., Plotnikov, D.A., Eseva, E.A., Tarakanova, A.V., Anisimov, A.V. and Karakhanov, E.A., 2019. Desulfurization of Light Distillates by Oxidation and Rectification of Gas Condensate. *Petroleum Chemistry*, *59*(6), pp.608-614.

Akpan, E.I., 2011. Effective safety and health management policy for improved performance of organizations in Africa. *International Journal of Business and Management,* 6(3), pp.159-165.

Akpoviroro, K.S. and Owotutu, S.O., 2018. Impact of external business environment on organizational Performance. *IJARIIE*, *4*(3), pp.498-506.

Aktürk, S., Büyükavcı, R. and Aktürk, Ü., 2019. Relationship between musculoskeletal disorders and physical inactivity in adolescents. *Journal of Public Health*, *27*(1), pp.49-56.

Aladejebi, O., 2020. Managing small businesses in Nigeria during covid-19 crisis: impact and survival strategies. *IOSR Journal of Business and Management* (IOSR-JBM), 22(8), pp.24-34.

Alhaj, A., 2020. Occupational Lead Exposure among Petrol Station Workers in Sana'a City, Yemen: Awareness and Self-Reported Symptoms. *Zagazig University Medical Journal*, *26*(5), pp.795-805.

Al-Harbi, M., Alhajri, I., AlAwadhi, A. and Whalen, J.K., 2020. Health symptoms associated with occupational exposure of gasoline station workers to BTEX compounds. *Atmospheric Environment*, *241*, p.117847.

Ali, S.H. and de Oliveira, J.A.P., 2018. Pollution and economic development: an empirical research review. *Environmental Research Letters*, *13*(12), p.123003.

Alias, S.A., Noor, N.M., Rahim, A.R.A. and Ong, M.H.A., 2017. The Influence of Work Environment Factors to the Effectiveness of Training among Civil Service Employees in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *7*(4), pp.1081-1097.

Aliyu, A.A. and Amadu, L., 2017. Urbanization, cities, and health: The challenges to Nigeria–A review. *Annals of African medicine,* 16(4), p.149.

Aliyu, A.A., Bello, M.U., Kasim, R. and Martin, D., 2014. Positivist and non-positivist paradigm in social science research: Conflicting paradigms or perfect partners. *J. Mgmt. & Sustainability*, *4*, p.79.

Al-Janabi, Y.T., 2020. An Overview of Corrosion in Oil and Gas Industry: Upstream, Midstream, and Downstream Sectors. *Corrosion Inhibitors in the Oil and Gas Industry*, pp.1-39. DOI:10.1002/9783527822140.

Alkallabi, S.A., Ingle, N.A., Baseer, M.A., Alsanea, J.A., AIshammery, S.A. and Almeslet, A.S., 2019. Self-reported Quality of Life among Dental Students in Kingdom of Saudi Arabia. *Journal of Oral Health and Community Dentistry*, *13*(2), p.45.

Allen, C., Metternicht, G. and Wiedmann, T., 2016. National pathways to the Sustainable Development Goals (SDGs): A comparative review of scenario modelling tools. *Environmental Science & Policy,* 66, pp.199-207.

Alli, B.O., 2008. Fundamental principles of occupational health and safety Second edition. *Geneva*, *International Labour Organization*, 15, p.2008.

Almadi, M.A. and Alghamdi, F., 2019. The gap between knowledge and undergoing colorectal cancer screening using the Health Belief Model: A national survey. *Saudi journal of gastroenterology: official journal of the Saudi Gastroenterology Association*, *25*(1), p.27.

Alrumman, S.A., El-kott, A.F. and Keshk, S.M., 2016. Water Pollution: Source & Treatment. *American Journal of Environmental Engineering*, 6(3), pp.88-98.

Alsbou, E.M. and Omari, K.W., 2020. BTEX indoor air characteristic values in rural areas of Jordan: Heaters and health risk assessment consequences in winter season. *Environmental Pollution*, *267*, p.115464.

Alshura, M.S.K. and Assuli, A.H., 2017. Impact of Internal Environment on Performance Excellence in Jordanian Public Universities from Faculty Points of View. *International Journal of Business and Social Science*, *8*(1), pp.45-57.

Alvesson, M. and Sköldberg, K., 2017. *Reflexive methodology: New vistas for qualitative research*. Sage.UK.

Ambituuni, A., Amezaga, J. and Emeseh, E., 2014. Analysis of safety and environmental regulations for downstream petroleum industry operations in Nigeria: Problems and prospects. *Environmental Development,* 9, pp.43-60.

Amegah, A.K. and Agyei-Mensah, S., 2017. Urban air pollution in Sub-Saharan Africa: Time for action. *Environmental Pollution,* 220, pp.738-743.

American College of Obstetricians and Gynaecologists, 2013. Exposure to toxic environmental agents.[pdf] Available at < https://prhe.ucsf.edu/sites/g/files/tkssra341/f/wysiwyg/Companion%20Piece%20to%20575%20Exposure%20to%20Toxic%20Environmental%20Agents.pdf> [Accessed 27 May 2022].

American Petroleum Institute, 2014. Understanding Crude Oil and Product Markets. < https://www.api.org/~/media/Files/Oil-and-Natural-Gas/Crude-Oil-Product-Markets/Crude-Oil-Primer/Understanding-Crude-Oil-and-Product-Markets-Primer-High.pdf> [Accessed 20 April 2019].

Amine, M. and Barakat, Y., 2019. Properties of gasoline-ethanol-methanol ternary fuel blend compared with ethanol-gasoline and methanol-gasoline fuel blends. *Egyptian Journal of Petroleum*, *28*(4), pp.371-376.

Aminiyan, M.M., Kalantzi, O.I., Etesami, H., Khamoshi, S.E., Hajiali Begloo, R. and Aminiyan, F.M., 2021. Occurrence and source apportionment of polycyclic aromatic hydrocarbons (PAHs) in dust of an emerging industrial city in Iran: implications for human health. *Environmental Science and Pollution Research,* 28(44), pp.63359-63376.

Amran, F.W., Gazali, H. and Hashim, S., 2019. Influence Of Working Environment, Workload and Job Autonomy Towards Job Stress: A Case of Casual Dining Restaurant Employees In Klang Valley, Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *9*(5), pp. 744-55.

Anakwue, A.M., Anakwue, R., Okeji, M., Idigo, F., Agwu, K. and Nwogu, U., 2017. Sonographic assessment of petroleum-induced hepatotoxicity in Nigerians: does biochemical assessment underestimate liver damage?. *African Health Sciences,* 17(1), pp.270-277.

Andersen, Z.J., 2020. Air pollution epidemiology. *Traffic-Related Air Pollution*, pp. 163-182). Elsevier.

Anderson, M.L., 2020. As the wind blows: The effects of long-term exposure to air pollution on mortality. *Journal of the European Economic Association*, *18*(4), pp.1886-1927.

Anenberg, S.C., Miller, J., Henze, D.K., Minjares, R. and Achakulwisut, P., 2019. The global burden of transportation tailpipe emissions on air pollution-related mortality in 2010 and 2015. *Environmental Research Letters*, *14*(9), p.094012.

Anjum, A., Ming, X., Siddiqi, A.F. and Rasool, S.F., 2018. An empirical study analyzing job productivity in toxic workplace environments. *International Journal of Environmental Research and Public Health*, *15*(5), p.1035.

Anokye, N.K., Trueman, P., Green, C., Pavey, T.G. and Taylor, R.S., 2012. Physical activity and health related quality of life. *BMC Public Health*, *12*(1), pp.1-8.

Anonymous, 2017. Pilot study. [Unpublished].

Anskär, E., Lindberg, M., Falk, M. and Andersson, A., 2019. Legitimacy of work tasks, psychosocial work environment, and time utilization among primary care staff in Sweden. *Scandinavian Journal of Primary Health Care*, *37*(4), pp.476-483.

Antom, V.L., 2021. Interrogating The Powers Of The Governor As Chief Security Officer Of The State In Nigeria: Any Need For State Police?. *International Review of Law And Jurisprudence (IRLJ)*, *3*(1), pp.70-76.

Antwi, S.K. and Hamza, K., 2015. Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management*, *7*(3), pp.217-225.

Anyanwu, M.U. and Okoye, R.C., 2017. Antimicrobial activity of Nigerian medicinal plants. *Journal of Intercultural Ethnopharmacology,* 6(2), p.240.

API Energy, 2020. Refining processes. < https://www.api.org/oil-and-natural-gas/wells-to-consumer/fuels-and-refining/refineries/how-refinery-works/refinery-processes>

Araújo, P.S.I., Costa, B.D., and de Moraes, B.J.R., 2014. Identification and Characterization of Particulate Matter Concentrations at Construction Jobsites. [Pdf] Sustainability (6) pp. 7666-7688.

Arevalo, M. and Brown, L.D., 2019. Using a reasoned action approach to identify determinants of organized exercise among Hispanics: a mixed-methods study. *BMC Public Health*, *19*(1), p.1181.

Arezes, P.M., Baptista, J.S., Barroso, M.P., Carneiro, P., Cordeiro, P., Costa, N., Melo, R.B., Miguel, A.S. and Perestrelo, G. eds., 2016. *Occupational Safety and Hygiene IV*. CRC Press.

Arokoyu S.B, Mark O, & Jochebed A.O. (2015). Petrol filling stations location and minimum environmental safety requirements in Obio Akpor LGA, Nigeria. *International Journal of Scientific Research and Innovative Technology,* 2(11), pp.19

Arora, S., Jain, K.C. and Lokhande, S.R., 2017. Review of Heavy Metal Contamination in Soil. *International Journal of Environmental Sciences and Natural Resources*, 3(5). DOI: 10.19080/IJESNR.2017.03.555625

Arulprakasajothi, M., Chandrasekhar, U., Yuvarajan, D. and Teja, M.B., 2020. An analysis of the implications of air pollutants in Chennai. *International Journal of Ambient Energy*, *41*(2), pp.209-213.

Asefaw, T., Wolde, M., Edao, A., Tsegaye, A., Teklu, G., Tesfay, F. and Gebremariam, G., 2020. Assessment of liver and renal function tests among gasoline exposed gas station workers in Mekelle city, Tigray region, Northern Ethiopia. *PloS One*, *15*(10), p.e0239716.

Asgary, A., Ozdemir, A.I. and Özyürek, H., 2020. Small and Medium Enterprises and Global Risks: Evidence from Manufacturing SMEs in Turkey. *Int J Disaster Risk Sci* .11 pp. 59–73

Ashraf, M.A., Maah, M.J. and Yusoff, I., 2014. Soil contamination, risk assessment and remediation. In *Environmental Risk Assessment of Soil Contamination*. Pp. 3-56. InTech. Croatia

Aspers, P. and Corte, U., 2019. What is qualitative in qualitative research. *Qualitative Sociology*, *42*(2), pp.139-160.

Astin, F & Long, A., 2014. Characteristics of qualitative research and its application. *British journal of Cardiac Nursing* 9(2), pp. 93 -98

Atieno, O.P., 2009. An analysis of the strengths and limitation of qualitative and quantitative research paradigms. *Problems of Education in the 21st Century*, *13*(1), pp.13-38.

Atmaja, N.P.C.D. and Puspitawati, N.M.D., 2018. Effect of physical work environment through productivity employees job satisfaction as an intervening variable. *International Journal of Business, Economics and Law,* 17(5), pp.98-104.

Attademo, L. and Bernardini, F., 2017. Air pollution and urbanicity: common risk factors for dementia and schizophrenia? *The Lancet Planetary Health,* 1(3), pp.e90-e91.

Attademo, L., Bernardini, F., Garinella, R. and Compton, M.T., 2017. Environmental pollution and risk of psychotic disorders: A review of the science to date. S*chizophrenia Research,* 181, pp.55-59

Augusto, K.L., Araujo, L.A., Magalhaes, T.F., Marinho, M.C. and Bezerra, L.R., 2016. The impact of chronic pelvic pain and its associated symptoms on women's quality of life in a tertiary care hospital in Brazil. *Journal of Endometriosis and Pelvic Pain Disorders*, *8*(4), pp.167-171.

Augusto, K.L., Araujo, L.A., Magalhaes, T.F., Marinho, M.C. and Bezerra, L.R., 2016. The impact of chronic pelvic pain and its associated symptoms on women's quality of life in a tertiary care hospital in Brazil. *Journal of Endometriosis and Pelvic Pain Disorders*, *8*(4), pp.167-171.

Awan, A., and Tahir, M. T., 2015. Impact of working environment on employee's productivity: A case study of Banks and Insurance Companies in Pakistan. [Pdf] *European Journal of Business and Management* (7) 1, pp. 329.

Awasthi, G., Joshi, D., Swarup, A., Mandal, T.K. and Awasthi, D.K., 2016. Epidemiological studies on Petroleum toxicity. *Int J Pharm Drug Anlys*, 4, pp.251-7.

Ayanshola, A.M., Salami, A.W., and Sule, B.F., 2011. Assessment Of Water Consumption Pattern in Ilorin, Kwara State, Nigeria. *LAUTECH Journal of Engineering and Technology*, *7*(1), pp.93-100.

Ayo-Balogun, A.O. and Ogunsanwo, A.O., 2020. Promotion of Small and Medium Scale Enterprises: A Pathway to Nigeria Economy Growth. *Journal of Women in Technical Education and Employment (JOWITED)*, 1(1), pp.160-168.

Azubuike, S.O., Muirhead, C., Hayes, L. and McNally, R., 2018. Rising global burden of breast cancer: the case of sub-Saharan Africa (with emphasis on Nigeria) and implications for regional development: a review. *World Journal of Surgical Oncology*, *16*(1), pp.1-13.

Azzaro-Pantel, C. ed., 2018. *Hydrogen Supply Chain: Design, Deployment and Operation*. Academic Press.

Babayemi, J.O., Ogundiran, M.B. and Osibanjo, O., 2016. Overview of Environmental Hazards and Health Effects of Pollution in Developing Countries: A Case Study of Nigeria. *Environmental Quality Management*, 26(1), pp.51-71.

Babu, A.S. and Londhe, B., 2014. Dynamics of Ethyl Benzene Synthesis Using Aspen Dynamics. *International Journal of Scientific Engineering and Technology*, 3(7), pp. 946-950

Backé, E.M., Seidler, A., Latza, U., Rossnagel, K. and Schumann, B., 2012. The role of psychosocial stress at work for the development of cardiovascular diseases: a systematic review. *International Archives of Occupational and Environmental Health,* 85(1), pp.67-79.

Badenhorst, C.J., 2007. Occupational health and safety risks associated with sulphur dioxide. *Journal of the Southern African Institute of Mining and Metallurgy*, 107(5), pp.299-303.

Baghani, A.N., Sorooshian, A., Heydari, M., Sheikhi, R., Golbaz, S., Ashournejad, Q., Kermani, M., Golkhorshidi, F., Barkhordari, A., Jafari, A.J. and Delikhoon, M., 2019. A case study of BTEX characteristics and health effects by major point sources of pollution during winter in Iran. *Environmental Pollution*, *247*, pp.607-617.

Bahadori, A., 2019. *Waste Management in the Chemical and Petroleum Industries.* Eds. John Wiley & Sons. USA

Bairagi, V. (Ed.), Munot, M. (Ed.)., 2019. *Research Methodology.* New York: Chapman and Hall/CRC, https://doi.org/10.1201/9781351013277.

Bakas, T., McLennon, S.M., Carpenter, J.S., Buelow, J.M., Otte, J.L., Hanna, K.M., Ellett, M.L., Hadler, K.A. and Welch, J.L., 2012. Systematic review of health-related quality of life models. *Health and quality of life outcomes*, *10*(1), p.134.

Bakhtiari, S., Breunig, R., Magnani, L. and Zhang, J., 2020. Financial constraints and small and medium enterprises: A review. *Economic Record*, *96*(315), pp.506-523.

Bala, M. and Verma, D., 2020. Investigation & Examination of Noise Pollution-Definition, Sources, Effects, Monitoring and Control. *International Journal of Research in Social Sciences*, *10*(7), pp.182-207.

Balakrishnan, N.R., Render, B., Stair, R. and Munson, C., 2017. 4th eds. *Managerial Decision Modeling: Business Analytics with Spreadsheets*. Walter de Gruyter GmbH & Co KG. Boston.

Ban, H.J. and Kim, H.S., 2020. Applying the Modified Health Belief Model (HBM) to Korean Medical Tourism. *International Journal of Environmental Research and Public Health*, *17*(10), p.3646.

Bank of Industry, Nigeria, 2018. MSME'S Definition. Available at : < https://www.boi.ng/smedefinition/> [Accessed 27 February 2019].

Barakat, A.M. and Kasemy, Z.A., 2020. Preventive health behaviours during coronavirus disease 2019 pandemic based on health belief model among Egyptians. *Middle East Current Psychiatry*, *27*(1), pp.1-9.

Barnes, B.R., 2019. Transformative mixed methods research in South Africa: Contributions to social justice. *Research Methods in the Social Sciences*, p.303. DOI:10.18772/22019032750.24.

Barringer, R. B., 2016. *Preparing Effective Business Plans*. Prentice Hall. USA.

Barthwal, V., Jain, S., Babuta, A., Jamir, C., Sharma, A.K. and Mohan, A., 2022. Health impact assessment of Delhi's outdoor workers exposed to air pollution and extreme weather events: an integrated epidemiology approach. *Environmental Science and Pollution Research.* https://doi.org/10.1007/s11356-022-18886-9.

Bassey Udo, 2017. Fuel queues resurface in Abuja. Premium Times, Nigeria [online] Available at< https://www.premiumtimesng.com/.../225366-fuel-queues-resurface-abuja. Html> [Accessed 6 March 2019].

Bastani, P., Shojaei, P. and Salehi, A., 2020. A Comprehensive Environmental Scanning and Strategic Analysis of Iranian Public Hospitals: A Prospective Approach. *Research Square*. DOI: https://doi.org/10.21203/rs.2.18281/v3.

Bates, K.H. and Jacob, D.J., 2020. An Expanded Definition of the Odd Oxygen Family for Tropospheric Ozone Budgets: Implications for Ozone Lifetime and Stratospheric Influence. *Geophysical Research Letters*, *47*(4), p.e2019GL084486.

Bauleo, L., Bucci, S., Antonucci, C., Sozzi, R., Davoli, M., Forastiere, F. and Ancona, C., 2019. Long-term exposure to air pollutants from multiple sources and mortality in an industrial area: a cohort study. *Occupational and Environmental Medicine*, 76(1), pp.48-57.

Bayomie, O.S., Abdelaziz, O.Y. and Gadalla, M.A., 2019. Exceeding Pinch limits by process configuration of an existing modern crude oil distillation unit–A case study from refining industry. *Journal of Cleaner Production*, *231*, pp.1050-1058.

Beauchamp, M.R., Crawford, K.L. and Jackson, B., 2019. Social cognitive theory and physical activity: Mechanisms of behavior change, critique, and legacy. *Psychology of Sport and Exercise*, *42*, pp.110-117.

Begou, P., Kassomenos, P. and Kelessis, A., 2020. Effects of road traffic noise on the prevalence of cardiovascular diseases: The case of Thessaloniki, Greece. *Science of The Total Environment*, *703*, p.134477.

Belás, J., Bartoš, P., Ključnikov, A. and Doležal, J., 2015. Risk perception differences between micro-, small and medium enterprises. *Journal of International Studies*, 8(3), p. 20-30

Belie, O., Mofikoya, B.O., Fadeyibi, I.O., Ugburo, A.O., Buari, A. and Ugochukwu, N.N., 2020. Cooking gas explosions as cause of burns among patients admitted to a regional burn centre in Nigeria. *Annals of Burns and Fire Disasters*, *33*(1), p.62.

Bell, E., Bryman, A. and Harley, B., 2018. *Business research methods*. Oxford university press. UK.

Bepko, J. and Mansalis, K., 2016. Common occupational disorders: asthma, COPD, dermatitis, and musculoskeletal disorders. *American Family Physician*, *93*(12), pp.1000-1006.

Bergeron, K., Abdi, S., DeCorby, K., Mensah, G., Rempel, B. and Manson, H., 2017. Theories, models and frameworks used in capacity building interventions relevant to public health: a systematic review. *BMC Public Health*, *17*(1), pp.1-12.

Berger-Tal, O., Wong, B.B., Candolin, U. and Barber, J., 2019. What evidence exists on the effects of anthropogenic noise on acoustic communication in animals? A systematic map protocols. *Environmental Evidence*, *8*(1), pp.1-7.

Berhanu, F., Gebrehiwot, M. and Gizaw, Z., 2019. Workplace injury and associated factors among construction workers in Gondar town, Northwest Ethiopia. *BMC musculoskeletal disorders*, *20*(1), p.523.

Bešenić, T., Vujanović, M., Baleta, J., Pachler, K., Samec, N. and Hriberšek, M., 2020. Numerical analysis of sulfur dioxide absorption in water droplets. *Open Physics*, *18*(1), pp.104-111.

Bhagawati, B., 2015. Basics of occupational safety and health. *IOSR J Environ Sci Toxicol Food Technol*, *9*, pp.91-94.

Bhaskar, S.B. and Manjuladevi, M., 2016. Methodology for research II. *Indian Journal of Anaesthesia*, *60*(9), p.646.

Biesta, G. J. J., 2010. *Pragmatism and the philosophical foundations of mixed methods research*. In A. Tasshakori & C. Teddlie (Eds.), SAGE *Handbook of mixed methods in social and behavioral researc*h, 2nd edn (pp. 95–117). Thousand Oaks, CA: Sag

Biron, C, & Burke, RJ 2017. Creating Healthy Workplaces : Stress Reduction, Improved Well-Being, and Organizational Effectiveness, Taylor & Francis Group, Farnham. Available from: ProQuest Ebook Central. [30 July 2020].

Biswas, S., Bipeta, R., Molangur, U. and Reshaboyina, L.R., 2019. A study to assess the quality of life of undergraduate medical students. *Open Journal of Psychiatry & Allied Sciences*, *10*(1), pp. 19-25.

Bjorlykke, K., 2015. *Petroleum geoscience: From sedimentary environments to rock physics*. (Second Edition). Springer Science & Business Media. Norway.

Blaikie, N. and Priest, J., 2019. *Designing social research: The logic of anticipation*. John Wiley & Sons. UK.

Bloemeke, J., Silva, N., Bullinger, M., Witt, S., Dörr, H.G. and Quitmann, J., 2019. Psychometric properties of the quality of life in short statured youth (QoLISSY) questionnaire within the course of growth hormone treatment. *Health and quality of life outcomes*, *17*(1), p.49.

Blom, E.E., Aadland, E., Skrove, G.K., Solbraa, A.K. and Oldervoll, L.M., 2019. Health-related quality of life and intensity-specific physical activity in high-risk adults attending a behavior change service within primary care. *PloS One*, *14*(12), p.e0226613.

Blom, E.E., Aadland, E., Skrove, G.K., Solbraa, A.K. and Oldervoll, L.M., 2020. Health-related quality of life and physical activity level after a behavior change program at Norwegian healthy life centers: A 15-month follow-up. *Quality of Life Research*, *29*(11), pp.3031-3041.

Boadu, E.F., Wang, C.C. and Sunindijo, R.Y., 2021. Challenges for occupational health and safety enforcement in the construction industry in Ghana. *Construction Economics and Building,* 21(1), pp.1-21.

Bodin, Ö., Baird, J., Schultz, L., Plummer, R. and Armitage, D., 2020. The impacts of trust, cost and risk on collaboration in environmental governance. *People and Nature*, *2*(3), pp.734-749.

Bodo, T. and Gimah, B.G., 2020. The Pollution and Destruction of the Niger Delta. Ecosystem in Nigeria: Who is to be blamed. *European Scientific Journal*, *16*(5), pp.161-182.

Bol, O., Koyuncu, S. and Günay, N., 2018. Prevalence of hidden carbon monoxide poisoning in auto service workers; a prospective cohort study. *Journal of Occupational Medicine and Toxicology*, 13(1), pp.1-7.

Boladale, M., Olakunle, O., Olutayo, A. and Adesanmi, A., 2015. Sexual orientation and quality of life among students of Obafemi Awolowo University (OAU), Nigeria. *African Health Sciences*, *15*(4), pp.1065-1073.

Bolden, A.L., Kwiatkowski, C.F. and Colborn, T., 2015. New look at BTEX: Are ambient levels a problem? *Environmental Science & Technology*, 49(9), pp.5261-5276.

Bolton, K., Kremer, P., Rossthorn, N., Moodie, M., Gibbs, L., Waters, E., Swinburn, B. and de Silva, A., 2014. The effect of gender and age on the association between weight status and health-related quality of life in Australian adolescents. *BMC Public Health*, *14*(1), pp.1-8.

Boon, M. and Van Baalen, S., 2019. Epistemology for interdisciplinary research–shifting philosophical paradigms of science. *European Journal for Philosophy of Science*, *9*(1), p.16.

Boonhat, H. and Lin, R.T., 2020. Association between leukemia incidence and mortality and residential petrochemical exposure: A systematic review and meta-analysis. *Environment International*, *145*, p.106090.

Boubekri, M., Cheung, I.N., Reid, K.J., Wang, C.H. and Zee, P.C., 2014. Impact of windows and daylight exposure on overall health and sleep quality of office workers: a case-control pilot study. *Journal of Clinical Sleep Medicine*, 10(6), pp.603-611.

Bourdel, N., Chauvet, P., Billone, V., Douridas, G., Fauconnier, A., Gerbaud, L. and Canis, M., 2019. Systematic review of quality of life measures in patients with endometriosis. *PloS One*, *14*(1).

Boyce, P.R., 2019. The benefits of light at night. *Building and Environment*, *151*, pp.356-367.

BP, 2017. BP Statistical Review of World Energy. Available at:< [https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/ statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf]> [Accessed 6 February 2018].

Bradt, J., Burns, D.S. and Creswell, J.W., 2013. Mixed methods research in music therapy research. *Journal of Music Therapy*, *50*(2), pp.123-148.

Braithwaite, I., Zhang, S., Kirkbride, J.B., Osborn, D.P. and Hayes, J.F., 2019. Air pollution (particulate matter) exposure and associations with depression, anxiety, bipolar, psychosis and suicide risk: a systematic review and meta-analysis. *Environmental Health Perspectives*, *127*(12), p.126002.

Brand, P., Bertram, J., Chaker, A., Jörres, R.A., Kronseder, A., Kraus, T. and Gube, M., 2016. Biological effects of inhaled nitrogen dioxide in healthy human subjects. *International Archives of Occupational and Environmental Health*, 89(6), pp.1017-1024.

Brauer, M., Freedman, G., Frostad, J., Van Donkelaar, A., Martin, R.V., Dentener, F., Dingenen, R.V., Estep, K., Amini, H., Apte, J.S. and Balakrishnan, K., 2015. Ambient air pollution exposure estimation for the global burden of disease 2013. *Environmental science & technology*, 50(1), pp.79-88.

Braunscheidel, K.M., Wayman, W.N., Okas, M.P. and Woodward, J.J., 2020. Self-Administration of Toluene Vapor in Rats. *Frontiers in Neuroscience*, *14*, p.880.

Breslin, G., Shannon, S., Ferguson, K., Devlin, S., Haughey, T. and Prentice, G., 2019. Predicting athlete mental health stigma using the theory of reasoned action framework. *Journal of Clinical Sport Psychology*, *13*(1), pp.103-115.

Bretón, J.G.C., Bretón, R.M.C., Ucan, F.V., Baeza, C.B., Fuentes, M.D.L.L.E., Lara, E.R., Marrón, M.R., Pacheco, J.A.M., Guzmán, A.R. and Chi, M.P.U., 2017. Characterization and Sources of Aromatic Hydrocarbons (BTEX) in the Atmosphere of Two Urban Sites Located in Yucatan Peninsula in Mexico. *Atmosphere,* 8(6), p.107.

Brijs, B., 2016. *Business analysis for business intelligence*. CRC Press.

Brockmeyer, S. and D'Angiulli, A., 2016. How air pollution alters brain development: the role of neuroinflammation. *Translational Neuroscience*, 7(1), pp.24-30.

Brogan, E., Duffield, C. and Denney-Wilson, E., 2020. Start healthy & stay healthy a workplace health promotion intervention for new graduate nurses: Study protocol. *Collegian*, *27*(5), pp.573-580.

Brown, A., Page, T.E., Daley, S., Farina, N., Basset, T., Livingston, G., Budgett, J., Gallaher, L., Feeney, Y., Murray, J. and Bowling, A., 2019. Measuring the quality of life of family

carers of people with dementia: development and validation of C-DEMQOL. *Quality of Life Research*, *28*(8), pp.2299-2310.

Brown, R.I. ed., 2021. *Quality of life for handicapped people*. Routledge. London.

Brucker, N., do Nascimento, S.N., Bernardini, L., Charão, M.F. and Garcia, S.C., 2020. Biomarkers of exposure, effect, and susceptibility in occupational exposure to traffic-related air pollution: A review. *Journal of Applied Toxicology,* 40(6), pp.722-736.

Bryman, A. and Bell, E., 2015.l *Business research methods*. Oxford university press. UK.

Bull, F.C., Al-Ansari, S.S., Biddle, S., Borodulin, K., Buman, M.P., Cardon, G., Carty, C., Chaput, J.P., Chastin, S., Chou, R. and Dempsey, P.C., 2020. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), pp.1451-1462.

Burger, J. and Gochfeld, M., 2016. Health Risks to Ecological Workers on Contaminated Sites-the Department of Energy as a Case Study. *Journal of Community Medicine & Health Education,* 6(3),pp.427.

BusinessDictionary, 2018. Pollutant. Available at:< http://www.businessdictionary.com/definition/pollutant.html> [Accessed 4 March 2018].

Byambasukh, O., Snieder, H. and Corpeleijn, E., 2020. Relation Between Leisure Time, Commuting, and Occupational Physical Activity with Blood Pressure in 125 402 Adults: The Lifelines Cohort. *Journal of the American Heart Association*, *9*(4), p.e014313.

Cakmak, S., Dales, R.E., Liu, L., Kauri, L.M., Lemieux, C.L., Hebbern, C. and Zhu, J., 2014. Residential exposure to volatile organic compounds and lung function: results from a population-based cross-sectional survey. *Environmental Pollution,* 194, pp.145-151.

Calderón-Garcidueñas, L., Leray, E., Heydarpour, P., Torres-Jardón, R. and Reis, J., 2016. Air pollution, a rising environmental risk factor for cognition, neuroinflammation and neurodegeneration: The clinical impact on children and beyond. *Revue Neurologique,* 172(1), pp.69-80.

Campo, L., Rossella, F., Mercadante, R. and Fustinoni, S., 2015. Exposure to BTEX and Ethers in Petrol Station Attendants and Proposal of Biological Exposure Equivalents for Urinary Benzene and MTBE. *Annals of Occupational Hygiene,* 60(3), pp.318-333.

Can, G., Sayılı, U., Sayman, Ö.A., Kuyumcu, Ö.F., Yılmaz, D., Esen, E., Yurtseven, E. and Erginöz, E., 2019. Mapping of carbon monoxide related death risk in Turkey: a ten-year analysis based on news agency records. *BMC Public Health*, *19*(1), p.9.

Caputo, J. and Simon, R.W., 2013. Physical limitation and emotional well-being: Gender and marital status variations. *Journal of Health and Social Behavior*, *54*(2), pp.241-257.

Carico, R., Sheppard, J. and Thomas, C.B., 2020. Community pharmacists and communication in the time of COVID-19: applying the health belief model. *Research in Social and Administrative Pharmacy*, 17(1), pp.1984-1987.

Caroli, E. and Godard, M., 2016. Does job insecurity deteriorate health?. *Health Economics*, *25*(2), pp.131-147.

Caruth, G.D., 2013. Demystifying Mixed Methods Research Design: A Review of the Literature. *Online Submission*, *3*(2), pp.112-122.

Carvalho A.L., de Lima Vazquez F., de Oliveira C.Z., 2018. The Role of Cross-Sectional and Cohort Studies in Oncology. In: Araújo R., Riechelmann R. (eds) Methods and Biostatistics in Oncology (pp. 125-146). Springer, Cham.

CBE, C.L.C., Biron, C. and Burke, R.J. eds., 2014. *Creating healthy workplaces: Stress reduction, improved well-being, and organizational effectiveness*. Grower Publishing, Ltd. England.

Centre for Disease Control and Prevention (CDC), 2018. Health-Related Quality of Life (HRQOL): Well-Being Concepts. [online] Available at < https://www.cdc.gov/hrqol/wellbeing.htm#three> [Accessed 11 February 2019].

Centre for Public Impact (CPI), 2017. Universal Basic Education in Nigeria. [online] Available at < https://www.centreforpublicimpact.org/case-study/universal-basic-education-nigeria> [Accessed 22 March 2021].

Centres for Disease Control and Prevention (CDC), 2014. Air Pollutants. [online] Available at:<https://www.cdc.gov/air/pollutants.htm> [Accessed 22 March 2021].

Centres for Disease Control and Prevention, (CDC), 2016. Other Uses and Types of water: Water Contamination. [online] Available at<https://www.cdc.gov/healthywater/other/agricultural/contamination.html> [Accessed 24 March 2021].

Centres for Disease Control and Prevention, 2021. Guidance for Reducing Health Risks to Workers Handling Human Waste or Sewage. National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Foodborne, Waterborne, and Environmental Diseases at CDC. [online]. [Accessed 22 March 2021].

Cezar-Vaz, M.R., Rocha, L.P., Bonow, C.A., Da Silva, M.R.S., Vaz, J.C. and Cardoso, L.S., 2012. Risk perception and occupational accidents: a study of gas station workers in Southern Brazil. *International Journal of Environmental Research and Public Health*, *9*(7), pp.2362-2377.

Chaboksavar, F., Azar, F.E.F., Solhi, M. and Azadi, N.A., 2020. Combination of self-management theory with PRECEDE–PROCEED model to promote life quality in patients with hypertension. *Journal of Public Health*, pp.1-10.

Chadar, S. and Keerti C., 2017. Solid Waste Pollution: A Hazard to Environment. *Recent Adv Petrochem Sci.* 2017; 2(3):555586.

Charan, J., and Biswas, T., 2013. How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian Journal of Psychological Medicine,* 35(2), 121–126. [Assessed 2nd April 2017].

Charkiewicz, A.E. and Backstrand, J.R., 2020. Lead Toxicity and Pollution in Poland. *International Journal of Environmental Research and Public Health*, *17*(12), p.4385.

Charles, S.T. and Leger, K.A., 2016. Age and Emotion. *Encyclopedia of Mental Health.* pp.29-32.

Charles, S.T., Piazza, J.R., Mogle, J.A., Urban, E.J., Sliwinski, M.J. and Almeida, D.M., 2016. Age differences in emotional well-being vary by temporal recall. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *71*(5), pp.798-807.

Charlesworth, S.M. and Booth, C.A. eds., 2019. *Urban Pollution: Science and Management*. John Wiley & Sons. UK

Chaudhry F.N. and Malik, M.F, 2017.Factors Affecting Water Pollution: A Review. *Journal Ecosyst Ecography*; 7(1). DOI: 10.4172/2157-7625.1000225

Chaudhuri, U.R., 2016. *Fundamentals of petroleum and petrochemical engineering*. Crc Press. New York.

Chavan, B. R., 2018. Analysis of Fashion Industry Business Environment. *Trends in Textile & Fash Design 2(4).*

Che Huei, L., Ya-Wen, L., Chiu Ming, Y., Li Chen, H., Jong Yi, W. and Ming Hung, L., 2020. Occupational health and safety hazards faced by healthcare professionals in Taiwan: A systematic review of risk factors and control strategies. *SAGE Open Medicine*, *8*, p.2050312120918999.

Chen, I.S. and Fellenz, M.R., 2020. Personal resources and personal demands for work engagement: Evidence from employees in the service industry. *International Journal of Hospitality Management*, *90*, p.102600.

Chen, J., 2020. Exploration & Production (E&P). Investopedia. Available at< <https://www.investopedia.com/terms/e/exploration-production-company.asp> [Accessed 15 June 2020].

Chen, J.C. and Samet, J.M., 2017. Air pollution and suicide risk: another adverse effect of air pollution? *European Journal of Epidemiology*, *32*(11), pp.943-946.

Chen, W., Zheng, Q., Liang, C., Xie, Y. and Gu, D., 2020. Factors Influencing College Students'Mental Health Promotion: The Mediating Effect of Online Mental Health Information Seeking. *International Journal of Environmental Research and Public Health*, *17*(13), p.4783.

Chen, X., O'Leary, S. and Johnston, V., 2018. Modifiable individual and work-related factors associated with neck pain in 740 office workers: a cross-sectional study. *Brazilian Journal of Physical Therapy*, *22*(4), pp.318-327.

Chen, X.W., Wong, J.T.F., Mo, W.Y., Man, Y.B., Ng, C.W.W. and Wong, M.H., 2016. Ecological Performance of the Restored Southeast New Territories (SENT) Landfill in Hong Kong (2000–2012). *Land Degradation & Development,* 27(6), pp.1664-1676.

Chen, Y., Zang, L., Chen, J., Xu, D., Yao, D. and Zhao, M., 2017. Characteristics of ambient ozone (O 3) pollution and health risks in Zhejiang Province. *Environmental Science and Pollution Research,* 24(35), pp.27436-27444.

Cheng, X., Fan, L. and Gu, W., 2019. *Comprehensive Practice of Exploration and Evaluation Techniques in Complex Reservoirs*. Springer. China.

Cheng, Y., Chen, Y., Jiang, Y., Jiang, L., Sun, L., Li, L. and Huang, J., 2016. Migration of BTEX and Biodegradation in Shallow Underground Water through Fuel Leak Simulation. *BioMed research international*, Article ID 7040872, http://dx.doi.org/10.1155/2016/7040872.

Chenhao, J. and Yupeng, X., 2021. Risk Analysis and Emergency Response to Marine Oil Spill Environmental Pollution. In *IOP Conference Series: Earth and Environmental Science* 687, (1) p. 012070.

Cherunilam, F., 2018. *Business Environment*. Himalaya Publishing House, Mumbai.

Cherunilam, F., 2020. *International business*. PHI Learning Pvt. Ltd, India.

Chibuike, G.U. and Obiora, S.C., 2014. Heavy metal polluted soils: effect on plants and bioremediation methods. *Applied and Environmental Soil Science*, Article ID 752708, pp. 1-12.

Chichirez, C.M. and Purcărea, V.L., 2018. Health marketing and behavioral change: a review of the literature. *Journal of medicine and life*, *11*(1), p.15.

Chin, W., Guo, Y.L., Liao, S., Wu, H., Kuo, C., Chen, C., and Shiao, S.J., 2018. Quality of life at 6 years after occupational injury. *Qual Life Res* 27, p. 609–618.

Chineke, H.I.N., Adogu, P.O.U., Egenti, N.B., Ezemenahi, B.E. and Egwuatu, C.C., 2016. Occupational hazards among workers in petroleum-allied industries in Nigeria: A case study. *Journal of Environmental Science, Toxicology and Food Technology,* 10(7), pp.72-76.

Cholakov, G.S., 2010. Control of pollution in the petroleum industry. *Pollution Control Technologies*, 3, pp.1-10.

Choudhury, S.P., Feng, Z., Gao, C., Ma, X., Zhan, J. and Jia, F., 2020. BN quantum dots decorated ZnO nanoplates sensor for enhanced detection of BTEX gases. *Journal of Alloys and Compounds*, *815*, p.152376.

Chowdhury, M.F., 2014. Interpretivism in aiding our understanding of the contemporary social world. *Open Journal of Philosophy*, *4*(03), p.432.

Choy, L.T., 2014. The strengths and weaknesses of research methodology: Comparison and complimentary between qualitative and quantitative approaches. *IOSR Journal of Humanities and Social Science*, *19*(4), pp.99-104.

Clark, S.N., Alli, A.S., Brauer, M., Ezzati, M., Baumgartner, J., Toledano, M.B., Hughes, A.F., Nimo, J., Moses, J.B., Terkpertey, S. and Vallarino, J., 2020. Protocol: High-resolution spatiotemporal measurement of air and environmental noise pollution in Sub-Saharan African cities: Pathways to Equitable Health Cities Study protocol for Accra, Ghana. *BMJ Open*, *10*(8), e035798.

Clausen, T., Madsen, I.E., Christensen, K.B., Bjorner, J.B., Poulsen, O.M., Maltesen, T., Borg, V. and Rugulies, R., 2019. The Danish psychosocial work environment questionnaire (DPQ): development, content, reliability, and validity. *Scandinavian Journal of Work, Environment & Health*, *45*(4), pp.356-369.

Cohen, A.J., Brauer, M., Burnett, R., Anderson, H.R., Frostad, J., Estep, K., Balakrishnan, K., Brunekreef, B., Dandona, L., Dandona, R. and Feigin, V., 2017. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: an analysis of data from the Global Burden of Diseases Study 2015. *The Lancet,* 389(10082), pp.1907-1918

Cohen, L, Manion, L, and Morrison, K., 2017. *Research Methods in Education*. Routledge, London. Available from: ProQuest Ebook Central. [Accessed 28 August 2019].

Cohen, L., Manion, L. and Morrison, K., 2018. *Research methods in education.8ᵗʰ ed.* Taylor & Francis Ltd. England.

Coker, A.K., 2018. *Petroleum Refining Design and Applications Handbook.* John Wiley & Sons. USA.

Colenberg, S., Jylhä, T. and Arkesteijn, M., 2021. The relationship between interior office space and employee health and well-being–a literature review. *Building Research & Information*, *49*(3), pp.352-366.

Colillas-Malet, E., Prat, G., Espelt, A. and Juvinyà, D., 2020. Gender differences in health-related quality of life in people with severe mental illness. *PloS One*, *15*(2), p.e0229236.

College of Occupational Therapists, 2010. Working for health: occupational therapy and how it can benefit your organisation.[online] Available at<*www.cot.org.uk*> [Accessed 12 August 2019].

Collins, C.S. and Stockton, C.M., 2018. The central role of theory in qualitative research. *International Journal of Qualitative Methods*, *17*(1), p.1609406918797475.

Compound Interest, 2016. The chemistry of petrol & diesel. [online] Available at www.compoundchem.com > [Accessed 1 March 2019].

Cooklin, A., Joss, N., Husser, E. and Oldenburg, B., 2017. Integrated approaches to occupational health and safety: A systematic review. *American Journal of Health Promotion*, *31*(5), pp.401-412.

Cooper, C.L. and Leiter, M.P. eds., 2017. *The Routledge companion to wellbeing at work.* Taylor & Francis. New York

Copes, M.S., Kopp, A. R., and Chen, H., 2020. Association between road traffic noise and incidence of diabetes mellitus and hypertension in Toronto, Canada: a population-based cohort study. *Journal of the American Heart Association*, *9*(6), p.e013021.

Cox, V., Mann, L., Blotnicky, K. and Rossiter, M., 2017. University Students' Eating Behaviors: Implications for the Social Cognitive Theory. *International Journal of Health Sciences,* 5(4), pp. 25-37.

Creswell, J. W., 2012. *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson Education, Inc.

Creswell, J.W. and Hirose, M., 2019. Mixed methods and survey research in family medicine and community health. *Family Medicine and Community Health*, *7*(2), e000086.

Creswell, J.W. and Poth, C.N., 2017. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications UK.

Creswell, J.W., 2011. Controversies in mixed methods research. *The Sage handbook of qualitative research*, *4*, pp.269-284.SAGE publication, UK.

Creswell, J.W., 2014. Chapter One: The selection of a research approach. In: Creswell, J.W. *Research design: qualitative, quantitative, and mixed methods approach*, Pp.3-23. SAGE publication. UK

Creswell, J.W., Klassen, A.C., Plano Clark, V.L. and Smith, K.C., 2011. Best practices for mixed methods research in the health sciences. *Bethesda (Maryland): National Institutes of Health*, *2013*, pp.541-545.

Cross, F.B. and Miller, R.L., 2016. *The legal environment of business: Text and cases*. Cengage Learning.UK

Cross, F.B. and Miller, R.L., 2020. *The legal environment of business: Text and cases* (11th ed.). Cengage Learning.USA

Cruz, P. S. L., Alves, Akácia, P. L., Santos, S. V., Esteves,B.M., Gomes, V.S.I. and Nunes, S. S. L., 2017. Assessment of BTEX Concentrations in Air Ambient of Gas Stations Using Passive Sampling and the Health Risks for Workers. *Journal of Environmental Protection*, 8, p. 12-25

Da Costa, P.R.F., da Silva, D.R., Martínez-Huitle, C.A. and Garcia-Segura, S., 2016. Fuel station effluent treatment by electrochemical technology. *Journal of Electroanalytical Chemistry*, 763, pp.97-103.

Dabiran, S., Khajehnasiri, F., Varzdar, F. and Beheshti, M.H., 2018. Assessment of Quality of Life of the Teachers in Girlâ s High School Compared to General Population in Iran. *Annals of Medical and Health Sciences Research*, *8*(3), pp. 170-173.

Dadgarmoghaddam, M., Khajedaluee, M. and Khadem-Rezaiyan, M., 2016. A Population-based Study into Knowledge, Attitudes and Beliefs (KAB) about HIV/AIDS. *Razavi International Journal of Medicine*, *4*(1), p.e34349.

Dai, H., Ma, D., Zhu, R., Sun, B. and He, J., 2019. Impact of Control Measures on Nitrogen Oxides, Sulfur Dioxide and Particulate Matter Emissions from Coal-Fired Power Plants in Anhui Province, China. *Atmosphere*, *10*(1), p.35.

Dalvi, S., 2015. *Fundamentals of Oil & Gas Industry for Beginners*. Notion Press. Chennai

Daly, A., Grove, S.J., Dorsch, M.J. and Fisk, R.P., 2009. The impact of improvisation training on service employees in a European airline: a case study. *European Journal of Marketing*, *43*(3/4), pp.459-472.

Daniel, B., 2018. Reimaging research methodology as data science. *Big Data and Cognitive Computing*, *2*(1), p.4.

Daniel, B.K., 2018a. Contestable professional academic identity of those who teach research methodology. *International Journal of Research & Method in Education*, *41*(5), pp.548-561.

Darnell, J. and Wolstencroft, P., 2018. The best of both worlds: pragmatism, personality, investigator greed, self-identity and the multi-skills set in the choice of mixed methods.[pdf]

Darvishmotevali, M. and Ali, F., 2020. Job insecurity, subjective well-being and job performance: The moderating role of psychological capital. *International Journal of Hospitality Management*, *87*, p.102462.

Darwish, M.M.M., Zayet, H.H., Alhaj, M.S. and Elghazally, S.A., 2020. HealtH Hazards and some Correlates among oil refinery Workers. *Egyptian Journal of Occupational Medicine*, *43*(3), pp.761-776.

Dauda, A. and Ismaila, M.Y., 2013. Influence of technological environmental factors on the strategic choice of quoted manufacturing firms in Nigeria's food and beverage industry. *International Journal of Business, Humanities and Technology*, *3*(8), pp.159-169.

Dave, V.R., Khanpara, H.J., Shukla, R.P., Sonaliya, K.N., Tolani, J. and Patel, R., 2019. Risk factors of occupation related back pain and neck pain among patients attending tertiary care hospital, Ahmedabad, India. *Journal of Preventive Medicine and Hygiene*, *60*(4), p.E419.

Davey, A.J., Bailey, L., Bewes, V., Mubaiwa, A., Hall, J., Burgess, C., Dunbar, M.J., Smith, P.D. and Rambohul, J., 2020. Water quality benefits from an advice-led approach to reducing water pollution from agriculture in England. *Agriculture, Ecosystems & Environment*, *296*, p.106925.

Davoodi, S., Haghighi, K.S., Kalhori, S.R.N., Hosseini, N.S., Mohammadzadeh, Z. and Safdari, R., 2017. Occupational Disease Registries–Characteristics and Experiences. *Acta Informatica Medica*, *25*(2), p.136.

Dawoud, D.M., El-Dahiyat, F., Abojedi, A., Dawoud, N., Soliman, A.M., Hussein, M., Mohamed, O., Hasan, S.S. and Kharroubi, S.A., 2020. Translation, cultural adaptation and psychometric validation of the SF-6D measure of health-related quality of life for use in Arabic-Speaking countries. *Research in Social and Administrative Pharmacy* 16(12), pp.1754-1759.

Day, A. and Nielsen, K., 2017. What Does Our Organization Do 16 to Help Our Well-Being? Creating Healthy Workplaces and Workers. *An introduction to work and organizational psychology: An international Perspective,* p.295. John Wiley & Sons, UK.

De Deus Honório, T.C., de Oliveira Neto, J.R., Oliveira, F.N.M., Salazar, V.C.R., de Carvalho Cruz, A. and da Cunha, L.C., 2020. Occupational Exposure Evaluation of Brazil University Community to the Volatile Organic Compounds. *Journal of Pharmaceutical and Biomedical Analysis*, 191, p.113637.

De Jesus, A.L., Rahman, M.M., Mazaheri, M., Thompson, H., Knibbs, L.D., Jeong, C., Evans, G., Nei, W., Ding, A., Qiao, L. and Li, L., 2019. Ultrafine particles and PM2. 5 in the air of cities around the world: Are they representative of each other?. *Environment International*, *129*, pp.118-135.

De Lisle, J., 2011. The benefits and challenges of mixing methods and methodologies: Lessons learnt from implementing qualitatively led mixed methods research designs in Trinidad and Tobago. *Caribbean Curriculum,* 18, pp.87-120.

Dehghani, M.H., Sanaei, D., Nabizadeh, R., Nazmara, S. and Kumar, P., 2017. Source apportionment of BTEX compounds in Tehran, Iran using UNMIX receptor model. *Air Quality, Atmosphere & Health,* 10(2), pp.225-234.

Deirmentzoglou, G.A., Agoraki, K.K., Fousteris, A.E. and Pekka-Economou, V., 2020. The Impact of Cultural Values on Corporate Sustainable Development Practices. *International Journal of Innovation and Research in Educational Sciences*, 7(2), pp.92-107.

Demetillo, M.A.G., Navarro, A., Knowles, K.K., Fields, K.P., Geddes, J.A., Nowlan, C.R., Janz, S.J., Judd, L.M., Al-Saadi, J., Sun, K. and McDonald, B.C., 2020. Observing Nitrogen Dioxide Air Pollution Inequality Using High-Spatial-Resolution Remote Sensing Measurements in Houston, Texas. *Environmental Science & Technology*, 54(16), pp.9882-9895.

Deng, S.Z., Jalaludin, B.B., Antó, J.M., Hess, J.J. and Huang, C.R., 2020. Climate change, air pollution, and allergic respiratory diseases: a call to action for health professionals. *Chinese Medical Journal*, *133*(13), p.1552.

Department for Environment Food and Rural Affairs (DEFRA), 2016. Air Pollution in the UK 2015.[pdf].

Department for Environment Food and Rural Affairs (DEFRA), 2017. Air Pollution in the UK 2016. Available at:< https://uk-air.defra.gov.uk/assets/documents/annualreport/air_pollution_uk_2016_issue_1.pdf > [Accessed 25 April 2021]

Department of Ecology, 2016. Focus on Environmental Harm from Oil Spills. Available at: <https://fortress.wa.gov/ecy/publications/documents/1008001.pdf> [Accessed 3 April 2021]

Department of Petroleum Resources (DPR), 2017. 2017 Nigerian Oil and Gas Industry Annual Report. [pdf] Available at < https://www.dpr.gov.ng/wp-content/uploads/2018/10/2017-NOGIAR-WEB.pdf.> [Accessed 3 April 2021]

Department of petroleum Resources (DPR), 2018. DPR guidelines for approval to construct and operate petroleum products filling station. [pdf] < https://www.dpr.gov.ng/wp-content/uploads/2018/08/FILLING-STATION-GUIDELINES.pdf>[Accessed 25 May 2020]

Derakhshan-Nejad, A., Rangkooy, H.A., Cheraghi, M. and Yengejeh, R.J., 2020. Removal of ethyl benzene vapor pollutant from the air using TiO 2 nanoparticles immobilized on the ZSM-5 zeolite under UVradiation in lab scale. *Journal of Environmental Health Science and Engineering*, 18(1), pp.201-209.

Der-Martirosian, C., Kritz-Silverstein, D. and Barrett-Connor, E., 2010. Five-year stability in associations of health-related quality of life measures in community-dwelling older adults: the Rancho Bernardo Study. *Quality of Life Research*, *19*(9), pp.1333-1341.

Desikan, A., 2017. Outdoor air pollution as a possible modifiable risk factor to reduce mortality in post-stroke population. *Neural Regeneration Research,* 12(3), p.351.

Dewi Navisa, F., Winarno, B. and Hamidah, S., 2019. Political Risks Faced by Investors of Direct Investment. *International Journal of Civil Engineering and Technology,* 10(7), pp. 333-342.

Dhanapati Subedi, 2016. "Explanatory Sequential Mixed Method Design as the Third Research Community of Knowledge Claim." *American Journal of Educational Research*, 4(7), pp.570-577. doi: 10.12691/education-4-7-10.

Dieronitou, I., 2014. The ontological and epistemological foundations of qualitative and quantitative approaches to research. *International Journal of Economics, Commerce and Management*, *2*(10), pp.1-17.

Ding D. (2013) *Ecological Models: Application to Physical Activity*. In: Gellman M.D., Turner J.R. (eds) *Encyclopedia of Behavioral Medicine.* Springer, New York, NY. https://doi.org/10.1007/978-1-4419-1005-9_1125

Diugwu I. A., Baba D. L., and Egila A. E.,2012 Effective Regulation and Level of Awareness: An Exposé of the Nigeria's Construction Industry.[pdf] *Journal of Safety Science and Technology*, (2), pp. 140-146. doi:http://dx.doi.org/10.1016/j.jbusres.2012.04.013

Diwe, K.C., Duru, C.B., Iwu, A.C., Merenu, I.A., Uwakwe, K.A., Oluoha, U.R., Ogunniyan, T.B., Madubueze, U.C. and Ohale, I., 2016. Occupational hazards, safety and hygienic practices among timber workers in a South Eastern State, Nigeria. *Occupational Diseases and Environmental Medicine,* 4(3), pp.63-71.

Dobaradaran, S., Schmidt, T.C., Kaziur-Cegla, W. and Jochmann, M.A., 2021. BTEX compounds leachates from cigarette butts into water environment: A primary study. *Environmental Pollution*, *269*, p.116185.

Dolson, J., 2016. *Understanding oil and gas shows and seals in the search for hydrocarbons*. Springer Cham. Switzerland.

Dong, F., Wang, Y., Zheng, L., Li, J. and Xie, S., 2020. Can industrial agglomeration promote pollution agglomeration? Evidence from China. *Journal of Cleaner Production*, *246*, p.118960.

Doris, S.F., Yan, E.C. and Chow, C.K., 2015. Interpreting SF-12 mental component score: an investigation of its convergent validity with CESD-10. *Quality of Life Research*, *24*(9), pp.2209-2217.

DrugBank, 2016. Toluene.[online] Available at:< https://www.drugbank.ca/drugs/DB11558> [Accessed 26 April 2018].

Dubrovski, D., 2020. Developmental and Technological Restructuring for the Implementation of Competitive Business Models. *Management*, *20*, p.22.

Durokifa, A.A. and Abdul-Wasi, B.M., 2016. Evaluating Nigeria's achievement of the millennium development goals (MDGs): Determinants, deliverables, and shortfalls. *Africa's Public Service Delivery & Performance Review*, 4(4), pp.656-683.

Duryan, M., Smyth, H., Roberts, A., Rowlinson, S. and Sherratt, F., 2020. Knowledge transfer for occupational health and safety: cultivating health and safety learning culture in construction firms. *Accident Analysis & Prevention*, *139*, p.105496.

Dutta, A., Khramstova, G., Brito, K., Alexander, D., Mueller, A., Chinthala, S., Adu, D., Ibigbami, T., Olamijulo, J., Odetunde, A. and Adigun, K., 2018. Household air pollution and chronic hypoxia in the placenta of pregnant Nigerian women: A randomized controlled ethanol Cookstove intervention. *Science of the Total Environment,* 619, pp.212-220.

Echarte, M.E.P., Rodríguez, R.M. and López, O.D., 2019. *Non-seismic and Non-conventional Exploration Methods for Oil and Gas in Cuba*. Springer Cham, Switzerland.

Edokpayi, J.N., Odiyo, J.O. and Durowoju, O.S., 2017. Impact of Wastewater on Surface Water Quality in Developing Countries: A Case Study of South Africa. In Water Quality. [Pdf] Available at:< https://cdn.intechopen.com/pdfs-wm/53194.pdf.> [Accessed 7 October 2018].

Ehinomen, C. and Adeleke, A., 2012. An assessment of the distribution of petroleum products in Nigeria. *Journal of Business Management and Economics*, *3*(6), pp.232-241.

Ejiba, I.V., Onya, S.C. and Adams, O.K., 2016. Impact of Oil Pollution on Livelihood: Evidence from the Niger Delta Region of Nigeria. *Journal of Scientific Research and Reports*, 12(5), pp.1-12.

Ejiogu, A.R., 2013. A nuclear Nigeria: How feasible is it?. *Energy Strategy Reviews,* 1(4), pp.261-265.

Ejlertsson, L., Heijbel, B., Ejlertsson, G. and Andersson, I., 2018. Recovery, work-life balance and work experiences important to self-rated health: A questionnaire study on salutogenic work factors among Swedish primary health care employees. *Work,* 59(1), pp.155-163.

Ekong, A.E., Ezeokoro, C., Nwaichi, E.O. and Obele, R.E., 2020. Occupational Health and Safety Management in Selected Stone Quarries in Akamkpa, Cross River State, Nigeria. *Current Journal of Applied Science and Technology*, 39(34), pp.107-122.

El Bab, A.F. and Jauregui, L.,2015. High Performance Carbon Monoxide Gas Sensor based on Graphene. *International Journal of Engineering Research & Technology (IJERT)*4(6).

Elbashir, N.O., El-Halwagi, M.M., Economou, I.G. and Hall, K.R. eds., 2019. *Natural Gas Processing from Midstream to Downstream*. John Wiley & Sons. USA

El-Gendy, N.S. and Nassar, H.M.N., 2018. *Biodesulfurization in Petroleum Refining*. John Wiley & Sons. USA

Eludoyin, O.M. and Adelekan, I.O., 2013. The physiologic climate of Nigeria. *International Journal of Biometeorology*, 57(2), pp.241-264.

Emmanuel, I.F. and Olaniran, S.O., 2020. Federalism and Sustainable Development in Nigeria. *African Renaissance (1744-2532)*, *17*(3).

Emmanuel, Y., 2017. Influence of entrepreneurship education, technology and globalisation on performance of SMEs in Nigeria. *African Journal of Business Management,* 11(15), pp.367-374.

Emokpae, M.A., Oyakhire, F.O. and Kolawole, J.J., 2020. Awareness of health hazards and use of personal protective equipment among fuel pump attendants in Benin City, Nigeria. *Nigerian Journal of Experimental and Clinical Biosciences,* 8(2), p.128.

Encyclopaedia Britannica, 2019. Ilorin. *Encyclopaedia Britannica, inc /* Available at:< https://www.britannica.com/place/Ilorin/> [Accessed 29 August 2018].

Engberg, I., Segerstedt, J., Waller, G., Wennberg, P. and Eliasson, M., 2017. Fatigue in the general population-associations to age, sex, socioeconomic status, physical activity, sitting time and self-rated health: the northern Sweden MONICA study 2014. *BMC Public Health*, *17*(1), pp.1-9.

Environmental Pollution Centres (EPC), 2017. Soil.[online] Available at< https://www.environmentalpollutioncenters.org/soil/> [Accessed 9 July 2018].

Environmental Protection Agency (EPA), 2017.Criteria Air Pollutants.[online] Available at:<https://www.epa.gov/criteria-air-pollutants>. [Accessed 9 July 2018].

Environmental Protection Agency, 2016a. Indoor Air Quality (IAQ): Carbon Monoxide's Impact on Indoor Air Quality. [online] Available at< https://19january2017snapshot.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality_.html>[Accessed 9 July 2018].

Environmental Protection Agency, 2016b. Xylenes (A) (Mixed Isomers). [online] Available at<https://www.epa.gov/sites/production/files/2016-09/documents/xylenes.pdf> [Accessed 9 July 2018].

Eom, S.Y., Choi, J., Bae, S., Lim, J.A., Kim, G.B., Yu, S.D., Kim, Y., Lim, H.S., Son, B.S., Paek, D. and Kim, Y.D., 2018. Health effects of environmental pollution in population living near industrial complex areas in Korea. *Environmental Health and Toxicology*, *33*(1), e2018004.

Esterhuyzen, E., & Louw, L. B., 2019. Small business success: Identifying safety hazards and safety risks. *Jamba (Potchefstroom, South Africa)*, *11*(1), pp. 767.

Etikan, I. and Bala, K., 2017. Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, *5*(6), p.00149.

Etikan, I., Musa, S.A. and Alkassim, R.S., 2016. Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), pp.1-4.

Europa Technologies Ltd, 2019. Map of Ilorin, Nigeria. Available at:<Europa.uk.com < https://www.europa.uk.com/global-1000-atlas/global-1000-atlas-map/?pid=106642> [Accessed 25 October 2018].

European Agency for Safety and Health at Work, 2013. Well-being at work: creating a positive work environment. [pdf] Available at< https://osha.europa.eu/en/publications/well-being-work-creating-positive-work-environment> [Accessed 17 June 2020].

European Chemical Agency (ECHA), 2017. Proposal by the European Chemical Agency (ECHA) in support of occupational exposure limit values for benzene in the workplace.

European Environment Agency (EEA), 2016. Introductory to Risk Assessment Concepts. [online] Available at:< https://www.eea.europa.eu/publications/GH-07-97-595-EN-C2/chapter1h.html>[Accessed 17 June 2020].

European Environment Agency (EEA), 2020. Environmental noise in Europe — 2020. [pdf] Luxembourg.

European Environmental Agency, 2017. Diffuse sources. [online] Available at:<https://www.eea.europa.eu/themes/water/water-pollution/diffuse-sources> [Accessed 10 July 2018].

European Petroleum Refiners Association, 2016. Concawe report: Review of recent health effect studies with sulphur dioxide. [pdf] Available at:<https://www.concawe.eu/wp-content/uploads/2017/01/rpt-16-4.pdf>[Accessed 10 July 2018].

Evaluating the association between artificial light-at-night exposure and breast and prostate cancer risk in Spain (MCC-Spain study). *Environmental Health Perspectives*, *126*(4), p.047011.

Ezeagba, C., 2017. Financial reporting in small and medium enterprises (SMEs) in Nigeria. Challenges and options. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *7*(1), pp.1-10.

Fajana, S., 2005. Industrial relations in the oil industry in Nigeria. International Labour Organisation. [pdf] Available at< https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_161189.pdf> [Accessed 18 September 2020].

Fakinle, B.S., Adesanmi, A.J., Olalekan, A.P., Alagbe, A.A., Odekanle, E.L. and Sonibare, J.A., 2017. Changes in evaporative emissions from gasoline in the Nigeria market. *Petroleum Science and Technology*, *35*(10), pp.1040-1046.

Fakunle, E., 2013. Building Biobanks for Africa. Available at <https://parentsguidecordblood.org/en/news/building-biobanks-africa> [Accessed 27 March 2021]

Falchi, F., Furgoni, R., Gallaway, T.A., Rybnikova, N.A., Portnov, B.A., Baugh, K., Cinzano, P. and Elvidge, C.D., 2019. Light pollution in USA and Europe: The good, the bad and the ugly. *Journal of Environmental Management*, *248*, p.109227.

Fallon, C.K. and Karlawish, J., 2019. Is the WHO definition of health aging well? Frameworks for "Health" after three score and ten. *American Journal of Public Health*, 109(8), pp.1104-1106.

Fanchi, R. J and Christiansen, L. R., 2016. *Introduction to Petroleum Engineering.* John Wiley & Sons. New Jersey.

Fandi, N.F.M., Jalaludin, J., Latif, M.T., Abd Hamid, H.H. and Awang, M.F., 2020. BTEX Exposure Assessment and Inhalation Health Risks to Traffic Policemen in the Klang Valley Region, Malaysia. *Aerosol and Air Quality Research*, *20*, pp.1922-1937.

Fang, S.C., Cassidy, A. and Christiani, D.C., 2010. A systematic review of occupational exposure to particulate matter and cardiovascular disease. *International Journal of Environmental Research and Public Health,* 7(4), pp.1773-1806.

Faraji, A., Nabibidhendi, G. and Pardakhti, A., 2017. Risk assessment of exposure to released BTEX in district 12 of Tehran municipality for employees or shopkeepers and gas station customers. *Pollution,* 3(3), pp.407-415.

Farisni, T.N., Syahputri, V.N., Lestary, L.A. and Helmyati, S., 2020. Implementing Precede-Proceed Model toward the Mothers Perception on the Importance of Feeding of Home-Made

Complementary Food to Wasting and Stunting Toddlers. *Current Research in Nutrition and Food Science Journal*, *8*(2), pp.489-495.

Farmani, Z. and Schrader, W., 2019. A Detailed Look at the Saturate Fractions of Different Crude Oils Using Direct Analysis by Ultrahigh Resolution Mass Spectrometry (UHRMS). *Energies*, *12*(18), p.3455.

Fatai, A., 2011. Small and medium scale enterprises in Nigeria: The problems and prospects. *International Journal of Economic Development Research and Investment*, *2*(5), pp.102-125.

Fatima, S., Muzammal, M., Rehman, A., Rustam, S.A., Shehzadi, Z., Mehmood, A. and Waqar, M., 2020. Water pollution on heavy metals and its effects on fishes. *International Journal of Fisheries and Aquatic Studies*, *8*(3), pp.6-14.

Fayers, P. M., & Machin, D. (2016). *Quality of life: the assess- ment, analysis and reporting of patient-reported outcomes* (3rd ed.). Hoboken, NJ: Wiley Blackwell.

Fayomi, O.S.I., Okokpujie, I.P. and Udo, M., 2018, September. The role of research in attaining sustainable development goals. *In IOP Conference Series: Materials Science and Engineering*, 413 (1) p. 012002.

Fehér, J. and Reich, M. 2020. "Perceived impacts of company Workplace Health Promotion on employment relationship", *Journal of Eastern European and Central Asian Research,* 7 (3), pp. 238-254.

Feliz, S. and Maggi, C., 2019. *What is the Impact of Increased Business Competition?* [Ebook].International Monetary Fund.

Ferrer, R., & Klein, W. M.,2015. Risk perceptions and health behavior. *Current Opinion in Psychology*, *5*, 85–89.

Fesharaki, F. and Isaak, D.T., 2016. *OPEC, the Gulf, and the World Petroleum Market (Routledge Revivals): A Study in Government Policy and Downstream Operations*. Routledge. New York.

Fetters, M.D., Curry, L.A. and Creswell, J.W., 2013. Achieving integration in mixed methods designs—principles and practices. *Health Services Research*, *48*(6pt2), pp.2134-2156.

Fink, J.K., 2016. *Guide to the practical use of chemicals in refineries and pipelines*. Gulf Professional Publishing.UK.

Flick, U., 2014. An introduction to qualitative research. 5th ed SAGE Publications: London

Flick, U., 2018. *An introduction to qualitative research*. 6th ed Sage Publications Limited. London

Fobbe, L., 2020. Analysing Organisational Collaboration Practices for Sustainability. *Sustainability*, *12*(6), p.2466.

Food and Agriculture organisation (FAO), 2021. FAOLEX Database. Available at< http://www.fao.org/faolex/results/details/en/c/LEX-FAOC120671/#:~:text=Nuclear%20Safety%20and%20Radiation%20Protection,emitting%20 and%20generating%20ionising%20radiation> [Accessed 25 March 2021]

Forlani, C., Bhatt, S., Cameletti, M., Krainski, E. and Blangiardo, M., 2020. A joint Bayesian space–time model to integrate spatially misaligned air pollution data in R-INLA. *Environmetrics*, p.e2644.

Fotourehchi, Z., 2016. Health effects of air pollution: An empirical analysis for developing countries. *Atmospheric Pollution Research, 7*(1), pp.201-206.

Francová, A., Chrastný, V., Šillerová, H., Vítková, M., Kocourková, J. and Komárek, M., 2017. Evaluating the suitability of different environmental samples for tracing atmospheric pollution in industrial areas. *Environmental Pollution, 220*, pp.286-297.

Friedrich, T., Schlauderer, S., Weidinger, J. and Raab, M., 2017. On the Research Paradigms and Research Methods Employed in the BISE Journal-A Ten-Year Update. *13th International Conference on Wirtschaftsinformatik Proceeding*, pp. 1111-1125.

Friend, M. and Kohn, J. P., 2018. fundamentals of occupational safety and health. The Rowan & Littlefield Publishing Group. USA.

Friman, M., Huck, J. and Olsson, L.E., 2017. Transtheoretical model of change during travel behavior interventions: An integrative review. *International Journal of Environmental Research and Public Health*, *14*(6), p.581.

Fu, S.N., Dao, M.C., Wong, C.K.H. and Yu, W.C., 2019. SF-6D utility scores of smokers and ex-smokers with or without respiratory symptoms attending primary care clinics. *Health and Quality of Life Outcomes*, *17*(1), p.48.

Furman, K.C., El-Bakry, A.S. & Song, J., 2017. Optimization in the oil and gas industry. *Optim Eng* 18, p.1–2.

Gaikwad, P.A., Gawand, A.A. and Naik, R., 2020. Assessment of Lung Function, Exercise Capacity and Quality of Life in Petrol Pump Workers. *International Journal of Health Sciences and Research* 10(9), pp.55-62.

Gale, N.K., Heath, G., Cameron, E., Rashid, S. and Redwood, S., 2013. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC medical research methodology*, *13*(1), pp.1-8.

Galea, S., Ettman, C.K. and Vlahov, D. eds. 2019. *Urban Health*. Oxford University Press. UK.

Galindo-Reyes, J.G. and Alegria, H., 2018. Toxic effects of exposure to pesticides in farm workers in Navolato, Sinaloa (Mexico). *Revista internacional de contaminación ambiental,* 34(3), pp.505-516.

Gallon, K., 2016. A Look at the Midstream Energy Value Chain. Market Realist. [online] Available at:*<https://marketrealist.com/2016/11/look-midstream-energy-value-chain/>* [Accessed 15 June 2020].

Gana, A. J., and. Peter, A.T., 2015. Environmental Pollution and Sustainability. *Journal of Research in Environmental Science and Toxicology* (ISSN: 2315-5698),4(1) pp.1-9.

Gangadhar, S. Z., 2014. Environmental Impact Assessment on Soil Pollution Issue about Human Health. *International Research Journal of Environment Sciences,* 3(11), p.78-81

Garcia, M.L., Gatdula, N., Bonilla, E., Frank, G.C., Bird, M., Rascón, M.S. and Rios-Ellis, B., 2019. Engaging Intergenerational Hispanics/Latinos to Examine Factors Influencing Childhood Obesity Using the PRECEDE–PROCEED Model. *Maternal and Child Health Journal*, *23*(6), pp.802-810.

Garcia-Saenz, A., Sánchez de Miguel, A., Espinosa, A., Valentin, A., Aragonés, N., Llorca, J., Amiano, P., Martín Sánchez, V., Guevara, M., Capelo, R. and Tardón, A., 2018. Evaluating the association between artificial light-at-night exposure and breast and prostate cancer risk in Spain (MCC-Spain study). *Environmental Health Perspectives*, 126(4), p.047011.

Garratt, A.M. and Stavem, K., 2017. Measurement properties and normative data for the Norwegian SF-36: results from a general population survey. *Health and Quality of Life Outcomes*, *15*(1), p.51.

Gauffin, K. and Dunlavy, A., 2019. Finding common ground: how the development of theory in public health research can bring us together. *Social Theory & Health*, pp.1-10.

GBD 2016 Occupational Risk Factors Collaborators, 2020. Global and regional burden of disease and injury in 2016 arising from occupational exposures: a systematic analysis for the global burden of disease study 2016. *Occupational and Environmental Medicine*, *77*(3), pp.133-141.

Gebremedhin, T., Workicho, A. and Angaw, D.A., 2019. Health-related quality of life and its associated factors among adult patients with type II diabetes attending Mizan Tepi University Teaching Hospital, Southwest Ethiopia. *BMJ Open Diabetes Research and Care*, *7*(1), p.e000577.

Gentles, S.J., Charles, C., Nicholas, D.B., Ploeg, J. and McKibbon, K.A., 2016. Reviewing the research methods literature: principles and strategies illustrated by a systematic overview of sampling in qualitative research. *Systematic Reviews*, *5*(1), p.172.

Gershon, O. and Asaolu, K., 2020. Evaporative quality of Nigeria's gasoline: truck loading perspective. *Energy, Ecology and Environment*, pp.1-9.

Ghaderi, M., Naderloo, L., Javadikia, H., Mostafaei, M. and Rabbani, H., 2019. Different blends of biodiesel, bioethanol, diesel and noise pollution emitted by stationary and moving MF285 tractor. *Journal of Environmental Health Science and Engineering*, *17*(2), pp.743-752.

Ghaffari, M., Rakhshanderou, S., Asadpour, M., Nasirzadeh, M. and Mazar, L., 2021. Design, implementation, and evaluation of a PRECEDE-PROCEED model-based

intervention for oral and dental health among primary school students of Rafsanjan city: a mixed method study. *BMC Public Health,* 21(1), pp.1-10.

Ghorani-Azam, A., Riahi-Zanjani, B. and Balali-Mood, M., 2016. Effects of air pollution on human health and practical measures for prevention in Iran. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*, 21 (65), pp.1-12.

Ghoreishi, M.S., Vahedian-shahroodi, M., Jafari, A. and Tehranid, H., 2019. Self-care behaviors in patients with type 2 diabetes: Education intervention base on social cognitive theory. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(3), pp.2049-2056.

Gilbert, J. R and Gilbert, T. P., 2019. *Maryland Tort Law.* (third editions). LexisNexis.UK

Gładka, A., Rymaszewska, J. and Zatoński, T., 2018. Impact of air pollution on depression and suicide. *Int J Occup Med Environ Health*, *31*(6), pp.711-721.

Glanz, K., Rimer, B.K. and Viswanath, K. eds., 2015. *Health behavior: Theory, research, and practice*.4th ed. John Wiley & Sons. San Fracisco

Global Centre for Healthy Workplace, 2017. Healthy Workplaces – A Selection of Global Good Practices. 5th Global Healthy Workpalce Awards & Summit, Singapore 2017. [pdf] Available at:<https://www.globalhealthyworkplace.org/documents/NGO-Advancing-Duty-of-Care-Healthy-Workplaces.pdf> [Accessed 12 June 2020].

Godfrey, N.O. and Oritsematosan, O., 2015. Deregulation of the downstream sector of the Nigerian petroleum industry: The role of leadership. *European Journal of Business and Management,* 7(8), pp.2222-2839.

Goertzen, M.J., 2017. *Applying quantitative methods to e-book collections*. ALA TechSource.

Golden, S.D., McLeroy, K.R., Green, L.W., Earp, J.A.L. and Lieberman, L.D., 2015. Upending the social ecological model to guide health promotion efforts toward policy and environmental change. *Health Education & Behavior,* 42(1_suppl), pp.8S-14S.

Gomaa, S and El-hoshoudy A.N., 2018. New Correlation Predicting Molecular Weight of Petroleum Fractions. *Petroleum & Petrochemical Engineering Journal* 2(1), pp.000139.

Goodarzi, A., Heidarnia, A., Tavafian, S.S. and Eslami, M., 2019. Predicting oral health behaviors among Iranian students by using health belief model. *Journal of Education and Health Promotion*, *8(10)*,pp.1-9.

Goodarzi, F., Araban, M., Eslami, A.A. and Zamani-Alavijeh, F., 2019. Development and psychometric evaluation of the diabetic Men's dietary behaviors inventory based on the theory of reasoned action. *Archives of Public Health*, *77*(1), p.3.

Gorgenyi-Hegyes, E., Nathan, R.J. and Fekete-Farkas, M., 2021. Workplace Health Promotion, Employee Wellbeing and Loyalty during Covid-19 Pandemic—Large Scale Empirical Evidence from Hungary. *Economies*, *9*(2), p.55.

Goswami, P., 2019. Literature review: Financial problems of micro, small and medium enterprises. *International Journal of Management, IT and Engineering*, *9*(4), pp.115-136

Gozubuyuk, A.A., Dag, H., Kaçar, A., Karakurt, Y. and Arica, V., 2017. Epidemiology, pathophysiology, clinical evaluation, and treatment of carbon monoxide poisoning in child, infant, and fetus. *Northern clinics of Istanbul,* 4(1), p.100.

Greene, L.C., 2016. Entrepreneurship: Ideas in Action, 6Ed. Cengage Learning. USA.

Greenfield, T, & Greener, S (eds) 2016, Research Methods for Postgraduates, John Wiley & Sons, Incorporated, New York. Available from: ProQuest Ebook Central.

Greyson, D.L. and Johnson, J.L., 2016. The role of information in health behavior: A scoping study and discussion of major public health models. *Journal of the Association for Information Science and Technology*, *67*(12), pp.2831-2841.

Grove, K. V., 2015: Research Approach: An Overview. *Golden Research Thoughts*, 4(8), pp.1-6.

Grulke, N.E. and Heath, R.L., 2020. Ozone effects on plants in natural ecosystems. *Plant Biology*, *22*, pp.12-37.

Guan, Y., Shao, C., Gu, Q., Ju, M. and Zhang, Q., 2015. Method for assessing the integrated risk of soil pollution in industrial and mining gathering areas. *International Journal Of Environmental Research and Public Health,* 12(11), pp.14589-14609.

Guest, G., 2013. Describing mixed methods research: An alternative to typologies. *Journal of Mixed Methods Research*, *7*(2), pp.141-151.

Guetterman, T.C. and Fetters, M.D., 2018. Two methodological approaches to the integration of mixed methods and case study designs: a systematic review. *American Behavioral Scientist*, *62*(7), pp.900-918.

Gumel, B.I., 2017. Critical challenges facing small business enterprises in Nigeria: A literature review. *International Journal of Scientific and Engineering Research,* 8(8), pp.796-808.

Günther, M. and Hellmann, T., 2017. International environmental agreements for local and global pollution. *Journal of Environmental Economics and Management,* 81, pp.38-58.

Guo, B., Liu, X. and Tan, X., 2017. Petroleum Production Engineering (Second Edition). Gulf Professional Publishing. New York City.

Gupta, A., Gupta, A., Jain, K. and Gupta, S., 2018. Noise pollution and impact on children health. *The Indian Journal of Pediatrics*, *85*(4), pp.300-306.

Gwangwava, E., Manuere, F., Kudakwashe, G., Tough, C. and Rangarirai, F., 2014. An assessment of risk management practices in SMEs in Zimbabwe: A review and synthesis. *IOSR Journal of Humanities and Social Sciences*, *19*(8), pp.6-14.

Hafeez, I., Yingjun, Z., Hafeez, S., Mansoor, R. and Rehman, K.U., 2019. Impact of workplace environment on employee performance: mediating role of employee health. *Business, Management and Education*, *17*(2), pp.173-193.

Hafizan, A.H., Rosliza, A.M., Juni, M.H. and Arif, M.N., 2018. Factors Associated with Quality of Life among Post Coronary Artery bypass Grafting Patients at a Cardiothoracic Centre in Malaysia. *International Journal of Public Health and Clinical Sciences*, *5*(6), pp.358-372.

Hagger, M.S., 2019. The reasoned action approach and the theories of reasoned action and planned behavior. In D. S. Dunn (Ed.), *Oxford Bibliographies in Psychology*. New York, NY: Oxford University Press. doi: 10.1093/OBO/9780199828340-0240

Hagger, M.S., Cameron, L.D., Hamilton, K., Hankonen, N. and Lintunen, T. eds., 2020. *The handbook of behavior change*. Cambridge University Press. UK.

Haggerty, L., Reischl, U., Handy, R.G., Sleeth, D.K., Adams, K. and Schaefer, C., 2020. The thermodynamics of indoor air pollution: A pilot study emulating traditional Kenyan homesteads. *Sustainable Cities and Society*, *53*, p.101926.

Halcomb, E.J. and Hickman, L., 2015. Mixed methods research. *Nursing Standard: Promoting Excellence in Nursing Care*, 29 (32), 41-47.

Halder, J.N. and Islam, M.N., 2015. Water pollution and its impact on the human health. *Journal of Environment and Human,* 2(1), pp.36-46.

Halmaghi, E.E., Iancu, D. and Băcilă, M.L., 2017, June. The Organization's Internal Environment and Its Importance in the Organization's Development. In *International Conference Knowledge-Based Organization*, 23 (1), pp. 378-381.

Halonen, J.I., Atkins, S., Hakulinen, H., Pesonen, S. and Uitti, J., 2017. Collaboration between employers and occupational health service providers: a systematic review of key characteristics. *BMC Public Health*, *17*(1), pp.1-9.

Han, B., 2020. Associations between perceived environmental pollution and health-related quality of life in a Chinese adult population. *Health and Quality of Life Outcomes* 18(10), pp.1-13.

Han, H., Pettee Gabriel, K. and Kohl III, H.W., 2017. Application of the transtheoretical model to sedentary behaviors and its association with physical activity status. *PloS one*, *12*(4), p.e0176330.

Han, K.T., Park, E.C., Kim, J.H., Kim, S.J. and Park, S., 2014. Is marital status associated with quality of life?. *Health and Quality of Life Outcomes*, *12*(1), pp.1-10.

Hanania, J., Stenhouse, K., and Donev, J., (2017). Energy Education - Oil well [Online]. Available: https://energyeducation.ca/encyclopedia/Oil_well.> [Accessed: November 9, 2020].

Handyside, L., Warren, R., Devine, S. and Drovandi, A., 2020a. Utilisation of the PRECEDE-PROCEED model in community pharmacy for health needs assessment: A narrative review. *Research in Social and Administrative Pharmacy*, 17(2), pp.292-299.

Handyside, L., Warren, R., Devine, S. and Drovandi, A., 2020b. Health needs assessment in a regional community pharmacy using the PRECEDE-PROCEED model. *Research in Social and Administrative Pharmacy*, 17(6), pp. 1151-1158.

Hanley, M.E. and Patel, P.H., 2017. *Toxicity, Carbon Monoxide*. StatPearls Publishing, Treasure Island (FL).

Hannemann, M., 2015. The Sub-Saharan Water Crisis: An Analysis of its Impact on Public Health in Urban and Rural Nigeria.[thesis] DePauw University.

Hansen, T., Lidsmoes, L.C., Laursen, P., Mathiassen, L., Jensen, A.M., Raby, C.S., Sørensen, L., Jurvelius, H., Rintala, J., Harðarson, S. and Sveinsdóttir, Þ., 2015. *Psychosocial working environment: Workplace Inspection of the psychosocial working environment in the Nordic countries*. Nordic Council of Ministers. Ved Stranden.

Hao, Y., Zheng, S., Zhao, M., Wu, H., Guo, Y. and Li, Y., 2020. Reexamining the relationships among urbanization, industrial structure, and environmental pollution in China—New evidence using the dynamic threshold panel model. *Energy Reports*, *6*, pp.28-39.

Haraldstad, K., Wahl, A., Andenæs, R., Andersen, J.R., Andersen, M.H., Beisland, E., Borge, C.R., Engebretsen, E., Eisemann, M., Halvorsrud, L. and Hanssen, T.A., 2019. A systematic review of quality of life research in medicine and health sciences. *Quality of life Research,* 28(10), pp.2641-2650.

Harizanova-Bartos, H. and Stoyanova, Z., 2019. Impact of agriculture on soil pollution in Bulgaria. *Economics of Agriculture*, *66*(2), pp.375-387.

Harrison, R.L. and Reilly, T.M., 2011. Mixed methods designs in marketing research. *Qualitative Market Research: An International Journal*, *14*(1), pp.7-26.

Harutyunyan H. and Mantashyan A., 2017. Recycling Of SO2: Its Conversion Into Elemental Sulfur. CEST2017_01219, Available at<https://cest.gnest.org/sites/default/files/presentation_file_list/cest2017_01219_oral_paper.pdf> [Accessed 20 July 2020].

Háša, S. and Brunet-Thornton, R. eds., 2017. *Impact of organizational trauma on workplace behavior and performance*. IGI Global. USA.

Haseena, M., Malik, M.F., Javed, A., Arshad, S., Asif, N., Zulfiqar, S. and Hanif, J., 2017. Water pollution and human health. *Environ Risk Assess Remediat.* 2017;1(3), pp.16-19.

Hassard, J., Teoh, K.R., Visockaite, G., Dewe, P. and Cox, T., 2018. The cost of work-related stress to society: A systematic review. *Journal of Occupational Health Psychology,* 23(1), p.1.

Hatori, M., Gronfier, C., Van Gelder, R.N., Bernstein, P.S., Carreras, J., Panda, S., Marks, F., Sliney, D., Hunt, C.E., Hirota, T. and Furukawa, T., 2017. Global rise of potential health hazards caused by blue light-induced circadian disruption in modern aging societies. *npj Aging and Mechanisms of Disease*, *3*(1), pp.1-3.

Haydary, J., 2019. *Chemical Process Design and Simulation: Aspen Plus and Aspen Hysys Applications*. John Wiley & Sons. United Kingdom.

Hayes, F., Sharps, K., Harmens, H., Roberts, I. and Mills, G., 2020. Tropospheric ozone pollution reduces the yield of African crops. *Journal of Agronomy and Crop Science*, *206*(2), pp.214-228.

Health Effects Institute (HEI), 2017. Health Effects Institute Releases First Annual State of Global Air Report. Available at:< https://www.healtheffects.org/sites/default/files/State-of-Global-Air-Press-Release-February-14-2017.pdf > [Accessed 3 April 2018].

Health Effects Institute. 2019. State of Global Air 2019. Special Report. Boston, MA: Health Effects Institute.

Heck, R.M., Farrauto, R.J. and Gulati, S.T., 2016. *Catalytic air pollution control: commercial technology*. John Wiley & Sons.

Hedayatzade, F. and Hassanzadeh, N., 2020. Occurrence, Probable Source, and Health Risk Assessment of Benzene, Toluene, Ethylbenzene, and Xylene Compounds in Ambient Urban Atmosphere in Ahvaz, Iran. *Archives of Hygiene Sciences*, *9*(2), pp.152-167.

Heibati, B., Pollitt, K.J.G., Charati, J.Y., Ducatman, A., Shokrzadeh, M., Karimi, A. and Mohammadyan, M., 2018. Biomonitoring-based exposure assessment of benzene, toluene,

ethylbenzene and xylene among workers at petroleum distribution facilities. *Ecotoxicology and Environmental Safety,* 149, pp.19-25.

Herkenhoff, L., 2018. *A profile of the oil and gas industry: Resources, market forces, geopolitics, and technology*. Business Expert Press. New York.

Hernawati, K., Insani, N. and Sahid, 2017, August. Mapping the Indonesian territory, based on pollution, social demography and geographical data, using self organizing feature map. In *AIP Conference Proceedings*, 1868 (1) p. 040002).

Heryanto, H., 2019. The Effect of Work Motivation and Work Environment on Performance With Satisfaction as Intervening Variables Education Personnel Rektorate Andalas University. *Archives of Business Research*, *7*(2), pp.103-120.

Hesse-Biber, S., 2015. Mixed methods research: The "thing-ness" problem. *Qualitative Health Research*, *25*(6), pp.775-788.

Hicks, D., Attia, D., Behar-Cohen, F., Carré, S., Enouf, O., Falcon, J., Gronfier, C., Martinsons, C., Metlaine, A., Tahkamo, L. and Torriglia, A., 2020. How good is the evidence that light at night can affect human health?. *Graefe's Archive for Clinical and Experimental Ophthalmology,* 258(2), pp.231-232.

Hill, M.K., 2020. *Understanding environmental pollution*. Cambridge University Press. UK.

Hilpert, M., Mora, B.A., Ni, J., Rule, A.M. and Nachman, K.E., 2015. Hydrocarbon release during fuel storage and transfer at gas stations: Environmental and health effects. *Current Environmental Health Reports,* 2(4), pp.412-422.

Hind, H., Afkar, H. and Suhad, J., 2020. A review study of waterborne parasites in Iraq. *GSC Biological and Pharmaceutical Sciences*, *10*(3), pp.022-026.

Hitchcock, J.H. and Onwuegbuzie, A.J., 2020. Developing mixed methods crossover analysis approaches. *Journal of Mixed Methods Research*, *14*(1), pp.63-83.

Holloway, I. and Galvin, K., 2016. *Qualitative research in nursing and healthcare*. 4th ed John Wiley & Sons.UK

Hoopman, R., Terwee, C.B., Devillé, W.,Knol, D.L. and Aaronson, N.K., 2009. Evaluation of the psychometric properties of the SF-36 health survey for use among Turkish and Moroccan ethnic minority populations in the Netherlands. *Qual Life Res.* 18(6): 753–764.

Hope, N.W., Obianuju, M.C. and Chibuzoh, A., 2017. Workplace environment and employee performance in selected brewing firms in Anambra State. *International Journal of Current Research and Academic Review*, *5*(1), pp.111-120.

Hsu, C.S. and Robinson, P.R. eds., 2017. *Springer handbook of petroleum technology*. Springer. USA.

Hsu, M., Wang, C., Tzou, S.J., Pan, T.C. and Tang, P.L., 2021. Effects of Zentangle art workplace health promotion activities on rural healthcare workers. *Public Health*, *196*, pp.217-222.

Hsu, S. C. and Robinson R. P., 2019. *Petroleum Science and Technology* .[eBook] Springer Nature Switzerland

Hsu, T.L. and Barrett, A.E., 2020. The association between marital status and psychological well-being: Variation across negative and positive dimensions. *Journal of Family Issues*, *41*(11), pp.2179-2202.

Huang, B., Lei, C., Wei, C. and Zeng, G., 2014. Chlorinated volatile organic compounds (Cl-VOCs) in environment—sources, potential human health impacts, and current remediation technologies. *Environment international,* 71, pp.118-138.

Hulls, P.M., Richmond, R.C., Martin, R.M. and de Vocht, F., 2020. A systematic review protocol examining workplace interventions that aim to improve employee health and well-being in male-dominated industries. *Systematic Reviews*, *9*(1), pp.1-7.

Hultqvist, J., Lund, K., Argentzell, E. and Eklund, M., 2019. Predictors of clinically important improvements in occupational and quality of life outcomes among mental health service users after completion and follow-up of a lifestyle intervention: multiple regression modelling based on longitudinal data. *BMC Psychology*, *7*(1), pp.1-15.

Hunter, R.J., and Smith, A.Z., 2012. Protecting Our Environment*: Lessons from the European Union*. State University of New York Press. USA.

Huo, T., Guo, Y., Shenkman, E. and Muller, K., 2018. Assessing the reliability of the short form 12 (SF-12) health survey in adults with mental health conditions: a report from the wellness incentive and navigation (WIN) study. *Health and Quality of Life Outcomes*, *16*(1), p.34.

Hymel, P.A., Loeppke, R.R., Baase, C.M., Burton, W.N., Hartenbaum, N.P., Hudson, T.W., McLellan, R.K., Mueller, K.L., Roberts, M.A., Yarborough, C.M. and Konicki, D.L., 2011. Workplace health protection and promotion: a new pathway for a healthier—and safer—workforce. *Journal of Occupational and Environmental Medicine,* 53(6), pp.695-702.

Ibhadode, O., Tenebe, I.T., Emenike, P.C., Adesina, O.S., Okougha, A.F. and Aitanke, F.O., 2018. Assessment of noise-levels of generator-sets in seven cities of South-Southern Nigeria. *African Journal of Science, Technology, Innovation and Development*, *10*(2), pp.125-135.

Idoro, G. I., 2008. Health and Safety Management Efforts as Correlates of Performance in the Nigerian Construction Industry.[pdf*] Journal of Civil Engineering and Management*, 14 (4), pp 277-285.

Idubor, E.E. and Oisamoje, M.D., 2013. An exploration of health and safety management issues in Nigeria's effort to industrialize. *European Scientific Journal,* 9(12), pp.154-169.

Idungafa, E.D. and Charles, T.W., 2019. Socio Demographic Factors Associated with Knowledge of Occupational Hazard and Safety Measures among Workers in Selected Downstream Petroleum Companies in Port Harcourt, Rivers State, Nigeria. *Journal of Advances in Medicine and Medical Research,* 29(11) pp.1-12.

Ifeyinwa, A.E., Emerole, C.O., Amadi, A.N. and Johnkennedy, N., 2016. Gasoline fumes exposure and risk of respiratory disease among fuel pump attendants in Owerri Municipal Council, Nigeria. *Journal of Advances in Biological and Basic Research*, 2(3), pp.10-17.

Ilbahar, E., Karaşan, A., Cebi, S. and Kahraman, C., 2018. A novel approach to risk assessment for occupational health and safety using Pythagorean fuzzy AHP & fuzzy inference system. *Safety Science*, *103*, pp.124-136.

Iliev, S., 2018, . 'Comparison of Ethanol and Methanol Blending with Gasoline Using Engine Simulation', in M. A. Qubeissi (ed.), *Biofuels - Challenges and opportunities*, IntechOpen, London. 10.5772/intechopen.81776.

Imoukhuede, O.B. and Afuye, G.G., 2016. Water Pollution and its Effect on Water Consumption in Akure. *International Journal of Environmental & Agriculture Research* (IJOEAR), 2(5), pp. 1-5.

In, J., 2017. Introduction of a pilot study. *Korean Journal of Anaesthesiology* 70(6) p. 601-605 <https://doi.org/10.4097/kjae.2017.70.6.601

Institute of Marine Affairs, 2015. Oil Spills. Agency of the Ministry of the Environment and Water Resources.[pdf].

International Energy Agency (IEA), 2016. Energy and Air Pollution: World Energy Outlook Special Report. Available at:<https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlookSpecialReport2016EnergyandAirPollution.pdf>[Accessed 20 June 2018].

International Labour Organisation (ILO), 2017. Nigeria Country Profile on Occupational Safety and Health 2016 [pdf]. Available at< https://www.ilo.org/africa/countries-covered/nigeria/WCMS_552748/lang--en/index.htm> [Accessed 24 March 2021].

International Labour Organisation (ILO), 2019. Occupational safety and health: Workplace well-being. Available at:< https://www.ilo.org/safework/areasofwork/workplace-health-promotion-and-well-being/WCMS_118396/lang--en/index.htm>[Accessed 24 March 2021].

International Labour Organisation (ILO), 2020. World Statistics: The enormous burden of poor working conditions. [https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249278/lang--en/index.htm] [assessed 2, November 2020].

International Labour Organisation (ILO), 2021. Workplace well-being. [online] Available at < https://www.ilo.org/global/topics/safety-and-health-at-work/areasofwork/workplace-health-promotion-and-well-being/WCMS_118396/lang--en/index.htm> [Accessed 6 April 2021]

International Labour Organisation (ILO), 2021a. Personal protective equipment. Available at < https://www.ilo.org/global/topics/labour-administration-inspection/resources-

library/publications/guide-for-labour-inspectors/personal-protective-equipment/lang--en/index.htm> [Accessed 15 March 2021].

International Labour Organisation (ILO), 2021b. How can occupational safety and health be managed? Available at < https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/guide-for-labour-inspectors/how-can-osh-be-managed/lang--en/index.htm> [Accessed 20 March 2021].

International Labour Organisation, 2016. ILO in Nigeria. [online] Available at< https://www.ilo.org/africa/countries-covered/nigeria/WCMS_461891/lang--en/index.htm> [Accessed 16 March 2021].

International Labour Organization 2019. Work for a brighter future – Global Commission on the Future of Work. *International Labour Office – Geneva*

Isha, A.S.N., Javaid, M.U., Zaib Abbasi, A., Bano, S., Zahid, M., Memon, M.A., Rehman, U., Nübling, M., Sabir, A.A., Ur Rehman, S. and Imtiaz, N., 2020. Malay Validation of Copenhagen Psychosocial Work Environment Questionnaire in Context of Second Generation Statistical Techniques. *BioMed Research International. Article ID 7680960, https://doi.org/10.1155/2020/7680960.*

Islam, A., Tedford, D., 2012. Risk determinants of small and medium-sized manufacturing enterprises (SMEs) - an exploratory study in New Zealand. *J Ind Eng Int*, 8 (1), p. 1-13.

Israel, B.A., Schulz, A.J., Coombe, C.M., Parker, E.A., Reyes, A.G., Rowe, Z. and Lichtenstein, R.L., 2019. Community-based participatory research. *Urban Health*, p.272.

Israel, BA, Eng, E, & Schulz, AJ (eds) 2012, Methods for Community-Based Participatory Research for Health, John Wiley & Sons, Incorporated, Somerset. Available from: ProQuest Ebook Central. [29 July 2019].

Ivanova, A.S., Holionko, N.G., Tverdushka, T.B., Olejarz, T. and Yakymchuk, A.Y., 2019. The Strategic Management in Terms of an Enterprise's Technological Development. *Journal of Competitiveness*, *11*(4), p.40.

Iyanda, A. (2018). Serum heavy metal levels in teenagers currently or formerly employed as gas station attendants. *Bangladesh Journal of Medical Science,* 17(2), 224-229.

Izyan, Z.N. and Shuhaimi, M., 2014. Exergy analysis for fuel reduction strategies in crude distillation unit. *Energy*, *66*, pp.891-897.

J.M.K.C. Donev et al. (2020). Energy Education - Fractional distillation [Online]. Available at:< https://energyeducation.ca/encyclopedia/Fractional_distillation.> [Accessed: June 26, 2020].

Jabeen, A., Huang, X. and Aamir, M., 2015. The Challenges of Water Pollution, Threat to Public Health, Flaws of Water Laws and Policies in Pakistan. *Journal of Water Resource and Protection*, 7(17), p.1516.

Jafarinejad, S. and Jiang, S.C., 2019. Current technologies and future directions for treating petroleum refineries and petrochemical plants (PRPP) wastewaters. *Journal of Environmental Chemical Engineering*, *7*(5), p.103326.

Jafarinejad, S., 2016a. Odours emission and control in the petroleum refinery: A review. *Current Science Perspectives* 2(3) 78-82.

Jafarinejad, S., 2016b. Control and treatment of sulfur compounds specially sulfur oxides (SOx) emissions from the petroleum industry: a review. *Chemistry International,* 2(4), pp.242-253.

Jagosh, J., Bush, P.L., Salsberg, J., Macaulay, A.C., Greenhalgh, T., Wong, G., Cargo, M., Green, L.W., Herbert, C.P. and Pluye, P., 2015. A realist evaluation of community-based participatory research: partnership synergy, trust building and related ripple effects. *BMC public health*, *15*(1), p.725.

Jahromi, V.K., Ghashghaei, S.B. and Sharifi, N., 2020. Improvement of osteoporosis-related behaviors in female students based on trans theoretical model. *Journal of Education and Health Promotion*, *9* (221), p.1-6.

Jain, R., Cui, Z. and Domen, J.K., 2016. Environmental impacts of mining. *Environmental Impact of Mining and Mineral Processing*, pp.53-157.

Jaiswal A., 2020. Effect of petrol fumes on an anthropometry and ventilatory function among petrol pump workers of Pondicherry, India. *Human Biology Review,* 9 (4), 358-369.

Jane, N.K., Justus, M. and Francis, K., 2014. Influence of internal organizational environment on performance of community-based HIV and aids organizations in Nairobi County, Kenya. *European Scientific Journal*, *10*(28), pp. 405-426.

Janković, M., Mihajlović, M. and Cvetković, T., 2016. Influence of external factors on business of companies in Serbia. *Ekonomika*, *62*(4), pp.31-38.

Jaworsky, D., 2019. An allied research paradigm for epidemiology research with Indigenous peoples. *Archives of Public Health*, *77*(1), p.22.

Jeihooni, A.K., Harsini, P.A., Kashfi, S.M. and Rakhshani, T., 2019. Effect of educational intervention based on the PRECEDE-PROCEED model on preventive behaviors of cutaneous leishmaniasis among housewives. *Cadernos de Saude Publica*, *35*, p.e00158818.

Johansson, C., Lövenheim, B., Schantz, P., Wahlgren, L., Almström, P., Markstedt, A., Strömgren, M., Forsberg, B. and Sommar, J.N., 2017. Impacts on air pollution and health by changing commuting from car to bicycle. *Science of the Total Environment,* 584, pp.55-63.

Johari, J. and Yahya, K.K., 2016. Job characteristics, work involvement, and job performance of public servants. *European Journal of Training and Development*, 40 (7), pp. 554-575.

Johnson, O., 2016. "Application of the PRECEDE-PROCEED Model in the evaluation of a community-based youth fitness and nutrition summer camp program". *Graduate College Dissertations and Theses.* 647. https://scholarworks.uvm.edu/graddis/647.

Johnson, O.E. and Etokidem, A.J., 2019. Occupational hazards and health problems among butchers in Uyo, Nigeria. *Journal of the Nigeria Medical Association*, 60(3), p.106.

Johnson, O.E. and Umoren, Q.M., 2018. Assessment of occupational hazards, health problems and safety practices of petrol station attendants in Uyo, Nigeria. *Journal of Community Medicine and Primary Health Care*, *30*(1), pp.47-57.

Juliandra, A. and Purba, C.B., 2021. The Influence of Leadership Style, Work Environment, and Organizational Culture on the Performance of Local Government Employees in Bogor Regency. *International Journal of Innovative Science and Research Technology 6(5).*

Kabir, S.M., 2016. Methods of data collection. In book *Basic Guidelines for Research: An Introductory Approach for All Disciplines* (pp.201-275)Edition: FirstChapter: 9. Book Zone Publication, Chittagong-4203, Bangladesh.

Kaiser, M.J., de Klerk, A., Gary, J.H. and Handwerk, G.E., 2019. *Petroleum Refining: Technology, Economics, and Markets*. CRC Press. USA.

Kamal, S. S. L. B. A., 2019. Research Paradigm and the Philosophical Research Paradigm and the Philosophical Foundations of a Qualitative Study. PEOPLE*: International Journal of Social Sciences,* 4(3), 1386-1394.

Kanawade, V.P., Srivastava, A.K., Ram, K., Asmi, E., Vakkari, V., Soni, V.K., Varaprasad, V. and Sarangi, C., 2020. What caused severe air pollution episode of November 2016 in New Delhi? *Atmospheric Environment*, *222*, p.117125.

Kancijan, M., Ivanjko, M., Ilak, P. and Krajcar, S., 2015, May. An oil refinery production optimization. *In Energy (IYCE), 2015 5th International Youth Conference*, pp. 1-11.

Kankam, P.K., 2019. The use of paradigms in information research. *Library & Information Science Research*, 41(2), pp.85-92.

Karakitsios, S.P., Delis, V.K., Kassomenos, P.A. and Pilidis, G.A., 2007. Contribution to ambient benzene concentrations in the vicinity of petrol stations: Estimation of the associated health risk. *Atmospheric Environment*, *41*(9), pp.1889-1902.

Karthik, B.L, Sujith, B., Rizwan, S.A. and Sehgal, M., 2017. Characteristics of the Ozone pollution and its health effects in India. *Int J Med. Public Health,* 7(1)pp.56-60.

Kelly, J.D., Menezes, B.C., Grossmann, I.E., and Engineer, F., 2017. Crude-oil Blend Scheduling Optimization of an Industrial-Sized Refinery: a Discrete-Time Benchmark. Foundations of Computer Aided Process Operations: Tucson, United States. [pdf]. Available at:< http://egon.cheme.cmu.edu/Papers/Kelly_CBSO_paper.pdf> [Accessed 6 August 2020].

Kephart, J.L., Fandiño-Del-Rio, M., Williams, K.N., Malpartida, G., Steenland, K., Naeher, L.P., Gonzales, G.F., Chiang, M., Checkley, W., Koehler, K. and CHAP trial Investigators, 2020. Nitrogen dioxide exposures from biomass cookstoves in the Peruvian Andes. *Indoor Air,* 30(4), pp.735-744.

Kerrigan, M.R., 2014. A framework for understanding community colleges' organizational capacity for data use: A convergent parallel mixed methods study. *Journal of Mixed Methods Research*, *8*(4), pp.341-362.

Kesmodel U.S., 2018. Cross-sectional studies–what are they good for? *Acta Obstet Gynecol Scand*, 97, pp. 388–393

Kestenbaum, B., 2019. Cross-Sectional Studies. In *Epidemiology and Biostatistics* (pp. 39-43). Springer, Cham.[Ebook].

Khalilova, H.K., 2015. The impact of oil contamination on soil ecosystem. *J. Biological and Chemical Research,* 2(3), p.133.

Khan, W.A., Mustaq, T. and Tabassum, A., 2014. Occupational health, safety and risk analysis. *International Journal of Science, Environment and Technology*, *3*(4), pp.1336-1346.

Khatun, R., 2017. Water Pollution: Causes, Consequences, Prevention Method and Role of WBPHED with Special Reference from Murshidabad District. *International Journal of Scientific and Research Publications*, 7(8), pp.269-277.

Kilanowski, J.F., 2017. Breadth of the socio-ecological model. *Journal of Agromedicine*, 22(4), p.295-297.

Kim, A., Lee, J.A. and Park, H.S., 2018. Health behaviors and illness according to marital status in middle-aged Koreans. *Journal of Public Health*, *40*(2), pp.e99-e106.

Kim, H.K. and McKenry, P.C., 2002. The relationship between marriage and psychological well-being: A longitudinal analysis. *Journal of family Issues*, *23*(8), pp.885-911.

Kim, K.H., Kabir, E. and Kabir, S., 2015. A review on the human health impact of airborne particulate matter. *Environment International,* 74, pp.136-143.

Kim, K.Y., Lee, E., Kim, Y.J. and Kim, J., 2017. The association between artificial light at night and prostate cancer in Gwangju City and South Jeolla Province of South Korea. *Chronobiology International*, *34*(2), pp.203-211.

Kim, M.J., Seo, Y.K., Kim, J.H. and Baek, S.O., 2020. Impact of industrial activities on atmospheric volatile organic compounds in Sihwa-Banwol, the largest industrial area in South Korea. *Environmental Science and Pollution Research*, *27*, pp.28912-28930.

Kim, Y., Kang, S. and Hwang, J., 2017. Physical activity distribution and differences in its related processes of change strategies in adolescents. *Revista de Psicología del Deporte*, *26*(4), pp.5-9.

Kim, Y.H., 2018. Energy saving in a crude distillation unit with a divided wall column. *Chemical Engineering Communications*, *205*(1), pp.134-144.

Kinchin, G., Ismail, N. and Edwards, J.A., 2018. Pilot study, Does it really matter? Learning lessons from conducting a pilot study for a qualitative PhD thesis. *International Journal of Social Science Research*, *6*(1), pp.1-17.

King, M.K and Gonzalez, B.G., 2018. Increasing Physical Activity Using An Ecological Model. *American College of Sports Medicine,* 22(4), p.29-32.

Kinoshita, H., Türkan, H., Vucinic, S., Naqvi, S., Bedair, R., Rezaee, R. and Tsatsakis, A., 2020. Carbon monoxide poisoning. *Toxicology Reports*, *7*, pp.169-173.

Kirsop-Taylor, N.A., Hejnowicz, A.P. and Scott, K., 2020. Four Cultural Narratives for Managing Social-ecological Complexity in Public Natural Resource Management. *Environmental Management*, 66(3), pp.419-434.

Klein, L.L., Pereira, B.A. and Lemos, R.B., 2019. Quality of working life: Parameters and evaluation in the public service. *RAM. Revista de Administração Mackenzie*, *20*(3), eRAMG190134.

Klingbeil, B.T., La Sorte, F.A., Lepczyk, C.A., Fink, D. and Flather, C.H., 2020. Geographical associations with anthropogenic noise pollution for North American breeding birds. *Global Ecology and Biogeography*, *29*(1), pp.148-158.

Knauder, H. and Koschmieder, C., 2019. Individualized student support in primary school teaching: A review of influencing factors using the Theory of Planned Behavior (TPB). *Teaching and Teacher Education*, *77*, pp.66-76.

Knippertz, P., Evans, M.J., Field, P.R., Fink, A.H., Liousse, C. and Marsham, J.H., 2015. The possible role of local air pollution in climate change in West Africa. *Nature Climate Change,* 5(9), pp.815-822.

Koontz, T.M., 2006. Collaboration for sustainability? A framework for analyzing government impacts in collaborative-environmental management. *Sustainability: Science, Practice and Policy*, 2(1), pp.15-24.

Kot, S., 2018. Sustainable supply chain management in small and medium enterprises. *Sustainability*, 10(4), p.1143.

Kotera, Y., Green, P. and Sheffield, D., 2020. Work-life balance of UK construction workers: Relationship with mental health. *Construction Management and Economics*, 38(3), pp.291-303.

Kourti, M., Jiang, W.G. and Cai, J., 2017. Aspects of Carbon Monoxide in Form of CO-Releasing Molecules Used in Cancer Treatment: More light on the Way. *Oxidative medicine and cellular longevity,* , Article ID 9326454, https://doi.org/10.1155/2017/9326454.

Kowo, S., Adenuga, O. and Sabitu, O., 2019. The role of SMEs development on poverty alleviation in Nigeria. *Insights into Regional Development,* 1(3), pp.214-226.

Krantz, E., Wide, U., Trimpou, P., Bryman, I. and Landin-Wilhelmsen, K., 2019. Comparison between different instruments for measuring health-related quality of life in a population sample, the WHO MONICA Project, Gothenburg, Sweden: an observational, cross-sectional study. *BMJ Open*, 9(4), p.e024454.

Kuang, H., Liu, J., Zeng, Y., Zhou, W., Wu, P., Tan, J., Li, Y., Pang, Q., Jiang, W. and Fan, R., 2020. Co-exposure to polycyclic aromatic hydrocarbons, benzene and toluene may impair lung function by increasing oxidative damage and airway inflammation in asthmatic children. *Environmental Pollution*, 266, p.115220.

Kularatna, S., Senanayake, S., Gunawardena, N. and Graves, N., 2019. Comparison of the EQ-5D 3L and the SF-6D (SF-36) contemporaneous utility scores in patients with chronic kidney disease in Sri Lanka: a cross-sectional survey. *BMJ open*, 9(2), p.e024854.

Kulkarni, S.J., 2019. *Petroleum and Refining Sector: Towards Cost Effective and Sustainable Practices*. Literatureslight Publishing. India

Kumar, M. and Francisco, J.S., 2017. Elemental sulfur aerosol-forming mechanism. *Proceedings of the National Academy of Sciences*, 114(5), pp.864-869.

Kumar, S., Bharti, D., Shazib, S.U.A. and Shin, M.K., 2017. Discovery of a new hypotrich ciliate from petroleum contaminated soil. *PloS One,* 12(6), p.e0178657.

Kuppusamy, S., Maddela, N.R., Megharaj, M. and Venkateswarlu, K., 2019. *Total Petroleum Hydrocarbons: Environmental Fate, Toxicity, and Remediation*. Springer. Switzerland.

Kyba, C.C., Kuester, T., De Miguel, A.S., Baugh, K., Jechow, A., Hölker, F., Bennie, J., Elvidge, C.D., Gaston, K.J. and Guanter, L., 2017. Artificially lit surface of Earth at night increasing in radiance and extent. *Science Advances*, *3*(11), p.e1701528.

LaCaille L., 2020. Theory of Reasoned Action. In: Gellman M.D. (eds) Encyclopedia of Behavioral Medicine. Springer, Cham. https://doi.org/10.1007/978-3-030-39903-0_1619

LaDou, J., London, L. and Watterson, A., 2018. Occupational health: a world of false promises. *Environmental Health*, *17*(1), p.81.

Landrigan, P.J., 2017. Air pollution and health. *The Lancet Public Health,* 2(1), pp.e4-e5.

Landrigan, P.J., Fuller, R., Acosta, N.J., Adeyi, O., Arnold, R., Baldé, A.B., Bertollini, R., Bose-O'Reilly, S., Boufford, J.I., Breysse, P.N. and Chiles, T., 2017. The Lancet Commission on pollution and health. *The Lancet,* 391(10119), pp.462-512.

Lapsley, S., Maxwell, V. and Milev, R., 2016. Harnessing the potential of community-based participatory research approaches in bipolar disorder. *International Journal of Bipolar Disorders*, *4*(1), p.4.

Lapworth, D.J., Nkhuwa, D.C.W., Okotto-Okotto, J., Pedley, S., Stuart, M.E., Tijani, M.N. and Wright, J., 2017. Urban groundwater quality in sub-Saharan Africa: current status and implications for water security and public health. *Hydrogeology Journal,* 25(4), pp.1093-1116.

Laranjo, L., 2016. Social media and health behavior change. In *Participatory health through social media* (pp. 83-111). Academic Press. UK.

Laucis, N.C., Hays, R.D. and Bhattacharyya, T., 2015. Scoring the SF-36 in orthopaedics: a brief guide. *The Journal of Bone and Joint Surgery American volume*, *97*(19), p.1628.

Lavrusheva, O., 2020. The concept of vitality. Review of the vitality-related research domain. *New Ideas in Psychology*, *56*, p.100752.

Lawson, C., Gill, R., Feekery, A. and Witsel, M., 2019. *Communication skills for business professionals*. Cambridge University Press.UK.

Leavy, P., 2017a. *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. Guilford Publications. New York.

Leavy, P., 2017b. Introduction to arts-based research. *Handbook of arts-based research*, pp.3-21. New York, USA.

Lee, B.C., Bendixsen, C., Liebman, A.K. and Gallagher, S.S., 2017. Using the socio-ecological model to frame agricultural safety and health interventions. *Journal of Agromedicine*, *22*(4), pp.298-303.

 Lee, K.H., Xu, H. and Wu, B., 2020. Gender differences in quality of life among community-dwelling older adults in low-and middle-income countries: results from the Study on global AGEing and adult health (SAGE). *BMC Public Health*, *20*(1), p.114.

Lee, K.K., Spath, N., Miller, M.R., Mills, N.L. and Shah, A.S., 2020. Short-term exposure to carbon monoxide and myocardial infarction: A systematic review and meta-analysis. *Environment International*, *143*, p.105901.

Leech, N.L. and Onwuegbuzie, A.J., 2009. A typology of mixed methods research designs. *Quality & Quantity*, *43*(2), pp.265-275.

Leitão, J., Pereira, D. and Gonçalves, Â., 2019. Quality of work life and organizational performance: workers' feelings of contributing, or not, to the organization's productivity. *International journal of environmental research and public health*, *16*(20), p.3803.

Leitão, J., Pereira, D. and Gonçalves, Â., 2021. Quality of work life and contribution to productivity: Assessing the moderator effects of burnout syndrome. *International Journal of Environmental Research and Public Health*, *18*(5), p.2425.

Lelieveld, J., Evans, J.S., Fnais, M., Giannadaki, D. and Pozzer, A., 2015. The contribution of outdoor air pollution sources to premature mortality on a global scale. *Nature,* 525(7569), p.367.

Leme, J., Guedes, M., Larkin, J., Han, M., Barra, A.B.L., Canziani, M.E.F., Cuvello Neto, A.L., Poli-de-Figueiredo, C.E., de Moraes, T.P., Pecoits-Filho, R. and HDFIT Study Investigators, 2020. Patient perception of vitality and measured physical activity in patients receiving haemodialysis. *Nephrology*, *25*(11), pp.865-871.

Leung, L., 2015. Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, *4*(3), p.324.

Levers, M.J.D., 2013. Philosophical paradigms, grounded theory, and perspectives on emergence. *Sage Open*, *3*(4), p.2158244013517243.

Li, X., Yang, S., Wang, Y., Yang, B. and Zhang, J., 2020. Effects of a transtheoretical model-based intervention and motivational interviewing on the management of depression in hospitalized patients with coronary heart disease: a randomized controlled trial. *BMC Public Health*, *20*, pp.1-12.

Library of Congress, 2008. Country Profile: Nigeria. [pdf] Available at < https://www.loc.gov/rr/frd/cs/profiles/Nigeria-new.pdf> [Accessed 27 March 2021]

Lifongo, L.L., Simoben, C.V., Ntie-Kang, F., Babiaka, S.B. and Judson, P.N., 2014. A bioactivity versus ethnobotanical survey of medicinal plants from Nigeria, West Africa. *Natural Products and Bioprospecting*, 4(1), pp.1-19.

Lin, M.H., Yang, Y.L., Sung, F.C., Liu, C.S., Lung, C.H. and Wang, J.Y., 2020. Risk of mental illness after the diagnosis of occupational injury or disease: a retrospective cohort study. *International Archives of Occupational and Environmental Health*, pp.1-14.

Lioudis, N., 2022. Oil Production Timeline. Investopedia. Available at:< <https://www.investopedia.com/ask/answers/061115/how-long-does-it-take-oil-and-gas-producer-go-drilling-production.asp> [Accessed 15 June 2020].

Lisitsa, S., Levina, A. and Lepekhin, A., 2019. Supply-chain management in the oil industry. In *E3S Web of Conferences,* 110 p. 02061. EDP Sciences.

Liu, D., Curtis, C. and Upchurch, R.S., 2019. The Evolving Field of Wind Energy Tourism: An Application of the Theory of Reasoned Action. *Tourism Review International*, *23*(1-2), pp.37-53.

Liu, H., Zhang, X., Zhang, H., Yao, X., Zhou, M., Wang, J., He, Z., Zhang, H., Lou, L., Mao, W. and Zheng, P., 2018b. Effect of air pollution on the total bacteria and pathogenic bacteria in different sizes of particulate matter. *Environmental Pollution,* 233, pp.483-493.

Liu, K.T., Kueh, Y.C., Arifin, W.N., Kim, Y. and Kuan, G., 2018c. Application of transtheoretical model on behavioral changes, and amount of physical activity among university's students. *Frontiers in psychology*, *9*, p.2402.

Liu, Q., Chen, W., Qi, R., Geng, Y., Liu, Y., Zhou, Y., Zhang, C., Wang, X., Wang, J. and Yu, J., 2019. The utility of health belief model to explain self-protective behaviour against pneumoconiosis in Chinese underground coal miners: a cross-sectional study. *BMJ Open*, *9*(6), p.e026772.

Liu, Y.A., Chang, A.F. and Pashikanti, K., 2018a. *Petroleum Refinery Process Modeling: Integrated Optimization Tools and Applications*. John Wiley & Sons. Weinheim, Germany.

Liu, Z., Xie, K., Li, L. and Chen, Y., 2020. A paradigm of safety management in Industry 4.0. *Systems Research and Behavioral Science*, *37*(4), pp.632-645.

Lodson, J., Ogbeba, J.E. and Elinwa, U.K., 2017. A Lesson from Vernacular Architecture in Nigeria. *Journal of Contemporary Urban Affairs*, 2(1), pp.84-95.

Lohr, S.L., 2019. *Sampling: Design and Analysis: Design and Analysis*. Chapman and Hall/CRC. New York

Long, H., 2014. An empirical review of research methodologies and methods in creativity studies (2003–2012). *Creativity Research Journal*, *26*(4), pp.427-438.

Louthrenoo, W., Kasitanon, N., Morand, E. and Kandane-Rathnayake, R., 2020. Comparison of performance of specific (SLEQOL) and generic (SF36) health-related quality of life questionnaires and their associations with disease status of systemic lupus erythematosus: a longitudinal study. *Arthritis Research & Therapy*, *22*(1), pp.1-12.

Lu, F., Li, S., Shen, B., Zhang, J., Liu, L., Shen, X. and Zhao, R., 2020. The emission characteristic of VOCs and the toxicity of BTEX from different mosquito-repellent incenses. *Journal of Hazardous Materials*, *384*, p.121428.

Luquis, R.R. and Kensinger, W.S., 2019. Applying the health belief model to assess prevention services among young adults. *International Journal of Health Promotion and Education*, *57*(1), pp.37-47.

Ma, J., Li, C., Kwan, M.P. and Chai, Y., 2018. A multilevel analysis of perceived noise pollution, geographic contexts and mental health in Beijing. *International Journal of Environmental Research and Public Health*, *15*(7), p.1479.

Mabahwi, N.A.B., Leh, O.L.H. and Omar, D., 2014. Human Health and Wellbeing: Human health effect of air pollution. *Procedia-Social and Behavioral Sciences*, 153, pp.221-229.

Maciel, L.A., Feitosa, S.B., Trolly, T.S. and Sousa, A.L., 2019. Genotoxic effects of occupational exposure among gas station attendants in Santarem, Para, Brazil. *Revista Brasileira de Medicina do Trabalho*, *17*(2), p.247.

Magana-Arachchi, D.N. and Wanigatunge, R.P., 2020. Ubiquitous waterborne pathogens. In *Waterborne Pathogens* (pp. 15-42). Butterworth-Heinemann.

Magnavita, N., 2018. Obstacles and future prospects: considerations on health promotion activities for older Workers in Europe. *International Journal of Environmental Research and Public Health,* 15(6), p.1096.

Mahajan, S., Kumar, P., Pinto, J.A., Riccetti, A., Schaaf, K., Camprodon, G., Smári, V., Passani, A. and Forino, G., 2020. A citizen science approach for enhancing public understanding of air pollution. *Sustainable Cities and Society*, *52*, p.101800.

Mahirah, D., Sauter, C., Thach, T.Q., Dunleavy, G., Nazeha, N., Christopoulos, G.I., Soh, C.K. and Car, J., 2020. Factors associated with health-related quality of life in a working population in Singapore. *Epidemiology and Health*, *42*, e2020048.

Mahmood, Z., Kouser, R., Ali, W., Ahmad, Z. and Salman, T., 2018. Does corporate governance affect sustainability disclosure? A mixed methods study. *Sustainability*, *10*(1), p.207.

Mahmudiono, T., Segalita, C. and Rosenkranz, R.R., 2019. Socio-Ecological Model of Correlates of Double Burden of Malnutrition in Developing Countries: A Narrative Review. *International Journal of Environmental Research and Public Health*, *16*(19), p.3730.

Maijama'a, R and Musa, K.S., 2020. Crude oil price, urbanization and environmental pollution in Nigeria: Evidence from ARDL approach. *Asian Journal of Economic Modelling*, *8*(4), pp.227-240.

Majewski, A.W. and Jääskeläinen, H., 2016. What is Diesel Fuel? DieselNet Technology Guide. Available at:<https://www.dieselnet.com/tech/fuel_diesel.php> [Accessed 19 September 2020].

Makatita, D.A., Nur Hasanah Haris, R.E.S.T.U., Endarti, D., Wiedyaningsih, C. and Andayani, T.M., 2019. Measurement of Health Related Quality of Life in Malaria Patients in Indonesia using EQ-5D-5L. *Journal of Clinical & Diagnostic Research*, *13*(7), p.1-6.

Makgopa, S.S. and Daniel, T., 2017. External environmental considerations in the planning of strategies of car dealerships. *Environmental Economics*, 8 (1), pp.83-92.

Malakar, S. and Saha, P., 2015. Estimation of VOC Emission in Petroleum Refinery ETP and Comparative Analysis with Measured VOC Emission Rate. *The IJES,* 4(10), pp.20-29.

Malalgoda, C., Amaratunga, D. and Haigh, R., 2018. Empowering local governments in making cities resilient to disasters: research methodological perspectives. *Procedia Engineering*, *212*, pp.902-909.

Manandhar, M., Hawkes, S., Buse, K., Nosrati, E. and Magar, V., 2018. Gender, health and the 2030 agenda for sustainable development. *Bulletin of the World Health Organization*, *96*(9), p.644.

Manisalidis, I., Stavropoulou, E., Stavropoulos, A. and Bezirtzoglou, E., 2020. Environmental and health impacts of air pollution: a review. *Frontiers in Public Health*, *8*, p.14.

Manneh, M., Kozhevnikov, M. and Chazova, T., 2020. Determinants of consumer preference for petrol consumption: The case of petrol retail in the Gambia. *International Journal of Energy Production and Management, 5*(2), pp.175-186.

Mannucci, P.M. and Franchini, M., 2017. Health Effects of Ambient Air Pollution in Developing Countries. *International Journal of Environmental Research and Public Health, 14*(9), p.1048.

Maps of World 2002-2017.Nigeria Map [Accessed 7 December 2017].

Margarita, G.R., Diep, L., Mulligan, J., Mukanga, P. and Parikh, P., 2022. Linking the UN SDGs and African Agenda 2063: Global goals and local priorities for Africa. *World Development Sustainability*, p.100010.

Mariano, J. and La Rovere, E., 2017. Environmental impacts of the oil industry. LAP Lambert Academic Publishing.

Mark, J. and Nwaiwu, J.N., 2015. Impact of political environment on business performance of multinational companies in Nigeria. *African Research Review*, *9*(3), pp.1-10.

Markham, A.C., 2019. *A brief history of pollution*. Routledge. London.

Marriam, S.B. & Tisdell, E.J, 2015. Qualitative Research: A guide to design and implementation, 4thedn, Wiley, Newark

Marsh, H.W., Huppert, F.A., Donald, J.N., Horwood, M.S. and Sahdra, B.K., 2020. The well-being profile (WB-Pro): Creating a theoretically based multidimensional measure of well-being to advance theory, research, policy, and practice. *Psychological Assessment*, *32*(3), p.294.

Martin, P.A., Zanin, A.C. and Odloak, D., 2019. Integrating Real Time Optimization and Model Predictive Control of a Crude Distillation Unit. *Brazilian Journal of Chemical Engineering*, *36*(3), pp.1205-1222.

Masovic, A., 2018. Socio-cultural factors and their impact on the performance of multinational companies. *Ecoforum Journal*, *7*(1).

Massoudi, A.H. and Hamdi, S.S.A., 2017. The Consequence of work environment on Employees Productivity. *Journal of Business and Management*, *1*(3), pp.35-42.

Mateo-Sagasta, J., Zadeh, S.M., Turral, H. and Burke, J., 2017. *Water pollution from agriculture: a global review.* Publisher: The Food and Agriculture Organisation of the United Nations Rome and the International Water Management Institute on behalf of the Water Land and Ecosystem research program Colombo. Rome, Italy.

Matsuo, M., 2021. Promoting employee's self-change skills: The role of job characteristics, goal clarity and learning goals. *International Journal of Training and Development*, *25*(1), pp.60-76.

Mattiuzzi, C. and Lippi, G., 2020. Worldwide epidemiology of carbon monoxide poisoning. *Human & Experimental Toxicology*, *39*(4), pp.387-392.

Matud, M.P., Bethencourt, J.M., Ibáñez, I. and Fortes, D., 2020. Gender and psychological well-being in older adults. *International Psychogeriatrics*, *32*(11), pp.1293-1302.

Mays, N. and Pope, C., 1995. Qualitative research: rigour and qualitative research. *Bmj*, *311*(6997), pp.109-112.

Mazidi, M. and Speakman, J.R., 2017. Ambient particulate air pollution (PM2. 5) is associated with the ratio of type 2 diabetes to obesity. *Scientific Reports,* 7(1), p.9144.

McCreddin, A., Gill, L., Broderick, B. and McNabola, A., 2013. Personal exposure to air pollution in office workers in Ireland: measurement, analysis and implications. *Toxics,* 1(1), pp.60-76.

McCrudden, M.T., Marchand, G. and Schutz, P., 2019. Mixed methods in educational psychology inquiry. *Contemporary Educational Psychology* 57, pp.1–8

McKerrow, I., Carney, P.A., Caretta-Weyer, H., Furnari, M. and Miller Juve, A., 2020. Trends in medical students'stress, physical, and emotional health throughout training. *Medical Education Online*, *25*(1), p.1709278.

McMahon, T.A., Rohr, J.R. and Bernal, X.E., 2017. Light and noise pollution interact to disrupt interspecific interactions. *Ecology*, *98*(5), pp.1290-1299.

Meng, G.R.A., Oni, T.M. and Shendell, D.G., 2020. Carbon Monoxide Exposure and Reported Health Conditions Among Filling Station Attendants in Ibadan, Nigeria. *Journal of Environmental Health*, *83*(1), pp.26-31.

Menkiti, N.U. and Agunwamba, J.C., 2015. Assessment of noise pollution from electricity generators in a high-density residential area. *African Journal of Science, Technology, Innovation and Development*, *7*(4), pp.306-312.

Merchant, N.D., Andersson, M.H., Box, T., Le Courtois, F., Cronin, D., Holdsworth, N., Kinneging, N., Mendes, S., Merck, T., Mouat, J. and Norro, A.M., 2020. Impulsive noise pollution in the Northeast Atlantic: Reported activity during 2015–2017. *Marine Pollution Bulletin*, *152*, p.110951.

Merem, E.C., Twumasi, Y., Wesley, J., Isokpehi, P., Shenge, M., Fageir, S., Crisler, M., Romorno, C., Hines, A., Hirse, G. and Ochai, S., 2017. Assessing the ecological effects of mining in West Africa: the case of Nigeria. *International Journal of Mining Engineering and Mineral Processing,* 6(1), pp.1-19.

Mertens, D.M. and Wilson, A.T., 2018. *Program evaluation theory and practice*. Guilford Publications. New York.

Mesfin, K., Hasen, A.S. and Birhanu, M., 2018. Determination of Noise Pollution Level in Dire-Dawa City, Ethiopia. *International Journal of Environmental Sciences & Natural Resources*, *8*(2), pp.61-65.

Meskhia, I. and Shaburishvili, S., 2015. Basics of researche of the technological environment of business. *Zeszyty Naukowe Uniwersytetu Przyrodniczo-Humanistycznego w Siedlcach. Administracja i Zarządzanie,* 34(107), pp.117-124.

Mette, J., Garrido, M.V., Harth, V., Preisser, A.M. and Mache, S., 2018. Healthy offshore workforce? A qualitative study on offshore wind employees' occupational strain, health, and coping. *BMC Public Health,* 18(1), pp.1-14.

Mettling, S., Lee, J.M., Blount, A. and Dinkel, D., 2018. A Needs Assessment for Physical Activity Programming Based on the Transtheoretical Model. *Recreational Sports Journal*, *42*(2), pp.202-216.

Mhlanga, O. and Steyn, J.N., 2017. Impacts of the macro environment on airline operations in southern Africa. Mhlanga, O., 2017. Impacts of the macro environment on airline operations in southern Africa. *African Journal of Hospitality, Tourism and Leisure, 6(1). ISSN: 2223-814X.*

Michalak, E.E., Jones, S., Lobban, F., Algorta, G.P., Barnes, S.J., Berk, L., Berk, M., Hole, R., Lapsley, S., Maxwell, V. and Milev, R., 2016. Harnessing the potential of community-based participatory research approaches in bipolar disorder. *International Journal of Bipolar Disorders*, 4(1), pp.1-9.

Michel, J. and Fingas, M., 2016. Oil Spills: Causes, Consequences, Prevention, and Countermeasures. Fossil Fuels: *Current Status and Future Directions,* 1, p.159.

Mihajlović, V., Grba, N., Suđi, J., Eichert, D., Krajinović, S., Gavrilov, M.B. and Marković, S.B., 2021. Assessment of Occupational Exposure to BTEX in a Petrochemical Plant via Urinary Biomarkers. *Sustainability*, *13*(13), p.7178.

Millennium Development Goals (Nigeria), 2010. Countdown strategy 2010 to 2015: Achieving the MDGs. Abuja: Federal Government of Nigeria.

Miller, D., 2019. How is Gasoline Made and Sold? : Where Do Goods Come From?. Cavendish Square Publishing, LLC. USA.

Miller, M.R. and Newby, D.E., 2020. Air pollution and cardiovascular disease: car sick. *Cardiovascular Research*, *116*(2), pp.279-294.

Mishra, A.K. and Kumar, G.S., 2015. Weathering of oil spill: modeling and analysis. *Aquatic Procedia,* 4, pp.43`-442.

Mishra, R.K., Mohammad, N. and Roychoudhury, N., 2016. Soil pollution: Causes, effects and control. *Tropical Forest Research Institute,* 3(1), pp.20-30.

Mitra, A., 2018. Chapter 7: Environmental Pollution and Its Control. Doi:10.13140/RG.2.2.26048.17927.

Moghadam, S.R., Afshari, M., Ganjali, A. and Moosazadeh, M., 2020. Effect of occupational exposure to petrol and gasoline components on liver and renal biochemical parameters among

gas station attendants, a review and meta-analysis. *Reviews on Environmental Health*, *35*(4), pp.517-530.

Mohammadi, L., Rahdar, A., Bazrafshan, E., Dahmardeh, H., Susan, M., Hasan, A.B. and Kyzas, G.Z., 2020. Petroleum Hydrocarbon Removal from Wastewaters: A Review. *Processes*, *8*(4), p.447.

Mohammadyan, M., Golafshani, F.Y., Yousefinejad, R., Boogaard, P.J. and Heibati, B., 2016. Risk Assessment of Benzene among Gas Station Refueling Workers. *Feb-Fresenius Environmental Bulletin*, p.3563.

Mohammed, A. and Elias, E., 2017. Domestic waste management and its environmental impacts in Addis Ababa City. *African Journal of Environmental and Waste Management,* 4 (3), pp. 206-216.

Mohammed, G., Karani, G., and Mitchell, D., 2017. Trace Elemental Composition in PM10 and PM2.5 Collected in Cardiff, Wales. *Energy Procedia (*111) 540 – 547.

Mohammed, M. U., Musa, I. J., and Jeb, D.N., 2014. GIS-Based Analysis of the Location of Filling Stations in Metropolitan Kano against the Physical Planning Standards. *American Journal of Engineering Research*, 3(9): 147-158.

Mojarad, S.A. A., Atashbari, V. and Tantau, A., 2018. Challenges for sustainable development strategies in oil and gas industries. *Proceedings of the 12th International Conference on Business Excellence*. pp. 626-638, ISSN 2558-9652.

Mokarami, H., Gharibi, V., Kalteh, H.O., Kujerdi, M.F. and Kazemi, R., 2020. Multiple environmental and psychosocial work risk factors and sleep disturbances. *International Archives of Occupational and Environmental Health*, 93 (5) pp.623-633.

Moke, E.G., 2019. Adherence to safety practices and the effect of petroleum products on petrol station attendants in Abraka, Delta State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 23(11), pp.2009-2012.

Molloy, B.K., Stock, M.L., Dodge, T. and Aspelund, J.G., 2019. Predicting Future Academic Willingness, Intentions, and Nonmedical Prescription Stimulant (NPS) Use with the Theory

of Reasoned Action and Prototype/Willingness Model. *Substance Use & Misuse*, *54*(14), pp.2251-2263.

Monney, I., Dramani, J.B., Aruna, A., Tenkorang, A.G. and Osei-Poku, F., 2015. Health and safety in high-risk work environments: A study of fuel service stations in Ghana. *Journal of Environmental and Occupational Health*, *4*(3), pp.132-140.

Monroe, M., Morse, E. and Price, J.M., 2020. The Relationship Between Critical Care Work Environment and Professional Quality of Life. *American Journal of Critical Care*, *29*(2), pp.145-149.

Moolla, R., Curtis, C.J. and Knight, J., 2015. Assessment of occupational exposure to BTEX compounds at a bus diesel-refueling bay: A case study in Johannesburg, South Africa. *Science of the Total Environment*, 537, pp.51-57.

Morakinyo, O.M., Adebowale, A.S., Mokgobu, M.I. and Mukhola, M.S., 2017. Health risk of inhalation exposure to sub-10 μm particulate matter and gaseous pollutants in an urban-industrial area in South Africa: an ecological study. *BMJ Open*, 7(3), p.e013941.

Morakinyo, O.M., Mukhola, M.S. and Mokgobu, M.I., 2020. Ambient Gaseous Pollutants in an Urban Area in South Africa: Levels and Potential Human Health Risk. *Atmosphere*, *11*(7), p.751.

Moreira, P.A., Faria, V., Cunha, D., Inman, R.A. and Rocha, M., 2020. Applying the transtheoretical model to adolescent academic performance using a person-centered approach: A latent cluster analysis. *Learning and Individual Differences*, *78*, p.101818.

Moreno Fortes, A., Tian, L. and Huebner, E.S., 2020. Occupational stress and employees complete mental health: a cross-cultural empirical study. *International Journal of Environmental Research and Public Health*, *17*(10), p.3629.

Morgan, D.L., 2014. Pragmatism as a paradigm for social research. *Qualitative Inquiry*, *20*(8), pp.1045-1053.

Moridi, P., Atabi, F., Nouri, J. and Yarahmadi, R., 2017. Selection of optimized air pollutant filtration technologies for petrochemical industries through multiple-attribute decision-making. *Journal of Environmental Management,* 197, pp.456-463.

Moridzadeh, M., Dehghani, S., Rafiee, A., Hassanvand, M.S., Dehghani, M. and Hoseini, M., 2020. Assessing BTEX exposure among workers of the second largest natural gas reserve in the world: a biomonitoring approach. *Environmental Science and Pollution Research*, *27*(35), pp.44519-44527.

Moro, A.M., Brucker, N., Charão, M.F., Sauer, E., Freitas, F., Durgante, J., Bubols, G., Campanharo, S., Linden, R., Souza, A.P. and Bonorino, C., 2015. Early hematological and immunological alterations in gasoline station attendants exposed to benzene. *Environmental Research*, 137, pp.349-356.

Moro, A.M., Sauer, E., Brucker, N., Charão, M.F., Gauer, B., do Nascimento, S.N., Goethel, G., Duarte, M.M.M.F. and Garcia, S.C., 2019. Evaluation of immunological, inflammatory, and oxidative stress biomarkers in gasoline station attendants. *BMC Pharmacology and Toxicology*, *20*(1), pp.1-9.

Mosavi, F., Aliakbari, F. and Rabiei, L., 2020. Effect of education based on "PRECEDE" model on self-care behavior in hemodialysis patients. *Journal of Education and Health Promotion*, *9* (69).

Moya-Alvarez, V., Mireku M.O., Ayotte P., Cot, M, Bodeau-Livinec, F., 2016. Elevated Blood Lead Levels are Associated with Reduced Risk of Malaria in Beninese Infants. *PLoS ONE* 11(2): e0149049. doi:10.1371/journal.pone.0149049

Moyo, D., Zungu, M., Kgalamono, S. and Mwila, C.D., 2015. Review of occupational health and safety organization in expanding economies: the case of Southern Africa. *Annals of Global Health,* 81(4), pp.495-502.

Mshelia, A.M., John, A. and Emmanuel, D.D., 2015. Environmental effects of petrol stations at close proximities to residential buildings in Maiduguri and Jere, Borno State, Nigeria. *IOSR Journal of Humanities and Social Science*, *20*, pp.1-8.

Muhammad, K.G. and Rana, A., 2020. Socio-Economic Development: the Impacts of Micro, Small, and Medium Scale Enteprises in Nigeria. Sustainable *Humanosphere,* 16(2), pp.448-460.

Muhammad, S.A., Oye, N.D. and Inuwa, I., 2011. Unemployment in Nigeria: implication on the gross domestic product (gdp) over the years. *International Journal Economics Resources*, *2*(1), pp.66-71.

Muhammad, S.A., Oye, N.D. and Inuwa, I., 2011. Unemployment in Nigeria: implication on the gross domestic product (gdp) over the years. *International Journal Economics Resources,* 2(1), pp.66-71.

Muhsin, F.A.R., 2020. Relation between Working in Petrol Station and Blood Hemoglobin Levels for the Filling Workers in Al-Najaf City/Iraq. *Indian Journal of Forensic Medicine & Toxicology*, *14*(2), p.492.

Muhsin, W.A., Zhang, J. and Lee, J., 2016. Modelling and Optimisation of a Crude Oil Hydrotreating Process Using Neural Networks. In 19th Conference on Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (PRES 2016). Newcastle University.

Muindi, F. and K'Obonyo, P., 2015. Quality of work life, personality, job satisfaction, competence, and job performance: a critical review of literature. *European Scientific Journal*, *11*(26), pp. 223-240.

Mukherjee, S. and Das, S.M., 2017. *SAP MII: Functional and Technical Concepts in Manufacturing Industries*. Apress. California.

Mulyana, Y., 2021. The Influence of Motivation, Ability, Organizational Culture, Work Environment on Teachers Performance. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(7), pp.99-108.

Munnangi S. and Boktor S. W., 2017. *Epidemiology of Study Design.* Treasure Island (FL): StatPearls Publishing. [Online] Available from:< https://www.ncbi.nlm.nih.gov/books/NBK470342/>

Muralidharan, S., La Ferle, C. and Pookulangara, S., 2018. Studying the impact of religious symbols on domestic violence prevention in India: applying the theory of reasoned action to bystanders' reporting intentions. *International Journal of Advertising*, *37*(4), pp.609-632.

Muriithi, S., 2017. African small and medium enterprises (SMEs) contributions, challenges and solutions. *European Journal of Research and Reflection in Management Sciences,* 5(1), pp. 36-48.

Musa, A.,2015. Attainability of Millennium Development Goals (MDGs) in Nigeria: Current Challenges and Future Prospects. *Journal of Economics and Sustainable Development*, 6(19) pp. 45-50.

Musa, M.R., 2020. Understanding foreign investment regulations in Nigerian mining industry. *International review of law and jurisprudence* (IRLJ), 2(3), pp. 11-19.

Mytton, O.T., Panter, J. and Ogilvie, D., 2016. Longitudinal associations of active commuting with wellbeing and sickness absence. *Preventive Medicine*, *84*, pp.19-26.

Na, J.U., Sim, M.S., Jo, I.J. and Song, H.G., 2012. The duration of acute health problems in people involved with the cleanup operation of the Hebei Spirit oil spill. *Marine Pollution Bulletin*, 64(6), pp.1246-1251.

Nadybal, S.M., Collins, T.W. and Grineski, S.E., 2020. Light pollution inequities in the continental United States: A distributive environmental justice analysis. *Environmental Research*, *189*, p.109959.

Nair, P.R. and Subash, T., 2019. Quality of work life and job satisfaction: A comparative study. *International Journal of Business and Management*, *8*(2), pp.15-21.

Namuhani, N. and Cyrus, K., 2015. Soil Contamination with Heavy Metals around Jinja Steel Rolling Mills in Jinja Municipality, Uganda. *Journal of Health and Pollution,* 5(9), pp.61-67.

Nathanson, A.J., 2017. Pollution ENVIRONMENT. Encylopaedia Britannica. Available at:<https://www.britannica.com/science/pollution-environment> [Accessed 10 April 2018].

National Bureau of Statistics (Nigeria), 2021. Key indicators. [online] Available at < https://www.nigerianstat.gov.ng/> [Accessed 27 March 2021].

National Centre for Biotechnology information (NCBI), 2018a. Pubchem Compound Database; CID=241. Available at:< hhtps://pubchem.ncbi.nlm.nih.gov/compound/241>. [Accessed 26 February 2021].

National Centre for Biotechnology information (NCBI), 2018b. Pubchem Compound Database; CID=1140. Available at:< hhttps://pubchem.ncbi.nlm.nih.gov/compound/1140>. [Accessed 26 February 2021].

National Centre for Biotechnology information (NCBI), 2018c. Pubchem Compound Database; CID=7500. Available at:<hhttps://pubchem.ncbi.nlm.nih.gov/compound/7500>. [Accessed 26 February 2021].

National Institute for occupational Safety and Health (NIOSH), 2015. ETHYLBENZENE. Available at:<https://www.cdc.gov/niosh/ipcsneng/neng0268.html>[Accessed 27 March 2021].

Naude, M.J. and Chiweshe, N., 2017. A proposed operational risk management framework for small and medium enterprises. *South African Journal of Economic and Management Sciences*, *20*(1), pp.1-10.

Nawrocka, D. and Parker, T., 2009. Finding the connection: environmental management systems and environmental performance. *Journal of Cleaner Production*, 17(6), pp.601-607.

NCH Europe, 2018. Properties of Diesel Fuel. Available at:<https://www.ncheurope.com/en/properties-of-diesel-fuel> [Accessed 5 July 2019].

Nganje, T.N., Edet, A.E. and Ekwere, S.J., 2007. Distribution of PAHs in surface soils from petroleum handling facilities in Calabar. *Environmental Monitoring and Assessment*, *130*(1), pp.27-34.

Nghitanwa, E.M. and Lindiwe, Z., 2017. Occupational accidents and injuries among workers in the construction industry of Windhoek, Namibia. *International Journal of Health (Dubai)*, *5*(1), pp.55-59.

Ngwama, J.C., 2016. Framework for occupational health and safety in Nigeria: the implication for the trade union movement. *Journal of Economics and Sustainable Development*, 7(11), pp. 98-109.

Ngwenya, N., Nkosi, B., Mchunu, L.S., Ferguson, J., Seeley, J. and Doyle, A.M., 2020. Behavioural and socio-ecological factors that influence access and utilisation of health

services by young people living in rural KwaZulu-Natal, South Africa: Implications for intervention. *Plos One*, *15*(4), p.e0231080.

Niaz, K., Bahadar, H., Maqbool, F. and Abdollahi, M., 2015. A review of environmental and occupational exposure to xylene and its health concerns. *EXCLI journal,* 14, p.1167

Niba Rawlings, N., Ambe, A.E. and Ngongalah, L., 2021. Air pollution exposure in relation to guard duty at Tidworth Camp: A cross-sectional study. *Plos one*, 16(9), p.e0258070.

Nidaul Izzah, S.E., Novita Rini, S.A.B. and Poernomo, B., 2019. The Influence of Non-Physical Work Environment and Job Characteristics on Employee Performance at P.T. Daliatex Kusuma in Bandung. *International Journal of Social Sciences Perspectives*, *4*(1), pp.22-37.

Nigeria High commission, 2021. About: Nigeria. Available at:<http://www.nigeriahc.org.uk/about-nigeria> [Accessed 27 March 2021]

Nigeria, MDGcountdown Strategy 2012 To 2015: Achieving the MDGS. Available at:< https://pdfslide.net/documents/mdgs-nigeria-countdown-strategy-2012-to-2015-achieving-the-mdgs.html> [Accessed 10 August 2020].

Nigerian National Petroleum Corporation, 2016. Nigeria Profile. Available at: https://nnpcgroup.com/NNPC-Business/Business-Information/Pages/Nigeria-Profile.aspx> [Accessed 10 September 2019].

Nigri, E.M., Santos, A.L. and Rocha, S.D., 2020. Removal of organic compounds, calcium and strontium from petroleum industry effluent by simultaneous electrocoagulation and adsorption. *Journal of Water Process Engineering*, *37*, p.101442.

Nogal-Meger, P., 2018. The quality of business legal environment and its relation with business freedom. *International Journal of Contemporary Management*, *17*(2), pp.111-136.

Norah, M., Shumirai, Z., Zelma, L. M. and Upenyu, M., 2015. Impacts of Untreated Sewage Discharge on Water Quality of Middle Manyame River: A Case of Chinhoyi Town, Zimbabwe. *International Journal of Environmental Monitoring and Analysis,* 3, (3) pp. 133-138. doi: 10.11648/j.ijema.20150303.14.

Nriagu, J., Udofia, E.A., Ekong, I. and Ebuk, G., 2016. Health risks associated with oil pollution in the Niger Delta, Nigeria. *International Journal of Environmental Research and Public Health,* 13(3), p.346.

Nur, N., Kıbık, A., Kılıç, E. and Sümer, H., 2017. Health-related quality of life and associated factors among undergraduate university students. *Oman Medical Journal*, *32*(4), p.329.

Nuramalina, G.A. and Cahyadi, E.R., 2021. How Does Work Environment Influence Productivity During Covid-19 Pandemics? A Case Study In Ipb University. *Jurnal Aplikasi Bisnis dan Manajemen (JABM)*, *7*(2), pp.295-295.

Nyirendaavwil, V., Chinniah, Y. and Agard, B., 2015. Identifying key factors for an occupational health and safety risk estimation tool in small and medium-size enterprises. *IFAC-PapersOnLine*, *48*(3), pp.541-546.

Obi, J.N., 2015. The role of small-scale enterprises in the achievement of economic growth in Nigeria. *International Journal of Social Sciences and Humanities*, 3(1), pp.1-27.

Obidimma, A.E. and Obidimma, E.O., 2015. Restructuring the Nigerian federation for proper functioning of the Nigerian federalism. *Public Policy and Administration*, *5*(9), pp.147-157.

Odipe, O.E., Sawyerr, H.O. and Adewoye, S.O., 2020. Characterized Organic Pollutants and Their Health Effects in Sampled Groundwater Around Ilorin Metropolis. *International Journal of Environmental Protection and Policy*, *8*(2), p.36.

Odipe, O.E., Sawyerr, H.O. and Adewoye, S.O., 2020. Control Measures on Groundwater Pollution through Leakages of Underground Storage Tanks of Filling Stations in Nigeria. *Journal of Scientific Research and Reports,* 26(5), pp.98-105.

Odunyemi, T.F., 2015. Millennium Development Goals in Nigeria, A Reality or a Mirage. *IOSR-Journal of Nursing and Health Science* (IOSR-JNHS), 4(4), pp.33-39.

Office of the Senior Special Assistant to the President on Millennium Development Goals (OSSAP-MDGs), 2015. Nigeria 2015 Millennium Development Goals (MDGs) End-point Report. [pdf]

Ogbodo, J.A. and Ogbodo, J.I., 2021. Analyzing the progress, pitfalls and prospects for attaining environmental-related sustainable development goals in Nigeria. *Animal Research International*, 18(1), pp.3990-4004.

Ogbonnaya, U.M., 2016. Terrorism, Agenda 2063 and the challenges of development in Africa. *South African Journal of International Affairs,* 23(2), pp.185-199.

Ogbuoji, O. and Yamey, G., 2019. How many child deaths can be averted in Nigeria? Assessing state-level prospects of achieving 2030 sustainable development goals for neonatal and under-five mortality. *Gates Open Research,* 3:1460. (https://doi.org/10.12688/gatesopenres.12928.1).

Ogen, Y., 2020. Assessing nitrogen dioxide (NO2) levels as a contributing factor to the coronavirus (COVID-19) fatality rate. *Science of The Total Environment*, 726, p.138605.

Ogri, O.R., 2001. A review of the Nigerian petroleum industry and the associated environmental problems. *Environmentalist,* 21(1), pp.11-21.

Ogu, R.N., Agholor, K.N. and Okonofua, F.E., 2016. Engendering the attainment of the SDG-3 in Africa: overcoming the socio cultural factors contributing to maternal mortality. *African Journal of Reproductive Health,* 20(3), pp.62-74.

Ogunkoya, O.O., 2016. Urban planning, downstream petroleum industry and human health. *Ife Journal of Science,* 18(4), pp.963-971.

Ogunleye, E.K., 2008. Natural resource abundance in Nigeria: From dependence to development. *Resources Policy,* 33(3), pp.168-174.

Ohwo, O., 2019. Analysis of households' vulnerability to waterborne diseases in Yenagoa, Nigeria. *Journal of Water, Sanitation and Hygiene for Development*, *9*(1), pp.71-79.

Oil well, (2020), in Cambridge Dictionary, Cambridge University Press Available at:<<https://dictionary.cambridge.org/dictionary/english/oil-well>. [Accessed 4 June 2020].

Okafoagu, C.N., Oche,O.M., Gana, J.G., Ango, T.J., and Yunusa U.E., 2017. Knowledge of occupational hazards and safety practices among petrol station attendants in Sokoto metropolis, Sokoto State, Nigeria. *Journal of Occupational Health and Epidemiology*, 6(3), pp.122-127.

Okedere, O.B., Sonibare, J.A., Ajala, O.E., Adesina, O.A. and Elehinafe, F., 2017. Estimation of sulphur dioxide emission from consumption of premium motor spirit and automotive gas oil in Nigeria. *Cogent Environmental Science*, 3(1), p.1330456.

Okeola, O.G. and Sule, B.F., 2012. Evaluation of management alternatives for urban water supply system using Multicriteria Decision Analysis. Journal of King Saud University-*Engineering Sciences*, 24(1), pp.19-24.

Okolie, V.O., Cisana, S., Schanfield, M.S., Adekoya, K.O., Oyedeji, O.A. and Podini, D., 2017. Population data of 21 autosomal STR loci in the Hausa, Igbo and Yoruba people of Nigeria. *International Journal of Legal Medicine*, 132 (3), pp. 735-737.

Okonkwo C.U., Orji, N.I., and Onwuamaeze, I., 2014. Environmental impact assessment of petrol and gas filling stations on air quality in Umuahia, Nigeria. *Global Journal of Engineering Research* (13) pp. 11-20.

Okoronkwo, C., 2017. A Review of the Nigerian Minerals/Mining Act 2007 for Economic Transformation. *International Journal of Innovative Research in Education, Technology & Social Strategies,* 4 (1), pp.40-45.

Okoye, P. U., 2018. Occupational Health and Safety Risk Levels of Building Construction Trades in Nigeria. *Construction Economics and Building,* 18(2), 92-109. https://doi.org/10.5130/AJCEB.v18i2.5882

Okumah, M., Chapman, P.J., Martin-Ortega, J. and Novo, P., 2019. Mitigating agricultural diffuse pollution: uncovering the evidence base of the awareness–behaviour–water quality pathway. *Water*, *11*(1), p.29.

Olabode, K.T., Adeigbe, Y., Kayode, Z.Y.H. and Owonibi, E., 2014. Millennium development goals (MDGs) in Nigeria: issues and problems. *Global Journal of Human-Social Science: Sociology & Culture,* 14(5), pp.42-53.

Olade, M.A., 2019. Solid Mineral Deposits and Mining in Nigeria: A Sector in Transitional Change. *Achievers Journal of Scientific Research*, 2, pp.1-16.

Oldenburg, M., Jensen, H.J. and Wegner, R., 2013. Burnout syndrome in seafarers in the merchant marine service. *International Archives of Occupational and Environmental Health,* 86(4), pp.407-416.

Olds, H.T., Corsi, S.R., Dila, D.K., Halmo, K.M., Bootsma, M.J. and McLellan, S.L., 2018. High levels of sewage contamination released from urban areas after storm events: A quantitative survey with sewage specific bacterial indicators. *PLoS Medicine*, *15*(7), p.e1002614.

Oleribe, O.O. and Taylor-Robinson, S.D., 2016. Before sustainable development goals (SDG): why Nigeria failed to achieve the millennium development goals (MDGs). *The Pan African Medical Journal,* 24 (156). doi:10.11604/pamj.2016.24.156.8447.

Oliveira-Martins, C.R. and Grisolia, C.K., 2009. Toxicity and genotoxicity of wastewater from gasoline stations. *Genetics and Molecular Biology*, *32*(4), pp.853-856.

Oloko-oba M. O, Badru R. A, Popoola O. S., Alaga T. A., Ogunyemi S. A., & Samson S. A., 2016. Assessment of Filling Station in Ilorin, Kwara State, Nigeria Using Geospatial Techniques. International Journal of Scientific Research in Computer Science, *Engineering and Information Technology,* (1)2, pp.7.

Olsen, T., 2014. An oil refinery walk-through. *Chemical Engineering Progress*, *110*(5), pp.34-40.

Olubodun, I.E., 2019. Influence of Political Environment on Firms'Corporate Performance: Evidence from Selected Manufacturing Firms in Oyo State, Nigeria. *International Journal of Management and Marketing Research*, *12*(1), pp.37-50.

Olukunle, O.F., Babajide, O. and Boboye, B., 2015. Effects of Temperature and pH on the Activities of Catechol 2, 3-dioxygenase Obtained from Crude Oil Contaminated Soil in Ilaje, Ondo State, Nigeria. *The Open Microbiology Journal*, 9, p.84.

Oluleye, A. and Ochei, M., 2017. Tropospheric Ozone Pollution in Some Major Cities of West Africa and its Relationship with Atmospheric Circulations. Pollution, 3(1), pp.123-146.

Olumıde, O.J. and Bada, A.A., 2021. Achieving the New Sustainable Development Goals: The Role of Scientific Research in Nigerian Universities. *European Journal of Education Studies,* 8(2), pp.461-477.

Omolekan, O.J., 2021. Empirical Analysis of Office Ergonomics and Employees' health and Safety in Nigerian Universities. *Ilorin Journal of Human Resource Management*, 5(01), pp.242-250.

Ondieki, M.C., 2015. Aspects of Water Quality and Water Pollution Control in Vulnerable Environments. *Journal of Geography and Earth Sciences* 3, (2), pp. 83-93.

Onwuegbuzie, A.J., Bustamante, R.M. and Nelson, J.A., 2010. Mixed research as a tool for developing quantitative instruments. *Journal of Mixed Methods Research*, *4*(1), pp.56-78.

Onyishi, I.E., Ugwu, F.O., Onyishi, C.N. and Okwueze, F.O., 2018. Job demands and psychological well-being: Moderating role of occupational self-efficacy and job social support among mid-career academics. *Journal of Psychology in Africa*, *28*(4), pp.267-272.

Oregon PSR 2015. Airborne Particulate Matter and Public Health. http://www.psr.org/chapters/oregon/assets/pdfs/airborne-particulate-matter.pdf. [Accessed 27 March 2017] .

Organisation for Economic Co-operation and Development (OECD), 2017. Diffuse Pollution, Degraded Waters: Emerging Policy Solutions. https://www.oecd.org/environment/resources/Diffuse-Pollution-Degraded-Waters-Policy-Highlights.pdf. [Accessed 27 March 2017].

Organisation of the Petroleum Exporting Countries (OPEC), 2021. Nigeria facts and figures. [online]. Available at < https://www.opec.org/opec_web/en/about_us/167.htm#:~:text=Apart%20from%20petroleum %2C%20Nigeria's%20other,cent%20of%20total%20exports%20revenue.> [Accessed 27 March 2021].

Organization For Economic Cooperation and Development (OECD), 2017. *OECD Guidelines on Measuring the Quality of the Working Environment.* OECD Publishing, Paris. *http://dx.doi.org/10.1787/9789264278240-en*

Orina, J.O., Were, S. and Muturi, W.,2018. The Influence of Institutional Leadership on Corruption Levels in The Public Service In Kenya. *International Journal of Economics, Commerce and Management United Kingdom,* 4(3),pp.162-184.

Orogbu, L., Onyeizugbe, C.U. and Chukwuma, E., 2017. Economic environment of small and medium scale enterprises: Implications on economic growth in Nigeria. *Journal of Economics, Management and Trade,* pp.1-12.

Osotimehin, K.O., Jegede, C.A., Akinlabi, B.H. and Olajide, O.T., 2012. An evaluation of the challenges and prospects of micro and small scale enterprises development in Nigeria. *American International Journal of Contemporary Research*, 2(4), pp.174-185.

Östlund, U., Kidd, L., Wengström, Y. and Rowa-Dewar, N., 2011. Combining qualitative and quantitative research within mixed method research designs: a methodological review. *International Journal of Nursing Studies*, *48*(3), pp.369-383.

Otaye-Ebede, L., Shaffakat, S. and Foster, S., 2020. A multilevel model examining the relationships between workplace spirituality, ethical climate and outcomes: A social cognitive theory perspective. *Journal of Business Ethics*, *166*(3), pp.611-626.

Oti, P.A. and Mbu-Ogar, G.B.M., 2018. Analysis of environmental and social disclosure and financial performance of selected quoted oil and gas companies in Nigeria (2012-2016). *Journal of Accounting and Financial Management*, 4(2), p.2018.

Otter, D. and Wetherly, P. eds., 2018. *The Business Environment: Themes and Issues in a Globalizing World*. Oxford University Press.UK.

Ovuakporaye, S.I., 2019. Assessment of changes in cardiovascular parameters among petrol pump attendants in Ughelli, Delta State Nigeria. *Journal of Applied Sciences and Environmental Management*, *23*(11), pp.2071-2075.

Owa, F.W., 2014. Water pollution: sources, effects, control and management. *International Letters of Natural Sciences,* 3, pp.1-6.

Owuor, O.J., Juma, O.A. and Johnmark, O.,2018. Effect of Organizational Environment on Procurement Performance of Sugar Firms in Kenya. *American Journal of Business and Society*, 3(3), pp. 83-93.

Oyedepo, O.S. and Saadu, A.A., 2010. Evaluation and analysis of noise levels in Ilorin metropolis, Nigeria. *Environmental Monitoring and Assessment*, *160*(1-4), p.563.

Oyedokun, G.E. and Micah, E.E.M., 2019. Small and Medium Scale Enterprises and Economic Growth in Nigeria. *Islamic University Multidisciplinary Journal.* 6(4).

Oyekan, S.O., 2018. *Catalytic Naphtha Reforming Process*. CRC Press. Boca Raton.

Padgett, D. and Loos, A., 2019. *Applied Marketing: Connecting Classrooms to Careers.* John Wiley & Sons. USA

Page, T.E., Farina, N., Brown, A., Daley, S., Bowling, A., Basset, T., Livingston, G., Knapp, M., Murray, J. and Banerjee, S., 2017. Instruments measuring the disease-specific quality of life of family carers of people with neurodegenerative diseases: a systematic review. *BMJ Open*, *7*(3), p.e013611.

Palanisamy, N., Ramya, J., Kumar, S., Vasanthi, N.S., Chandran, P. and Khan, S., 2014. Diesel biodegradation capacities of indigenous bacterial species isolated from diesel contaminated soil. *Journal of Environmental Health Science and Engineering,* 12(1), p.142.

Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N. and Hoagwood, K., 2015. Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research*, *42*(5), pp.533-544.

Palinkas, L.A., Mendon, S.J. and Hamilton, A.B., 2019. Innovations in mixed methods evaluations. *Annual Review of Public Health*, *40*, pp.423-442.

Pandey, P. and Pandey, M.M., 2015. *Research methodology: Tools and techniques.* Romania: Bridge Center.

Pandis, N., 2014. Cross- sectional studies. *American Association of Orthodontists Dentofacial Orthop* 146, p.127-9

Panhwar, A.H., Ansari, S. and Shah, A.A., 2017. Post-positivism: an effective paradigm for social and educational research. *International Research Journal of Arts and Humanities*, *45*(45), pp.253-259.

Pasko, O.A. and Mochalova, T.N., 2014. Toxicity assessment of contaminated soils of solid domestic waste landfill. In IOP Conference Series: *Earth and Environmental Science*, 21 (1)p. 012044. IOP Publishing.

Patel, H. and Vashi, R.T., 2015. Characterization and Column Adsorptive Treatment for Cod and Color Removal using Activated Neem Leaf Powder from Textile Wastewater. *Journal of Urban and Environmental Engineering,* 9(1), pp. 45-53.

Patel, K.S., Dahariya, N.S., Chakradhari, S., Sahu, P.K., Rajhans, K.P., Ramteke, S., Lata, L. and Milosh, H., 2015. Sewage Pollution in Central India. *American Journal of Analytical Chemistry,* 6, p.787-796.

Patten, M.L. and Newhart, M., 2017. *Understanding research methods: An overview of the essentials*. Routledge. New York.

Paul, O.O., 2021. Assessment of Petrol Filling Stations Locations in Oyo Township. *Bakolori Journal of General Studies*, *11*(1), pp.1-2.

Pawari, M.J. and Gawande S., 2015. Ground water pollution & its consequence. *International Journal of Engineering Research and General Science*, (4):773-76

Paz-Ferreiro, J., Lu, H., Fu, S., Méndez, A. and Gascó, G., 2014. Use of phytoremediation and biochar to remediate heavy metal polluted soils: a review. *Solid Earth*, 5(1), p.65.

Peersman, G., 2014. Overview: *Data collection and analysis methods in impact evaluation.* UNICEF Office of Research-Innocenti. Florence, Italy.

Pellegrini, E., Lorenzini, G., Loppi, S. and Nali, C., 2014. Evaluation of the suitability of Tillandsia usneoides (L.) L. as biomonitor of airborne elements in an urban area of Italy, Mediterranean basin. *Atmospheric Pollution Research,* 5(2), pp.226-235.

Peña-García, A. and Sędziwy, A., 2020. Optimizing lighting of rural roads and protected areas with white light: a compromise among light pollution, energy savings, and visibility. *Leukos*, *16*(2), pp.147-156.

Pepper, J.R., Barrett, M.A., Su, J.G., Merchant, R., Henderson, K., Van Sickle, D. and Balmes, J.R., 2020. Geospatial-temporal analysis of the impact of ozone on asthma rescue inhaler use. *Environment International*, *136*, p.105331.

Perera, R., 2017. *The PESTLE analysis*. Nerdynaut. Sri Lanka

Pérez-Flores, J., Hernández-Torres, A., Montón, F. and Nieto, A., 2020. Health-related quality of life and depressive symptoms in Friedreich ataxia. *Quality of life research*, *29*(2), pp.413-420.

Pescud, M., Teal, R., Shilton, T., Slevin, T., Ledger, M., Waterworth, P. and Rosenberg, M., 2015. Employers'views on the promotion of workplace health and wellbeing: a qualitative study. *BMC Public Health,* 15(1), pp.1-10.

Peterson, P.J., Aujla, A., Grant, K.H., Brundle, A.G., Thompson, M.R., Vande Hey, J. and Leigh, R.J., 2017. Practical Use of Metal Oxide Semiconductor Gas Sensors for Measuring Nitrogen Dioxide and Ozone in Urban Environments. *Sensors,* 17(7), p.1653.

Pham, C.T., Lee, C.B., Nguyen, T.L.H., Lin, J.D., Ali, S. and Chu, C., 2020. Integrative settings approach to workplace health promotion to address contemporary challenges for worker health in the Asia-Pacific. *Global Health Promotion*, *27*(2), pp.82-90.

Pipal, A.S. and Satsangi, P.G., 2015. Study of carbonaceous species, morphology and sources of fine (PM 2.5) and coarse (PM 10) particles along with their climatic nature in India. *Atmospheric Research*, 154, pp.103-115.

Pitchforth, J., Nelson-White, E., van den Helder, M. and Oosting, W., 2020. The work environment pilot: An experiment to determine the optimal office design for a technology company. *PloS One*, *15*(5), p.e0232943.

Plano Clark, L.V., 2019. Meaningful integration within mixed methods studies: Identifying why, what, when, and how. *Contemporary Educational Psychology* 57, pp. 106-111.

Plano Clark, V.L., Anderson, N., Wertz, J.A., Zhou, Y., Schumacher, K. and Miaskowski, C., 2015. Conceptualizing longitudinal mixed methods designs: A methodological review of health sciences research. *Journal of Mixed Methods Research*, *9*(4), pp.297-319.

Plecher, H., 2020. Labor force participation rate in Nigeria 2020. Statista. Available at< https://www.statista.com/statistics/993908/labor-force-participation-rate-in-nigeria/> [Accessed 27 March 2021]

Plecher, H., 2020. Unemployment rate in Nigeria 2020. Statista [online] Available at < https://www.statista.com/statistics/382366/unemployment-rate-in-nigeria/> [Accessed 16 March 2021].

Pommerehn, J., dos Santos Filha, V.A.V., Miolo, S.B. and Fedosse, E., 2016. Noise and quality of life in the perspective of gas station workers. *Revista CEFAC*, *18*(2), pp.377-384.

Pope III, C.A., Coleman, N., Pond, Z.A. and Burnett, R.T., 2020. Fine particulate air pollution and human mortality: 25+ years of cohort studies. *Environmental Research*, *183*, p.108924.

Pope, R.J., Butt, E.W., Chipperfield, M.P., Doherty, R.M., Fenech, S., Schmidt, A., Arnold, S.R. and Savage, N.H., 2016. The impact of synoptic weather on UK surface ozone and implications for premature mortality. *Environmental Research Letters,* 11(12), p.124004.

Porter, C.M., 2016. Revisiting Precede–Proceed: A leading model for ecological and ethical health promotion. *Health Education Journal*, *75*(6), pp.753-764.

Pöschl, U., 2020. Air Pollution, Oxidative Stress, and Public Health in the Anthropocene. In *Health of People, Health of Planet and Our Responsibility* (pp. 79-92). Springer, Cham.

Post, M., 2014. Definitions of quality of life: what has happened and how to move on. *Topics in Spinal Cord Injury Rehabilitation*, *20*(3), pp.167-180.

Pourmohammadi, K., Bastani, P., Shojaei, P., Hatam, N. and Salehi, A., 2020. A comprehensive environmental scanning and strategic analysis of Iranian Public Hospitals: a prospective approach. *BMC Research Notes*, *13*(1), pp.1-7.

Power, T.M., 2020. *The economic value of the quality of life*. Routledge. New York

Pradhan, P., Costa, L., Rybski, D., Lucht, W. and Kropp, J.P., 2017. A systematic study of sustainable development goal (SDG) interactions. *Earth's Future*, 5(11), pp.1169-1179.

Pradnyana, M.A.W., Agung, A.A.P. and Landra, N., 2019. The Effect of Competence on Employees'performance with Physical and Leadership Work Environment as Moderating Variables on Cv. Bali Bhuana Garment Denpasar. *International Journal of Sustainability, Education and Global Creative Economic (IJSEGCE)*, *2*(1), pp.39-47.

Praveen, K., Ganguly, S., Kumar, K and Kumari, K., 2016. Water Pollution and Its Hazardous Effects to Human Health: A Review on Safety Measures for Adoption. *International Journal of Science, Environment and Technology,* 5(3), pp.1559 – 1563.

Prüss-Ustün, A., Wolf, J., Corvalán, C., Bos, R. and Neira, M., 2016. Preventing disease through healthy environments: A global assessment of the burden of disease from environmental risks. World Health Organization. [pdf] Available at:http://apps.who.int/iris/bitstream/10665/204585/1/9789241565196_eng.pdf?ua=1 [Accessed 27 March 2021].

Public Health England (PHE), 2017. Lead: Toxicological Overview. Available at<https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/653725/Lead_toxicological_overview.pdf.> [Accessed 10 March 2019].

Public Health England (PHE), 2019. Health matters: health and work. [online] Available at < https://www.gov.uk/government/publications/health-matters-health-and-work/health-matters-health-and-work> [Accessed 6 April 2021].

Public Health England, 2016a. Carbon Monoxide: Toxicological Overview. Available at:<https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571154/carbon_monoxide_toxicological_overview.pdf> [Accessed 10 March 2019].

Public Health England, 2016b. Kerosene: general information. Available at:https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/561056/kerosene_general_information.pdf [Accessed 10 March 2019].

Public Health England, 2017. Psychosocial pathways and health outcomes: Informing action on health inequalities. [pdf] Available at:<<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647709/Psychosocial_pathways_and_health_equity.pdf>[Accessed 6 April 2021].

Pulungan, D.R., 2020. The Impact of Occupational Health, Safety (K3) Program and Work Environment on Employee Commitment of PT Perkebunan Nusantara III (Persero) Medan. *International Journal of Economic, Technology and Social Sciences (Injects)*, *1*(1), pp.40-48.

Punch, K.F., 2013. *Introduction to social research: Quantitative and qualitative approaches*. sage.UK.

Puri, P., Nandar, S.K., Kathuria, S. and Ramesh, V., 2017. Effects of air pollution on the skin: A review. *Indian Journal of Dermatology, Venereology, and Leprology,* 83(4), p.415.

PwC, 2021. Nigeria SME survey. [online] Available at < https://www.pwc.com/ng/en/events/nigeria-sme-survey.html< [Accessed 2 April 2021].

Qadri, H., Bhat, R.A., Mehmood, M.A. and Dar, G.H. eds., 2020. *Fresh Water Pollution Dynamics and Remediation*. Springer Singapore.

Qafisheh, N., Mohamed, O.H., Elhassan, A., Ibrahim, A. and Hamdan, M., 2021. Effects of the occupational exposure on health status among petroleum station workers, Khartoum State, Sudan. *Toxicology Reports*, *8*, pp.171-176.

Queirós, A., Faria, D. and Almeida, F., 2017. Strengths and limitations of qualitative and quantitative research methods. *European Journal of Education Studies*, 3(9), pp. 369-387.

Quick, J.C. and Henderson, D.F., 2016. Occupational stress: Preventing suffering, enhancing wellbeing. *International Journal of Environmental Research and Public Health*, *13*(5), pp.459.

Raamkumar, A.S., Tan, S.G. and Wee, H.L., 2020. Use of health belief model–based deep learning classifiers for covid-19 social media content to examine public perceptions of physical distancing: Model development and case study. *JMIR Public Health and Surveillance*, *6*(3), p.e20493.

Rahman, M.S., 2017. The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language" Testing and Assessment" Research: A Literature Review. *Journal of Education and Learning*, *6*(1), pp.102-112.

Ramadhany, P.S., Yunus, F. and Susanto, A.D., 2020. Lung Function and Respiratory Symptoms of Petrol Station Attendants in Central and North Jakarta and Its Contributing Factors. *Respiratory Science*, *1*(1), pp.46-60.

Ramanathan, V., 2020. Climate Change, Air Pollution, and Health: Common Sources, Similar Impacts, and Common Solutions. In *Health of People, Health of Planet and Our Responsibility* (pp. 49-59). Springer, Cham.

Ramayah, T., Nasurdin, A.M., Noor, M.N.M. and Hassan, H., 2020. Students'choice intention of a higher learning institution: An application of the theory of reasoned action (TRA). *Malaysian Management Journal*, *7*(1), pp.47-62.

Ramhit, K.S., 2019. The impact of job description and career prospect on job satisfaction: A quantitative study in Mauritius. *SA Journal of Human Resource Management*, *17*, p.7.

Ranganathan, P., & Aggarwal, R., 2018. Study designs: Part 1 - An overview and classification. *Perspectives in Clinical Research*, *9*(4), 184–186.

Rao, M.N., Ram, A., Rokade, M.A., Raja, P., Rakesh, P.S., Chemburkar, P. and Gajbhiye, S.N., 2016. A preliminary estimate of Total Petroleum Hydrocarbons in water and some commercially important Fish species in the Amba Estuary, west coast of India. *Bulletin Of Environmental Contamination and Toxicology*, 97(1), pp.56-62.

Rasool, S.F., Wang, M., Zhang, Y. and Samma, M., 2020. Sustainable work performance: the roles of workplace violence and occupational stress. *International Journal of Environmental Research and Public Health*, *17*(3), p.912.

Raza, W., Lee, J., Raza, N., Luo, Y., Kim, K.H. and Yang, J., 2019. Removal of phenolic compounds from industrial wastewater based on membrane-based technologies. *Journal Of Industrial and Engineering Chemistry*, *71*, pp.1-18.

Regnault, A., Willgoss, T. and Barbic, S., 2018. Towards the use of mixed methods inquiry as best practice in health outcomes research. *Journal of Patient-reported Outcomes*, *2*(1), p.19.

Reiner, M., Jekauc, D., Niermann, C. and Woll, A., 2013. Long-term health benefits of physical activity–a systematic review of longitudinal studies. *BMC Public Health* 813 (13).

Ren, J.C., Wang, T., Wu, H., Zhang, G.H., Sun, D., Guo, K., Li, H., Zhang, F., Wu, W. and Xia, Z.L., 2020. Promoter hypermethylation in CSF3R induces peripheral neutrophil reduction in benzene-exposure poisoning. *Environmental and Molecular Mutagenesis*, 61(8), pp.786-796.

Richter, A. and Näswall, K., 2019. Job insecurity and trust: Uncovering a mechanism linking job insecurity to well-being. *Work & Stress*, *33*(1), pp.22-40.

Ridde, V., Pérez, D. and Robert, E., 2020. Using implementation science theories and frameworks in global health. *BMJ Global Health*, *5*(4), p.e002269.

Robertson, S. and Miller, M.R., 2018. Ambient air pollution and thrombosis. *Particle and fibre toxicology,* 15(1), p.1.

Rocha, L.P., Cezar-Vaz, M.R., Almeida, M.C.V.D., Bonow, C.A., Silva, M.S.D. and Costa, V.Z.D., 2014. Use of personal protective equipment by gas stations workers: a nursing contribution. *Texto & Contexto-Enfermagem*, *23*(1), pp.193-202.

Rodríguez-Eugenio, N., McLaughlin, M. and Pennock, D., 2018. *Soil Pollution: a hidden reality*. Rome, FAO.

Rosário, S., Fonseca, J.A., Nienhaus, A. and da Costa, J.T., 2016. Standardized assessment of psychosocial factors and their influence on medically confirmed health outcomes in workers: a systematic review. *Journal of Occupational Medicine and Toxicology*, 11(1), pp.1-13.

Rosinger, A.Y. and Brewis, A., 2020. Life and death: Toward a human biology of water. *American Journal of Human Biology*, *32*(1), p.e23361.

Royal College of Nursing (RCN), 2015. Healthy workplace toolkit. [pdf]

Rožman, M., Treven, S., Mulej, M. and Čančer, V., 2019. Creating a healthy working environment for older employees as part of social responsibility. *Kybernetes*, 48 (5) pp. 1045-1059.

Rushton, L., 2017. The global burden of occupational disease. *Current Environmental Health Reports*, *4*(3), pp.340-348.

Ryan, Gemma (2018). Introduction to positivism, interpretivism and critical theory. *Nurse Researcher*, 25(4) pp. 41–49.

Saad, O.Y., 2013. The location of economic potentials of a frontier community in Nigeria: an exploit on Ilorin in the 20th. Century. *International Journal of Humanities and Social Science Invention*, *2*(1), pp.35-42.

Saad, S.M., Elsaghier, E.H. and Ezaga, D., 2018. Planning and optimising petroleum supply chain. *Procedia Manufacturing*, *17*, pp.803-810.

Sabbah, I., Sabbah, H., Khamis, R., Sabbah, S. and Droubi, N., 2013. Health related quality of life of university students in Lebanon: Lifestyles behaviors and socio-demographic predictors. *Health,* 5, pp.1-12.

Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G. and Woelm, F., 2021. Sustainable development report 2020. Cambridge Books, Cambridge University Press.UK.

Sahai, A. and Mahapatra, M., 2020. Subjective Well-Being At Workplace: A Review On Its Implications. *Journal of Critical Reviews,* 7(11), pp.807-810.

Saidi, N.S.A., Michael, F.L., Sumilan, H., Lim, S.L.O., Jonathan, V., Hamidi, H. and Ahmad, A.I.A., 2019. The Relationship Between Working Environment and Employee Performance. *Journal of Cognitive Sciences and Human Development*, *5*(2), pp.14-22.

Sait, M.R. and Srinivasaiah, N., 2019. Quality of Life Issues in Breast Cancer Surgery—A Review. *Indian Journal of Surgery*, *81*(1), pp.57-64.

Saji, V.S. and Umoren, S.A. eds., 2020. Corrosion Inhibitors in the Oil and Gas Industry. Wiley-VCH Verlag GmbH & Co. KGaA, Germany.

Sakanko, M.A. and David, J., 2018. Assessment of the Millennium Development Goals (MDGs) on the Eradication of Poverty and Hunger in Nigeria. *International Journal of Research in Arts and Social Sciences,* 11(2), pp.257-268.

Saleem, Z., Shenbei, Z. and Hanif, A.M., 2020. Workplace violence and employee engagement: The mediating role of work environment and organizational culture. *SAGE Open*, *10*(2), p.2158244020935885.

Salguero-Caparrós, F., Pardo-Ferreira, M.C., Martínez-Rojas, M. and Rubio-Romero, J.C., 2020. Management of legal compliance in occupational health and safety. A literature review. *Safety Science*, *121*, pp.111-118.

Salihu, H.M., Wilson, R.E., King, L.M., Marty, P.J. and Whiteman, V.E., 2015. Socio-ecological model as a framework for overcoming barriers and challenges in randomized

control trials in minority and underserved communities. *International Journal of MCH and AIDS*, *3*(1), p.85.

Samet, M.J., 2020. Air Pollution: Adverse Effects and Disease Burden In *Health of People, Health of Planet and Our Responsibility* (pp. 63-78). Springer, Cham.

Sánchez-Hernández, M.I., González-López, Ó.R., Buenadicha-Mateos, M. and Tato-Jiménez, J.L., 2019. Work-life balance in great companies and pending issues for engaging new generations at work. *International Journal of Environmental Research and Public Health*, *16*(24), p.5122.

Sangotola, T.M., Fasanmade, P.A., Ayanrinde, W.A., Olatinwo, I.O. and Olaniran, H.F., 2015. On The Effects of Petrol Stations in Nigeria. *International Journal of Science, Engineering and Technology Research (IJSETR)*, (4)4, pp. 947-954.

Sanmartín, R., Inglés, C.J., Vicent, M., Gonzálvez, C., Díaz-Herrero, Á. and García-Fernández, J.M., 2018. Positive and negative affect as predictors of social functioning in Spanish children. *PloS one*, *13*(8), p.e0201698.

Sanni, O.O.M., Abidoye, A.O., Ikoba, N.A. and Job, O., 2016. An Analysis of the Gender Distribution in Nigeria. *Nig. J. Pure &Appl. Sci.*, 29, pp.2757-2768

Santibáñez-Andrade, M., Chirino, Y.I., González-Ramírez, I., Sánchez-Pérez, Y. and García-Cuellar, C.M., 2020. Deciphering the code between air pollution and disease: the effect of particulate matter on cancer hallmarks. *International Journal of Molecular Sciences*, *21*(1), p.136.

Santos, J.M., Vetere, A., Wisniewski, A., Eberlin, M.N. and Schrader, W., 2018. Comparing Crude Oils with Different API Gravities on a Molecular Level Using Mass Spectrometric Analysis. Part 2: Resins and Asphaltenes. *Energies*, *11*(10), p.2767.

Sarathy, S.M., Farooq, A. and Kalghatgi, G.T., 2018. Recent progress in gasoline surrogate fuels. *Progress in Energy and Combustion Science*, *65*, pp.67-108.

Sarbazi, E., Moradi, F., Ghaffari-Fam, S., Mirzaeian, K. and Babazadeh, T., 2019. Cognitive predictors of physical activity behaviors among rural patients with type 2 diabetes: applicability of the Extended Theory of Reasoned Action (ETRA). *Journal of Multidisciplinary Healthcare*, *12*, p.429.

Sarıkoç, S., 2020. Fuels of the Diesel-Gasoline Engines and Their Properties. In *Diesel and Gasoline Engines*. IntechOpen.[online] Available at< https://www.intechopen.com/chapters/69204> [Accessed 5 May 2020].

Sarkar, D., Shikha, S., Ganguly, S. and Rakshit, A., 2017. Management of Increasing Soil Pollution in the Ecosystem. *Advances in Research*, 12(2)pp 1-9.

Sarwar, B.M., 2015. National MDG implementation: Lessons for the SDG era. Overseas Development Institute, UK.

Saunders, MNK, Thornhill, A, & Lewis, P 2019, Research Methods for Business Students, Pearson Education Limited, Harlow, United Kingdom. Available from: ProQuest Ebook Central.

Savasan, Z., 2017. *Pollution, Land.* Springer International Publishing AG

Savciuc, O. and Timotin, A., 2019. The Integration of Behavioural Change Models in Social Marketing Programs in Public Health. *Marketing–from Information to Decision Journal*, *2*(1), pp.30-39.

Sbai, S.E., Mejjad, N., Norelyaqine, A. and Bentayeb, F., 2021. Air quality change during the COVID-19 pandemic lockdown over the Auvergne-Rhône-Alpes region, France. *Air Quality, Atmosphere & Health*, *14*(5), pp.617-628.

Schikowski, T. and Hüls, A., 2020. Air pollution and skin aging. *Current Environmental Health Reports,* 7(1), pp.58-64.

Schnelle Jr, K.B. and Brown, A.C., 2016. *Air pollution control technology handbook*. CRC press. Boca Raton.

Scholten, B., Vlaanderen, J., Stierum, R., Portengen, L., Rothman, N., Lan, Q., Pronk, A. and Vermeulen, R., 2020. A Quantitative Meta-Analysis of the Relation between Occupational Benzene Exposure and Biomarkers of Cytogenetic Damage. *Environmental Health Perspectives*, *128*(8), p.087004.

Schoonenboom, J. and Johnson, R.B., 2017. How to construct a mixed methods research design. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *69*(2), pp.107-131.

Schraufnagel, D.E., Balmes, J.R., Cowl, C.T., De Matteis, S., Jung, S.H., Mortimer, K., Perez-Padilla, R., Rice, M.B., Riojas-Rodriguez, H., Sood, A. and Thurston, G.D., 2019. Air pollution and noncommunicable diseases: A review by the Forum of International Respiratory Societies' Environmental Committee, Part 2: Air pollution and organ systems. *Chest*, *155*(2), pp.417-426.

Schreurs, B., Van Emmerik, H., Notelaers, G. and De Witte, H., 2010. Job insecurity and employee health: The buffering potential of job control and job self-efficacy. *Work & Stress*, *24*(1), pp.56-72.

Schunk, D.H. and DiBenedetto, M.K., 2020. Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, p.101832.

Scotland, J., 2012. Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, *5*(9), pp.9-16.

Sears, C.G., Braun, J.M., Ryan, P.H., Xu, Y., Werner, E.F., Lanphear, B.P. and Wellenius, G.A., 2018. The association of traffic-related air and noise pollution with maternal blood pressure and hypertensive disorders of pregnancy in the HOME study cohort. *Environment International*, *121*, pp.574-581.

Sedgwick, P., 2014a. Cross sectional studies: advantages and disadvantages. *Bmj*, *348*, p.g2276.

Sedgwick, P., 2014b. "Cluster sampling", *BMJ : British Medical Journal (Online),* vol. 348.

Sekar, G., 2019. *Padhuka's Students Guide For Enterprise Information Systems & Strategic Management,* 4Ed. Wolters kluwer India Pvt Ltd.

Senen, S.H., Masharyono, M. and Edisa, N., 2020, February. The Effect of Job Characteristics to Employee's Performance: A Case Study on Employees at Interior Industry. In *3rd Global Conference on Business, Management, and Entrepreneurship (GCBME 2018)* (pp. 227-232). Atlantis Press.

Senzaki, M., Kadoya, T. and Francis, C.D., 2020. Direct and indirect effects of noise pollution alter biological communities in and near noise-exposed environments. *Proceedings of the Royal Society B*, *287*(1923), p.20200176.

Seow, L.S.E., Tan, T.H.G., Abdin, E., Chong, S.A. and Subramaniam, M., 2019. Comparing disease-specific and generic quality of life measures in patients with schizophrenia. *Psychiatry Research*, *273*, pp.387-393.

Setia, M.S., 2016. Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, *61*(3), p.261.

Setyaningrum, R.P., Pawar, A. and Pujiono, A., 2021. The Influence of Work Motivation, Career Development, and Work Environment on Organizational Citizenship Behavior (A Case of Mold Manufacturing Unit of PT. Bumimulia Indah Lestari, The Branch of Cikarang). European Alliance for Innovation. Indonesia. [eBook]. *Proceedings of the 1ˢᵗ international Conference on Economic Engineering and Social Science*, pp.29-40.

Shah, M.P., 2017. Wastewater Pollution. *Journal of Applied Biotechnology & Bioengineering* 3(2): 00054. DOI: 10.15406/jabb.2017.03.00054

Shamizadeh, T., Jahangiry, L., Sarbakhsh, P. and Ponnet, K., 2019. Social cognitive theory-based intervention to promote physical activity among prediabetic rural people: a cluster randomized controlled trial. *Trials*, *20*(1), p.98.

Shannon-Baker, P., 2016. Making paradigms meaningful in mixed methods research. *Journal of Mixed Methods Research*, *10*(4), pp.319-334.

Shariat, A., Cardoso, J.R., Cleland, J.A., Danaee, M., Ansari, N.N., Kargarfard, M. and Mohd Tamrin, S.B., 2018. Prevalence rate of neck, shoulder and lower back pain in association with age, body mass index and gender among Malaysian office workers. *Work*, *60*(2), pp.191-199.

Sharma, G., 2017. Pros and cons of different sampling techniques. *International Journal of Applied Research*, *3*(7), pp.749-752.

Sharma, S., 2019. Theory of Reasoned Action: Assessing Customers'Inclination Towards Eco-friendly Hotels in Northern India. *International Journal of research and Analytical reviews*, 6(2) p. 577- 595.

Shell,n.d. Safe and Responsible Decommissioning. Available at: <https://www.shell.com/energy-and-innovation/overcoming-technology-challenges/safe-responsible-decommissioning.html> [Accessed 21 June 2020].

Shen, S., Li, X., Yuan, C., Huang, Q., Liu, D., Ma, S., Hui, J., Liu, R., Wu, T. and Chen, Q., 2020. Association of short-term exposure to sulfur dioxide and hospitalization for ischemic and hemorrhagic stroke in Guangzhou, China. *BMC public health*, *20*(1), pp.1-7.

Shiamwama, S.M., Ombayo, J.A. and Mukolwe, M.S., 2014. Internal factors affecting the performance of businesses of retirees in kakamega municipality. *International Journal of Business, Humanities and Technology*, *4*(2), pp.144-157.

Shikwambana, L., Mhangara, P. and Mbatha, N., 2020. Trend analysis and first time observations of sulphur dioxide and nitrogen dioxide in South Africa using TROPOMI/Sentinel-5 P data. *International Journal of Applied Earth Observation and Geoinformation*, *91*, p.102130.

Shin, S., Bai, L., Oiamo, T.H., Burnett, R.T., Weichenthal, S., Jerrett, M., Kwong, J.C., Goldberg, M.S., Copes, R., Kopp, A. and Chen, H., 2020. Association between road traffic noise and incidence of diabetes mellitus and hypertension in Toronto, Canada: a population-based cohort study. *Journal of the American Heart Association,* 9(6), p.e013021.

Shorten, A. and Smith, J., 2017. Mixed methods research: expanding the evidence base. *Evidence-based nursing,* 20(3), pp.74-75.

Shoss, M.K., 2017. Job insecurity: An integrative review and agenda for future research. *Journal of Management*, *43*(6), pp.1911-1939.

Sihite, J., Dewi, T.R. and Widyastuti, N., 2020, February. The Influence of Nature of Work and Career Prospect Toward the Tourism Student Social Status. In *4th International Conference on Management, Economics and Business (ICMEB 2019)* (pp. 111-113). Atlantis Press.

Sileyew, J.K., 2019. Research Design and Methodology, Cyberspace, Evon Abu-Taieh, Abdelkrim El Mouatasim and Issam H. Al Hadid, IntechOpen, DOI: 10.5772/intechopen.85731. Available from: https://www.intechopen.com/books/cyberspace/research-design-and-methodology

Silver, D.A. and Hickey, G.M., 2020. Managing light pollution through dark sky areas: learning from the world's first dark sky preserve. *Journal of Environmental Planning and Management*, 63(14), pp.2627-2645.

Silvestre, R.T., Bravo, M., Santiago, F., Delmonico, L., Scherrer, L., Otero, U.B., Liehr, T., Alves, G., Chantre-Justino, M. and Ornellas, M.H., 2020. Hypermethylation in Gene Promoters Are Induced by Chronic Exposure to Benzene, Toluene, Ethylbenzene and Xylenes. *Pakistan Journal of Biological Sciences: PJBS*, *23*(4), pp.518-525.

Simbolon, S.A.B. and Oktafien, S., 2021. Effect of Work Discipline and The Work Environment on Employee Performance CV. Bolon Tua. *Technium Social Sciences Journal*, *20*, pp.704-725.

Singh, A.S. and Masuku, M.B., 2014. Sampling techniques & determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, *2*(11), pp.1-22.

Singh, J., Yadav, P., Pal, A.K. and Mishra, V., 2020. Water Pollutants: Origin and Status. In *Sensors in Water Pollutants Monitoring: Role of Material* (pp. 5-20). Springer, Singapore.

Singh, P., Ojha, A., Borthakur, A., Singh, R., Lahiry, D., Tiwary, D. and Mishra, P.K., 2016. Emerging trends in photodegradation of petrochemical wastes: a review. *Environmental Science and Pollution Research*, 23(22), pp.22340-22364.

Singh, R. and Rani, S., 2019. *International Business Environment*. Edu creation Publishing. New Delhi.

Sinha, C.V., 2020. *Business Environment. A publication of SBPD Publishing House (Sanjay Sahitya Bhawan)*. SBPD publishing. India.

Sirotkin, A.V. and Harrath, A.H., 2017. Influence of oil-related environmental pollutants on female reproduction. *Reproductive Toxicology,* 71, pp.142-145.

Sjöberg, A., Pettersson-Strömbäck, A., Sahlén, K.G., Lindholm, L. and Norström, F., 2020. The burden of high workload on the health-related quality of life among home care workers in Northern Sweden. *International Archives of Occupational and Environmental Health*, *93*(6), pp.747-764.

Slimani, M., Paravlic, A., Mbarek, F., Bragazzi, N.L. and Tod, D., 2020. The relationship between physical activity and quality of life during the confinement induced by COVID-19 outbreak: a pilot study in Tunisia. *Frontiers in Psychology*, *11*, p. 1882.

Smart, J.D., 2019. *Connecting with Upstream Oil and Gas: A Sales and Marketing Resource Guide.* Lulu Publishing services. [Ebook].

Snelling, A.M. ed., 2014. *Introduction to health promotion*. John Wiley & Sons. San Francisco, CA.

So, K.K.F., Oh, H. and Min, S., 2018. Motivations and constraints of Airbnb consumers: Findings from a mixed-methods approach. *Tourism Management*, *67*, pp.224-236.

Soares, M.V., Charão, M.F., Jacques, M.T., dos Santos, A.L.A., Luchese, C., Pinton, S. and Ávila, D.S., 2020. Airborne toluene exposure causes germline apoptosis and neuronal damage that promotes neurobehavioural changes in Caenorhabditis elegans. *Environmental Pollution*, *256*, p.113406.

Søgaard, K. and Sjøgaard, G., 2017. Physical activity as cause and cure of muscular pain: evidence of underlying mechanisms. *Exercise and Sport Sciences Reviews*, *45*(3), p.136.

Sohn, I., 2020. Why Is Nigeria-The" Giant of Africa"-Still Poor?. *The Journal of Applied Business and Economics,* 22(5), pp.11-41.

Sorensen, G., Sparer, E., Williams, J.A., Gundersen, D., Boden, L.I., Dennerlein, J.T., Hashimoto, D., Katz, J.N., McLellan, D.L., Okechukwu, C.A. and Pronk, N.P., 2018. Measuring best practices for workplace safety, health and well-being: The Workplace Integrated Safety and Health Assessment. *Journal of Occupational and Environmental Medicine*, *60*(5), p.430.

Speight, J.G., 2010. *The refinery of the future*. 1st ed. William Andrew. UK

Speight, J.G., 2011. Handbook of industrial hydrocarbon processes, Gulf Professional.UK

Speight, J.G., 2015. *Handbook of petroleum product analysis*. John Wiley & Sons. New Jersey

Speight, J.G., 2016. *Handbook of petroleum refining*. CRC press. Boca Raton.

Speight, J.G., 2017. *Rules of thumb for petroleum engineers*. 1st ed. John Wiley & Sons. New Jersey

Speight, J.G., 2019a. *Shale Oil and Gas Production Processes*. Gulf Professional Publishing. Houston, Texas.

Speight, J.G., 2019b. *Handbook of industrial hydrocarbon processes*. Gulf Professional Publishing. Oxford, UK.

Spinazzè, A. and Cavallo, D.M., 2019. Preface: Special Issue on Air Quality Assessment for Environmental Policy Support: Sources, Emissions, Exposures, and Health Impacts. *Environments,* 6(10), p.110.

Srivastava, S.P. and Hancsok, J., 2014. *Fuels and fuel-additives*. John Wiley & Sons. New Jersey.

Standaert, B., Dort, T., Linden, J., Madan, A., Bart, S., Chu, L., Hayney, M.S., Kosinski, M., Kroll, R., Malak, J. and Meier, G., 2019. Usability of daily SF36 questionnaires to capture the QALD variation experienced after vaccination with AS03 A-adjuvanted monovalent influenza A (H5N1) vaccine in a safety and tolerability study. *Health and Quality of Life Outcomes*, *17*(1), p.80.

Staszewski, T., Malawska, M., Studnik-Wójcikowska, B., Galera, H. and Wiłkomirski, B., 2015. Soil and plants contamination with selected heavy metals in the area of a railway junction. *Archives of Environmental Protection* ,41 (1) pp. 35–42.

Stedile, T., Beims, R.F., Ender, L., Scharf, D.R., Simionatto, E.L., Meier, H.F. and Wiggers, V.R., 2019. Evaluation of distillation curves for bio-oil obtained from thermal cracking of waste cooking oil. *Brazilian Journal of Chemical Engineering*, *36*(1), pp.573-585.

Stehle, S. and Schulz, R., 2015. Agricultural insecticides threaten surface waters at the global scale. *Proceedings of the National Academy of Sciences,* 112(18), pp.5750-5755.

Steyn, R. and Vawda, N., 2014. Job characteristics: their relationship to job satisfaction, stress and depression. *Journal of Psychology in Africa*, *24*(3), pp.281-284.

Stieb, D.M., Zheng, C., Salama, D., BerjawI, R., Emode, M., Hocking, R., Lyrette, N., Matz, C., Lavigne, E. and Shin, H.H., 2020. Systematic review and meta-analysis of case-crossover and time-series studies of short term outdoor nitrogen dioxide exposure and ischemic heart disease morbidity. *Environmental Health*, *19*, pp.1-19.

Stolte, J., Tesfai, M., Oygarden, L., Kvaerno, S., Keizer, J., Verheijen, F., Panagos, P., Ballabio, C. and Hessel, R., 2016. Soil threats in Europe: status, methods, drivers and effects on ecosystem services. *European Commission DG Joint Research Centre*.

Stone, T., de Sio, F.S. and Vermaas, P.E., 2020. Driving in the dark: designing autonomous vehicles for reducing light pollution. *Science and Engineering Ethics*, *26*(1), pp.387-403.

Sufiyan, I., Mohammed, K.D., Bello, I.E., and Zaharadeen, I., 2020. Impact of harmattan season on human health in Keffi, Nasarawa State, Nigeria. *Matrix Science Medica,* 4(2), p.44.

Sugiyanta, Y., Suyono, J., Elisabeth, D.R., Chikmawati, Z. and Zulkifli, C.Z., 2021. The Mediating Role of Work Environment in Relationship Between Leadership and Job Promotion on Employee Performance. *Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management Singapore, March 7-11, 2021.*

Suifan, T.S., 2019. The effects of work environmental factors on job satisfaction: the mediating role of work motivation. *Business: Theory and Practice*, *20*, pp.456-466.

Sujith, B. and Sehgal, M., 2017. Characteristics of the Ozone pollution and its Health Effects in India. *International Journal of Medicine and Public Health,* 7(1), p.56-60.

Sun, R., Xu, K., Ji, S., Pu, Y., Man, Z., Ji, J., Chen, M., Yin, L., Zhang, J. and Pu, Y., 2020. Benzene exposure induces gut microbiota dysbiosis and metabolic disorder in mice. *Science of the Total Environment*, *705*, p.135879.

Sutton, A., 2020. Living the good life: A meta-analysis of authenticity, well-being and engagement. *Personality and Individual Differences*, *153*, p.109645.

Sverke, M., Hellgren, J. & Näswall, K., 2002. No Security. *Journal of Occupational Health Psychology, 7*(3), 242–264.

Sweeney, F. and Mitchell, R., 2019. *Ecology, Environment and Pollution*. Ed-Tech Press. UK

Sylvester, O.A. and Tosin, A.O., 2016. Influence of Demographic Variable on Quality of Life among Women in Ibadan Metropolis, Oyo State of Nigeria. *International Journal of Applied*, *6*(3), pp.56-63.

Szyszkowicz, M., 2019. Urban Ambient Air Pollution and Behavioural Disorders. *Int Arch Subst Abuse Rehabil*, 1(005), p. 1-7

Szyszkowicz, M., Zemek, R., Colman, I., Gardner, W., Kousha, T. and Smith-Doiron, M., 2020. Air Pollution and Emergency Department Visits for Mental Disorders among Youth. *International Journal of Environmental Research and Public Health*, *17*(12), p.4190.

Tadesse, S. and Ayalew, A., 2018. Comparative Cross-Sectional Study on Pulmonary Function Status among Petrol Filling Workers in Jimma Town South West Ethiopia, 2018 . Jimma University. (Doctoral dissertation).

Tah D.S, 2017. "GIS-based locational analysis of petrol filling stations in Kaduna Metropolis". *Science World Journal*, 12(2). ISSN 1597-6343.

Tajeri Moghadam, M., Raheli, H., Zarifian, S. and Yazdanpanah, M., 2020. The power of the health belief model (HBM) to predict water demand management: A case study of farmers'water conservation in Iran. *Journal of Environmental Management*, *263*, p.110388.

Tapper, E.B., Baki, J., Parikh, N.D. and Lok, A.S., 2019. Frailty, psychoactive medications, and cognitive dysfunction are associated with poor patient-reported outcomes in cirrhosis. *Hepatology*, *69*(4), pp.1676-1685.

Täuscher, K. and Laudien, S.M., 2018. Understanding platform business models: A mixed methods study of marketplaces. *European Management Journal*, *36*(3), pp.319-329.

Tawabini, B.S., Plakas, K.V. and Karabelas, A.J., 2020. A pilot study of BTEX removal from highly saline water by an advanced electrochemical process. *Journal of Water Process Engineering*, *37*, p.101427.

Temam, L., Tadesse, S., and Ayalew, A., 2020. Pulmonary Function Status among Petrol Filling Workers in Jimma Town, Southwest Ethiopia, 2018. *Journal of Medical Research and Case Reports* 2(1).

Tengtarto, J.A.G., 2020. Influences Of Internal Environment, External Environment, Business Ethics and Entrepreneurship Toward Business Performances Through Differentiation Strategies and Competing Superiorities in Small Industries in Surabaya City. *Archives of Business Research*, *8*(1), pp.138-151.

Teo, S.T., Bentley, T. and Nguyen, D., 2019. Psychosocial work environment, work engagement, and employee commitment: A moderated, mediation model. *International Journal of Hospitality Management*, p.102415.

Terrell, S.R., 2012. Mixed-methods research methodologies. *The qualitative report*, *17*(1), pp.254-280.

Tetteh, R.N., 2015. Chemical soil degradation as a result of contamination: A review. *Journal of Soil Science and Environmental Management*, 6(11), pp.301-308.

Teufer, B., Ebenberger, A., Affengruber, L., Kien, C., Klerings, I., Szelag, M., Grillich, L. and Griebler, U., 2019. Evidence-based occupational health and safety interventions: a comprehensive overview of reviews. *BMJ Open*, *9*(12), p.e032528.

Thanh, N.C. and Thanh, T.T., 2015. The interconnection between interpretivist paradigm and qualitative methods in education. *American Journal of Educational Science*, *1*(2), pp.24-27.

The African Union Commission, 2015. Agenda 2063: First Ten-Year Implementation Plan 2013-2023. [pdf] Available at:< https://wedocs.unep.org/bitstream/handle/20.500.11822/20823/Agenda%202063%20-%20FIRST%20TEN%20YEAR%20PLAN%20%20%20September%20%202015.pdf?sequence=1&isAllowed=y> [Accessed 30 May 2022].

The National Energy Education Development (NEED) Project, 2018. Petroleum [pdf]. Intermediate Energy Infobook. *www.NEED.org*

Thojampa, S. and Sarnkhaowkhom, C., 2019. The social cognitive theory with diabetes: Discussion. *International Journal of Caring Sciences*, *12*(2), p.1251.

Thuraiselvam, S. and Thang, R.B., 2015. Factors that affect students'mental health: A study at Taylor's University School of Hospitality, Tourism and Culinary Arts final year students. In *Taylor's 7th Teaching and Learning Conference 2014 Proceedings* (pp. 109-125). Springer, Singapore.

Tiu, D.N. & Dubey, P. 2017, "Study of WBC Count and Its Association with Blood Pressure in Petrol Pump Filling Workers of Barabanki City, Uttar Pradesh". *Journal of Advanced Medical and Dental Sciences Research,* 5(4) pp. 87-90.

Tiwari, S., Dumka, C.U., Kaskaoutis, G.D., Ramd, K., Panicker, S.A., Srivastava, K.M., Tiwari, S., Attrif, D.S., Sonif, K.V., Pandeyg, K.A., 2016. Aerosol chemical characterization and role of carbonaceous aerosol on radiative effect over Varanasi in central Indo-Gangetic Plain. *Atmospheric Environment*, 125, pp. 437–449.

Tiwari, S., Pandithurai, G., Attri, S.D., Srivastava, A.K., Soni, V.K., Bisht, D.S., Anil Kumar, V., and Srivastava, M.K., 2015. Aerosol optical properties and their relationship with meteorological parameters during wintertime in Delhi, India. *Atmospheric Pollution Research*, 153, pp 465–479.

Tobin, G.A. and Begley, C.M., 2004. Methodological rigour within a qualitative framework. *Journal of Advanced Nursing*, *48*(4), pp.388-396.

Tol, A., Tavassoli, E., Shariferad, G.R. and Shojaeezadeh, D., 2013. Health-promoting lifestyle and quality of life among undergraduate students at school of health, Isfahan university of medical sciences. *Journal of Education and Health Promotion*, 2 (11), pp.29-32.

Tougas, M.E., Hayden, J.A., McGrath, P.J., Huguet, A. and Rozario, S., 2015. A systematic review exploring the social cognitive theory of self-regulation as a framework for chronic health condition interventions. *PloS one*, *10*(8), p.e0134977.

Trading Economics, 2021. Nigeria - Labor Force, Total. [online] Available at< https://tradingeconomics.com/nigeria/labor-force-total-wb-data.html#:~:text=Labor%20force%2C%20total%20in%20Nigeria,Bank%20on%20March%20of%202021.> [Accessed 27 March 2021].

Treviño-Reséndez, J., Medel, A. and Meas, Y., 2021. Electrochemical technologies for treating petroleum industry wastewater. *Current Opinion in Electrochemistry*, p.100690.

Trimm, H.H. and Hunter Jr, W. eds., 2016. *Industrial Chemistry: New Applications, Processes and Systems*. CRC Press. Boca Rato, Florida.

Tsai, C.H., 2014. Integrating social capital theory, social cognitive theory, and the technology acceptance model to explore a behavioral model of telehealth systems. *International Journal of Environmental Research and Public Health*, *11*(5), pp.4905-4925.

Tsiga, Z.D. and Tsiga, Z.D., 2018. Risk management practice in the Nigerian petroleum industry. *The Journal of Modern Project Management,* 6(2), pp.157-163.

Tualeka, A.R., Jalaludin, J., Widiyanti, P., Russeng, S.S., Rahmawati, P., Ahsan, A. and Susilowati, I.H., 2020. Determination Reference of Concentration (RfC) Xylen Exposure Based on Xylen NOAEL in White Rats and Workers'Body Weight and Height in Surabaya Car Painting Area, Indonesia. *Indian Journal of Forensic Medicine & Toxicology*, *14*(3), pp.1709-1715.

Tucker, G., Adams, R. and Wilson, D., 2016. The case for using country-specific scoring coefficients for scoring the SF-12, with scoring implications for the SF-36. *Quality of Life Research*, *25*(2), pp.267-274.

Tucker, S., 2019. Implementation: The linchpin of evidence-based practice changes. *American Nurse Today,* 14(3), pp. 8-13.

Tulchinsky, T.H. and Varavikova, E.A., 2014. Environmental and occupational health. *The New Public Health*, p.471.

Tunlathorntham, S. and Thepanondh, S., 2017. Prediction of ambient nitrogen dioxide concentrations in the vicinity of industrial complex area, Thailand. *Air, Soil and Water Research,* 10, p.1178622117700906.

Turner J.R. (2013) Cross-Sectional Study. In: Gellman M.D., Turner J.R. (eds) *Encyclopedia of Behavioral Medicine*. Springer, New York, NY

Tushabomwe-Kazooba, C. and Kakuru, W., 2015. Exploring Environmental Impacts and Responses in the Conduit to Sustainability Accounting In an African Country. *International Journal of Environment and Pollution Research*, 3(2), 84-117.

U.S Energy Information Administration (EIA), 2012. Crude oil distillation and the definition of refinery capacity. Available at:<https://www.eia.gov/todayinenergy/detail.php?id=6970#:~:text=Crude%20oil%20is%20made%20up,products%20boil%20off%20and%20are> [Accessed 12 March 2020].

U.S Energy Information Administration (EIA), 2019a. Oil and petroleum products explained: *Refining crude oil*. Available at:< https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-inputs-and-outputs.php> [Accessed 1 July 2020].

U.S Energy Information Administration (EIA), 2019b. Frequently Asked Questions (FAQS): What is the difference between crude oil, petroleum products, and petroleum? Available at:<https://www.eia.gov/tools/faqs/faq.php?id=40&t=6#:~:text=Crude%20oil%20is%20a%20mixture,when%20brought%20to%20the%20surface.&text=Petroleum%20is%20a%20broad%20category,petroleum%20are%20sometimes%20used%20interchangeably.> [Accessed 9 November 2020].

U.S Energy Information Administration (EIA), 2020a. Gasoline explained. Available at:<https://www.eia.gov/energyexplained/gasoline/> [Accessed 11 July 2020].

U.S Energy Information Administration (U.S EIA), 2016. Country Analysis Brief: Nigeria. [pdf] Available at < https://www.eia.gov/international/content/analysis/countries_long/Nigeria/nigeria.pdf> [Accessed 3 April 2021].

U.S Energy Information Administration, 2020b. Analysis: Nigeria. Available at < https://www.eia.gov/international/analysis/country/NGA> [Accessed 3 April 2021].

Ubangari, A.A. and Bako, R., 2014. Relationship of stress among university lecturers in Nigeria. *Journal of Humanities and Social Science*, *19*(1), pp.98-104.

Ubani, C.S., Joshua, P.E. and Umenwanne, V.C., 2009. Evaluation of toxicological implications of ingestion exposure to gasoline in mammals. *Biokemistri*, *21*(1), pp. 33-39.

Ufelle, S., Onyekwelu, K., Chinweoke, A., Ibegbu, D., Okoli, U. and Ikekpeazu, J., 2020. Assessment of hepatic functions, hematopoietic cytokines and haematological parameters in people occupationally exposed to volatile petroleum hydrocarbons. *Archives of Environmental & Occupational Health*, pp.1-5.

Ugwoha, E. and Omenogor, B.E., 2017. Effect of oil spillage on groundwater quality. *J Environ Stud,* 3(1), pp.1-3.

Uko, E., Erhabor, O., Bashiru, G., Isaac, I., Abdulrahaman, Y., Aghedo, F., Ikhuenbor, D., Iwueke, I., Adias, T. And Igbineweka, O., 2015. Some Haematological Indices Among Petrol Station Attendants Occupationally Exposed to Premium Motor Spirit in Sokoto, North Western, Nigeria. *J Int Res Med Pharm Sci,* 4(2), pp.53-58.

Ukoette, U.I, Akpan, P.L, Olilima, O.R., 2020. Attainment of the Millennium Development Goals and Sustainability Development Goals: The Achievement So Far in Nigeria Educational System. *International Journal of Education, Learning and Development*, 8 (7), pp.86-94.

UKPIA, 2015. Statistical Review 2015. UKPIA. Available at:< http://ukpia.com/docs/default-source/default-document-library/ukpia-2015-statistical-review.pdf?sfvrsn=0> [Accessed 3 April 2021].

UKPIA, 2019. Refining in the UK. Available at: < https://www.ukpia.com/our-contribution/uk-downstream-oil-sector/refining-in-the-uk/> [Accessed 3 April 2021].

Ulasi, J.O. and Uwadiegwu, B.O., 2020. Assessment of the Level of Compliance of Petroleum Filling Stations to Development Control Standards on Land Space/Size and Setbacks in Anambra State. *Assessment*, *12*(2), p.77-87.

Umeokafor, N., Evaggelinos, K., Lundy, S., Isaac, D., and Allan, S., 2014a. The Pattern of Occupational Accidents, Injuries, Accident Causal Factors and Intervention in Nigerian Factories. [Pdf] Available at:
<http://www.iiste.org/Journals/index.php/DCS/article/viewFile/14423/14732> [Accessed 3 April 2021].

Umeokafor, N., Isaac, D., Jones, G. K., and Umeadi, B., 2013. Enforcement of occupational safety and health regulations in Nigeria: An exploration. Proceedings of the 1st International Scientific Forum. [Pdf]Vol 3pp 92-103.

Umeokafor, N., Isaac, D., Jones, K. and Umeadi, B., 2014. Enforcement of Occupational Safety and Health Regulations in Nigeria: An Exploration. *European Scientific Journal,* 10(7), pp.1857–7881.

Umeokafor, N., Umeadi, B., Jones, K. and Igwegbe, O., 2014b. Compliance with occupational safety and health regulations in Nigeria's public regulatory entity: a call for attention. *International Journal of Scientific and Research Publications*, 4(5). ISSN 2250-3153.

Uner, D. ed., 2017. *Advances in Refining Catalysis*. CRC Press. Boca Raton, Florida.

UNESCO World Water Assessment Programme, 2019.The United Nations world water development report 2019: leaving no one behind, facts and figures. UNESCO (0000367276).

UNESCO World Water Assessment Programme, 2020. The United Nations world water development report 2020: water and climate change, facts and figures. UNESCO (0000372876).

United Nations Children's Fund (UNICEF), 2017. Danger in the air: How air pollution can affect brain development in young children. Available at:<https://www.unicef.org/environment/files/Danger_in_the_Air.pdf> [Accessed 22 March 2021].

United Nations Development Programme (UNDP), 2017. Mapping the oil and gas industry to the sustainable development goals: an atlas.[pdf] Available at:<https://www.undp.org/publications/mapping-oil-and-gas-industry-sdgs-atlas> [Accessed 22 March 2021].

United Nations Development Programme (UNDP), 2021a. Millennium Development Goals. [online] Available at < https://www.undp.org/content/undp/en/home/sdgoverview/mdg_goals.html> [Accessed 22 March 2021].

United Nations Development Programme (UNDP), 2021b. Sustainable Development Goals. [online] Available at < https://www.undp.org/content/undp/en/home/sustainable-development-goals.html> [Accessed 23 March 2021]

United Nations Environment Programme (UNEP), 2016. A snapshot of the world's water quality: towards a global assessment. Nairobi.

United Nations Environment Programme (UNEP), 2017. Towards a pollution-free planet: Report of the Executive Director. Available at: <https://papersmart.unon.org/resolution/uploads/25_19october.pdf> [Accessed 13 September 2020].

United Nations Population Fund (UNFPA), 2020. World Population Dashboard Nigeria. [online] Available at < https://www.unfpa.org/data/world-population/NG> [Accessed 27 March 2021].

United Nations, 2015. The Millennium Development Goals Report 2015. [pdf].

United Nations, Department of Economic and Social Affairs (UNDESA), 2017. World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248. United Nations, Department of Economic and Social Affairs, Population Division.

United Nations, Department of Economic and Social Affairs, Population Division, 2019. World Mortality 2019: Data Booklet (ST/ ESA/SER.A/436).

United States Agency for International Development (USAID), 2012. Nigeria: Climate vulnerability profile. [pdf] Available at < https://www.climatelinks.org/sites/default/files/asset/document/nigeria_climate_vulnerability _profile_jan2013.pdf> [Accessed 27 March 2021].

United States Environmental Protection Agency (US EPA), 2019. Clean Air Act Title IV – Noise Pollution. < https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution>[Accessed 27 March 2021].

Usman, N., Tijjani, M.B. and Atta, H.I., 2020. Isolation and Identification of BTEX-utilizing Fungi from Soil Polluted with Petroleum hydrocarbons. *Bioscience Research Journal*, *32*(1). Pp.43-53.

van Kasteren, Y.F., Lewis, L.K. and Maeder, A., 2020. Office-based physical activity: mapping a social ecological model approach against COM-B. *BMC Public Health*, *20*(1), p.163.

Vandervell, N., 2015. Readdressing the balance between petrol and diesel demand. The Royal Automobile Club Foundation for Motoring Ltd. [https://www.racfoundation.org/wp-content/uploads/2017/11/Readdressing_the_balance_between_petrol_and_diesel_demand_Ni ck_Vandervell_September_2015.pdf].

Varjani, S., Joshi, R., Srivastava, V.K., Ngo, H.H. and Guo, W., 2020. Treatment of wastewater from petroleum industry: current practices and perspectives. *Environmental Science and Pollution Research*, *27*(22), pp.27172-27180.

Varjani, S., Joshi, R., Srivastava, V.K., Ngo, H.H. and Guo, W., 2020. Treatment of wastewater from petroleum industry: current practices and perspectives. *Environmental Science and Pollution Research*, *27*(22), pp.27172-27180.

Varjani, S.J., Joshi, R.R., Kumar, P.S., Srivastava, V.K., Kumar, V., Banerjee, C. and Kumar, R.P., 2018. Polycyclic aromatic hydrocarbons from petroleum oil industry activities: effect on human health and their biodegradation. In *Waste bioremediation* (pp. 185-199). Springer, Singapore.

Varrella, S., 2020a. Largest cities in Nigeria 2020. Statista. Available< https://www.statista.com/statistics/1121444/largest-cities-in-nigeria/#statisticContainer> [Accessed 27 March 2021].

Varrella, S., 2020b. Population of Nigeria 1950-2020. Statista. Available< https://www.statista.com/statistics/1122838/population-of-nigeria/> [Accessed 27 March 2021].

Varrella, S., 2021. Age distribution of population in Nigeria 2021, by gender. [online] Available at < https://www.statista.com/statistics/1121317/age-distribution-of-population-in-nigeria-by-gender/#:~:text=In%20Nigeria%2C%20half%20of%20the,second%20largest%20share%20of%20population> [Accessed 27 March 2021].

Veal, A.J., 2017. *Research methods for leisure and tourism*. 5th ed. Pearson UK.

Venkatesh, V., Brown, S.A. and Bala, H., 2013. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS quarterly*, pp.21-54.

Verra, S.E., Benzerga, A., Jiao, B. and Ruggeri, K., 2019. Health promotion at work: A comparison of policy and practice across Europe. *Safety and Health at Work*, *10*(1), pp.21-29.

Viatte, C., Clerbaux, C., Maes, C., Daniel, P., Garello, R., Safieddine, S. and Ardhuin, F., 2020. Air pollution and sea pollution seen from space. *Surveys in Geophysics,* 41(6), pp.1583-1609.

Virdi, S.S., Lee, L.Y., Li, C. and Dev, A.K., 2021. Simulation of VOC Emission During Loading Operations in a Crude Oil Tanker. *International Journal of Maritime Engineering*, *163*(A1), pp.1-16.

Vishnyakov, V., Suleimanov, B., Salmanov, A. and Zeynalov, E., 2019. *Primer on Enhanced Oil Recovery*. Gulf Professional Publishing. UK.

Vito, R., 2020. Key variations in organizational culture and leadership influence: A comparison between three children's mental health and child welfare agencies. *Children and Youth Services Review*, *108*, p.104600.

W. K. Al-Delaimy, V. Ramanathan, M. Sánchez Sorondo (eds.), 2020. Health of People, Health of Planet and Our Responsibility: Climate change, air pollution and health. [pdf] https://doi.org/10.1007/978-3-030-31125-4_1

Waheed, M.A. and Oni, A.O., 2015. Performance improvement of a crude oil distillation unit. *Applied Thermal Engineering*, *75*, pp.315-324.

Waktola, B.S., 2019. Boosting Employee Performance; Effects of Working Environment on Employees Performance: Case of Ethio-Telecom in Ambo Branch. *Global Journal of Management and Business Research*, 9(11-A).

Wallace, S., n.d. Does Organisational Culture play an important role in the effectiveness of embedding Business Continuity? Available at:< https://static1.squarespace.com/static/5b45dc59f407b434fe0d9fd2/t/5eb91b93b2acbe6aa4fea 049/1589189523947/Inverroy+Further+reading.pdf> [Accessed 12 February 2019].

Walsh, J. and Winsor, B., 2019. Socio-cultural barriers to developing a regional entrepreneurial ecosystem. *Journal of Enterprising Communities: People and Places in the Global Economy*, 13(3) pp. 263-282.

Wan, Y.K.P., Wong, I.A. and Kong, W.H., 2014. Student career prospect and industry commitment: The roles of industry attitude, perceived social status, and salary expectations. *Tourism Management*, *40*, pp.1-14.

Wang, C., Li, Y., Xu, C., Badawy, T., Sahu, A. and Jiang, C., 2019b. Methanol as an octane booster for gasoline fuels. *Fuel*, *248*, pp.76-84.

Wang, J., Zhang, W., Cao, R., You, X.Y. and Lai, H.,2016. Analysis of Nitrogen Dioxide in Environment. *Advances in Bioscience and Biotechnology*, 7, 278-288. http://dx.doi.org/10.4236/abb.2016.76026

Wang, L., Wang, J., Tan, X. and Fang, C., 2020a. Analysis of NOx Pollution Characteristics in the Atmospheric Environment in Changchun City. *Atmosphere*, *11*(1), p.30.

Wang, M., Jia, S., Lee, S.H., Chow, A. and Fang, M., 2021. Polycyclic aromatic hydrocarbons (PAHs) in indoor environments are still imposing carcinogenic risk. *Journal of Hazardous Materials*, *409*, p.124531.

Wang, S., Hung, K. and Huang, W.J., 2019c. Motivations for entrepreneurship in the tourism and hospitality sector: A social cognitive theory perspective. *International Journal of Hospitality Management*, *78*, pp.78-88.

Wang, W.G., Dong, L.M. and Li, S.W., 2019a. SF36 Is a Reliable Patient-Oriented Outcome Evaluation Tool in Surgically Treated Degenerative Cervical Myelopathy Cases: A Systematic Review and Meta-Analysis. *Medical science monitor: international medical Journal of Experimental and Clinical Research*, *25*, p.7126.

Wang, Y., Jiao, Y., Nie, J., O'Neil, A., Huang, W., Zhang, L., Han, J., Liu, H., Zhu, Y., Yu, C. and Woodward, M., 2020b. Sex differences in the association between marital status and the risk of cardiovascular, cancer, and all-cause mortality: a systematic review and meta-analysis of 7,881,040 individuals. *Global Health Research and Policy*, *5*(1), pp.1-16.

Wang, Z., Li, J., Mu, X., Zhao, L., Gu, C., Gao, H., Ma, J., Mao, X. and Huang, T., 2021. A WRF-CMAQ modeling of atmospheric PAH cycling and health risks in the heavy petrochemical industrialized Lanzhou valley, Northwest China. *Journal of Cleaner Production*, *291*, p.125989.

Wang, Z., Liu, H., Yu, H., Wu, Y., Chang, S. and Wang, L., 2017. Associations between occupational stress, burnout and well-being among manufacturing workers: mediating roles of psychological capital and self-esteem. *BMC Psychiatry*, *17*(1), pp.1-10.

Wapner, A., 2017. Downstream Beneficiation Case Study: Nigeria. [pdf]. Columbia Centre on Sustainable Investment. Available at< http://ccsi.columbia.edu/files/2013/10/Nigeria-Case-Study-May-2017_CCSI-Final-2.pdf> [Accessed 3 April 2021].

Warburton, D.E., Nicol, C.W. and Bredin, S.S., 2006. Health benefits of physical activity: the evidence. *Cmaj*, *174*(6), pp.801-809.

Warhurst, C., Wright, S. and Lyonette, C., 2017. Understanding and measuring job quality: Part 1–Thematic Literature Review.[pdf]. *Institute for employment research. University of Warwick, Coventry*.

Watakakosol, R., Suttiwan, P., Ngamake, S.T., Raveepatarakul, J., Wiwattanapantuwong, J., Iamsupasit, S. and Tuicomepee, A., 2020. Integration of the Theory of Planned Behavior and Transtheoretical Model of Change for Prediction of Intentions to Reduce or Stop Alcohol Use among Thai Adolescents. *Substance Use & Misuse*, 56 (1), pp 72 - 80.

Weber Rawlins, M.L., Welch Bacon, C.E., Tomporowski, P., Gay, J.L., Bierema, L.L. and Schmidt, J.D., 2020. Using the health belief model to predict concussion-reporting intentions and behaviour. *Brain Injury,* 34(12), pp.16455-16465.

Weijs-Perrée, M., Appel-Meulenbroek, R., Arentze, T. and Romme, G., 2019. The influence of the physical work environment of business centres on social networking and knowledge sharing in the Netherlands. *Intelligent Buildings International*, *11*(2), pp.105-125

Welsh, J., Strazdins, L., Charlesworth, S., Kulik, C.T. and Butterworth, P., 2016. Health or harm? A cohort study of the importance of job quality in extended workforce participation by older adults. *BMC Public Health,* 16(1), pp.1-14.

Whatnall, M., Patterson, A. and Hutchesson, M., 2019. A brief web-based nutrition intervention for young adult university students: Development and evaluation protocol using the precede-proceed model. *JMIR Research Protocols*, *8*(3), p.e11992.

Wikimedia Commons, 2016a. Health effects of pollution.png [Accessed 8 December 2017].

Wikimedia Commons, 2016b. File: Kwara State Nigeria.png [Accessed 8 December 2017].

Wilson, C.M. and Oswald, A.J., 2005. How does marriage affect physical and psychological health? A survey of the longitudinal evidence. *The Institute for the Study of Labor.*[pdf].

Wokekoro, E., 2020. An Examination of Sources of Noise Pollution in Cities in Nigeria. *World Journal of Research and Review (WJRR)*, 11 (1) Pp. 01-06.

Wong, F.Y., Yang, L., Yuen, J.W., Chang, K.K. and Wong, F.K., 2018. Assessing quality of life using WHOQOL-BREF: A cross-sectional study on the association between quality of life and neighbourhood environmental satisfaction, and the mediating effect of health-related behaviors. *BMC Public Health*, *18*(1), p.1113.

World Bank Group, 2019. Nigeria; overview. Available at: <http://www.worldbank.org/en/country/nigeria/overview> [Accessed 27 March 2020].

World Bank Group, 2019a. Population, female (% of total population) – Nigeria. [online] Available at < https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=NG> [Accessed 24 April 2020].

World Bank Group, 2019b. Population, male (% of total population) – Nigeria. [online] Available at< https://data.worldbank.org/indicator/SP.POP.TOTL.MA.ZS?locations=NG> [Accessed 24 April 2020].

World Bank Group, 2021. Labor force, total – Nigeria. [online] Available at:<https://data.worldbank.org/indicator/SL.TLF.TOTL.IN?locations=NG> [Accessed 24 March 2021].

World Bank, 2017. Reducing Pollution. Available at:<http://www.worldbank.org/en/topic/environment/brief/pollution>[Accessed 27 March 2021].

World Health Organisation (WHO), 2012. Measurement of and target-setting for well-being: an initiative by the WHO Regional Office for Europe. Available at:<http://www.euro.who.int/__data/assets/pdf_file/0003/180048/E96732.pdf. >[Accessed 12 March 2020].

World Health Organisation (WHO), 2015. Lead exposure in African children: contemporary sources and concerns. [pdf] Available at:<https://apps.who.int/iris/handle/10665/200168>[Accessed 27 March 2020].

World Health Organisation (WHO), 2017. Priorities: Health impacts of climate and environmental change. Available at:<http://www.who.int/dg/priorities/climate-change/en/>[Accessed 27 March 2020]

World Health Organisation (WHO), 2020. Drinking-water. Available at<https://www.who.int/news-room/fact-sheets/detail/drinking-water >[Accessed 27 March 2021]

World Health Organisation, 2015. Health in 2015: from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals. *www.who.int.*

World Health Organisation, 2018. Millennium Development Goals (MDGs). [online] Available at < https://www.who.int/news-room/fact-sheets/detail/millennium-development-goals-(mdgs)> [Accessed 22 March 2021].

World Health Organisation, 2021a. Millennium Development Goals (MDGs). [online] Available at < https://www.who.int/topics/millennium_development_goals/en/> [Accessed 22 March 2021].

World Health Organization, 2001. Occupational health: A manual for primary health care workers. [pdf] Regional office of the Eastern Mediterranean. <https://www.who.int/occupational_health/regions/en/oehemhealthcareworkers.pdf>

World Health Organization, 2011. Tuberculosis prevalence surveys: a handbook. WHO Library Cataloguing-in-Publication Data, Geneva, Switzerland.

World Health Organization, 2019a. Water, sanitation, hygiene and health: a primer for health professionals. Geneva. (WHO/CED/PHE/WSH/19.149). Licence: CC BY-NC-SA 3.0 IGO

World Health Organization, 2019b. Lead poisoning and health. Geneva.

World Health Organization, 2020a. Drinking-water. Geneva [https://www.who.int/news-room/fact-sheets/detail/drinking-water] [Accessed 28, October 2020].

World Health Organization, 2020b. Air pollution: overview. [https://www.who.int/health-topics/air-pollution#tab=tab_1]. [Accessed 28, October 2020].

World Health Organization, 2020c. Air pollution. Household air pollution: Health impacts. [https://www.who.int/airpollution/household/health-impacts/en/].[Accessed 28, October 2020].

World Health Organization, 2020d. Occupational Health: Occupational and work-related diseases.
[https://www.who.int/occupational_health/activities/occupational_work_diseases/en/] [Accessed 28, October 2020].

World Health Organization, 2020e. Noise: Data and Statistics. Available at < https://www.euro.who.int/en/health-topics/environment-and-health/noise/data-and-statistics> [accessed 23 November 2020].

World Water Assessment Programme (WWAP), 2015. The United Nations World Water Development Report 2015: Water for a sustainable world. United Nations World Water Assessment Programme (WWAP). Paris, United Nations Educational, Scientific and Cultural Organization.

World Water Assessment Programme, 2017. The United Nations World Water Development Report 2017: Wastewater, the untapped resource. United Nations World Water Assessment Programme (WWAP). Paris, United Nations Educational, Scientific and Cultural Organization.

Worldatlas, 2021. Continents of the World. Available at <https://www.worldatlas.com/continents> [Accessed 27 March 2021].

Worsfold, P., Townshend, A., Poole, C.F. and Miró, M., 2019. *Encyclopedia of analytical science*. Elsevier. UK

Wright, C.J., 2017. *Fundamentals of oil & gas accounting*. PennWell books. Tulsa.

Wu, Y., Xu, Z., Liu, S., Tang, M. and Lu, S., 2021. Emission of organic components and distribution characteristics of PAHs in condensable particulate matter from coal-fired power and industrial plants. *Journal of the Energy Institute*, *97*, pp.109-116.

Wypych, G. ed., 2019. *Handbook of Solvents, Volume 1:* Volume 1: Properties. ChemTec Publishing. Canada.

Xu, H., Tang, L., Hu, Z., Gao, F., Yang, Y., Qin, L. and Luo, B.A., 2018. Association between physical activity and health-related quality of life in elderly individuals with pre-diabetes in rural Hunan Province, China: a cross-sectional study. *BMJ Open*, *8*(4), e019836.

Xu, J. and Wu, Z., 2018. *Tubular String Characterization in High Temperature High Pressure Oil and Gas Wells*. CRC Press. UK

Xu, R., Cai, Y., Wang, X., Li, C., Liu, Q. and Yang, Z., 2020. Agricultural nitrogen flow analysis in a watershed and implication for water pollution mitigation: A study in Beijing, China. *Journal of Cleaner Production*, 267, p.122034.

Xue, X., Lin, Y., Zheng, Q., Wang, K., Zhang, J., Deng, J., Abubakar, G.A. and Gan, M., 2020. Mapping the fine-scale spatial pattern of artificial light pollution at night in urban environments from the perspective of bird habitats. *Science of the Total Environment*, *702*, p.134725.

Yagil, D. and Oren, R., 2021. Servant Leadership, Engagement, and Employee Outcomes: The Moderating Roles of Proactivity and Job Autonomy. *Journal of Work and Organizational Psychology*, *37*(1), pp.58-67.

Yanar, B., Lay, M. and Smith, P.M., 2019. The interplay between supervisor safety support and occupational health and safety vulnerability on work injury. *Safety and Health at Work*, *10*(2), pp.172-179.

Yang, L., Quanliang, C., Hujia, Z., Lin, W., & Ran, T., 2015. Variations in PM10, PM2.5 and PM1.0 in an Urban Area of the Sichuan Basin and their Relation to Meteorological Factors. *Atmosphere,* 6(1) pp. 150-163.

Yang, M., Bell, T.G., Hopkins, F.E. and Smyth, T.J., 2016. Attribution of atmospheric sulfur dioxide over the English Channel to dimethyl sulfide and changing ship emissions. *Atmospheric Chemistry and Physics,* 16(8), pp.4771-4783.

Yang, W., He, J., He, C. and Cai, M., 2020. Evaluation of urban traffic noise pollution based on noise maps. *Transportation Research Part D: Transport and Environment*, *87*, p.102516.

Yao, P.H., Shyu, G.S., Chang, Y.F., Chou, Y.C., Shen, C.C., Chou, C.S. and Chang, T.K., 2015. Lead isotope characterization of petroleum fuels in Taipei, Taiwan. *International Journal of Environmental Research and Public Health,* 12(5), pp.4602-4616.

Yap, C.K., 2019. *Soil Pollution: Sources, Management Strategies and Health Effects*. Nova Science Publishers, Inc.; Hauppauge, NY, USA.

Yavari, S., Malakahmad, A. and Sapari, N.B., 2015. A review on phytoremediation of crude oil spills. *Water, Air, & Soil Pollution*, 226(8), p.279.

Yilmaz, A.K. and Flouris, T., 2017. *Corporate risk management for international business*. Springer Singapore.

Younis, N.M., Hussein, A.A., Ahmed, M.M. and Younis, N.M., 2020. Quality of life and occupational hazards among cement factory workers in Mosul city. *Annals of Tropical Medicine & Public Health;* 24, S2: SP24229.

Yousefian, F., Hassanvand, M.S., Nodehi, R.N., Amini, H., Rastkari, N., Aghaei, M., Yunesian, M. and Yaghmaeian, K., 2020. The concentration of BTEX compounds and health risk assessment in municipal solid waste facilities and urban areas. *Environmental Research*, *191*, p.110068.

Yu, X. and Khazanchi, D., 2017. Using Embedded Mixed Methods in Studying IS Phenomena: Risks and Practical Remedies with an Illustration. *Using Embedded Mixed Methods in Studying IS Phenomena: Risks and Practical Remedies with an Illustration*, 41, pp.555 – 595.

Yu, Y., Paul, K., Arah, O.A., Mayeda, E.R., Wu, J., Lee, E., Shih, I.F., Su, J., Jerrett, M., Haan, M. and Ritz, B., 2020. Air pollution, noise exposure, and metabolic syndrome–A cohort study in elderly Mexican-Americans in Sacramento area. *Environment International*, *134*, p.105269.

Yunus, S., 2019. Analysis of Locational Compliance and Fire Safety Preparedness among Petrol Filling Stations in Dutse Town, Jigawa State. *Confluence Journal of Environmental Studies*13 (1)p. 107-118.

Yunusa, A. and Paul, A.A., 2018. Assessment of the contributions of small scale enterprises to the development of the Nigerian economy. *Journal of Good Governance and Sustainable Development in Africa (JGGSDA),* 4(1), pp.37-47.

Yusof, J., 2021. Elements of Work Environment in the Construct of Special Education Teacher Workload in Malaysia. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(11), pp.5284-5288.

Zahir, F., 2019. Frontiers in occupational health and safety (volume 2), introduction to occupational health hazards. [e-book] Bentham science publishers Pte. Ltd

Zaware Sandeep Gangadhar, 2014. Environmental Impact Assessment on Soil Pollution Issue about Human Health. *International Research Journal of Environment Sciences* 3(11), pp.78-81.

Zefeiti, S.M.B.A. and Mohamad, N.A., 2015. Methodological considerations in studying transformational leadership and its outcomes. *International Journal of Engineering Business Management*, *7*, p.10.

Zeng, Y., Lin, R., Liu, L., Liu, Y. and Li, Y., 2019. Ambient air pollution exposure and risk of depression: a systematic review and meta-analysis of observational studies. *Psychiatry Research*, *276*, pp.69-78.

Zeydabadi, A., Askari, J., Vakili, M., Mirmohammadi, S.J., Ghovveh, M.A. and Mehrparvar, A.H., 2019. The effect of industrial noise exposure on attention, reaction time, and memory. *International Archives of Occupational and Environmental Health,* 92(1), pp.111-116.

Zhang, B., Matchinski, E.J., Chen, B., Ye, X., Jing, L. and Lee, K., 2019. Marine oil spills—Oil pollution, sources and effects. In *World seas: an environmental evaluation* (pp. 391-406). Academic Press.

Zhang, R., Fujimori, S., Dai, H. and Hanaoka, T., 2018. Contribution of the transport sector to climate change mitigation: insights from a global passenger transport model coupled with a computable general equilibrium model. *Applied Energy*, *211*, pp.76-88.

Zhao, J.L., Sun, M.X. and Li, Q., 2019, October. Joint prediction of CO, NOx, NMHC pollutant concentrations in urban area. In *IOP Conference Series: Earth and Environmental Science* 356 (1), p. 012010.

Zhong, Q., Shen, H., Yun, X., Chen, Y., Ren, Y.A., Xu, H., Shen, G., Du, W., Meng, J., Li, W. and Ma, J., 2020. Global sulfur dioxide emissions and the driving forces. *Environmental Science & Technology,* 54(11), pp.6508-6517.

Zhou, K., Zhuang, G., Zhang, H., Liang, P., Yin, J., Kou, L., Hao, M. and You, L., 2013. Psychometrics of the Short Form 36 Health Survey version 2 (SF-36v2) and the Quality of Life Scale for Drug Addicts (QOL-DAv2. 0) in Chinese mainland patients with methadone maintenance treatment. *PloS One*, *8*(11).

Zhu, Y. and Xia, Y., 2019. Industrial agglomeration and environmental pollution: Evidence from China under New Urbanization. *Energy & Environment*, *30*(6), pp.1010-1026.

Zhu, Y.X., Li, T., Fan, S.R., Liu, X.P., Liang, Y.H. and Liu, P., 2016. Health-related quality of life as measured with the Short-Form 36 (SF-36) questionnaire in patients with recurrent vulvovaginal candidiasis. *Health and Quality of Life Outcomes*, *14*(1), p.65.

Zhua, Y., Chenb, J., Bib, X., Kuhlmannc, G., Chand, K.L., Dietrichb, F., Brunnerc, D., Yea, S. and Weniga, M., 2020. Spatial and temporal representativeness of point measurements for nitrogen dioxide pollution levels in cities. *Atmospheric Chemistry and Physics, 20(21), pp.13241-13251.*

Zimmerman, R.S., DiClemente, R.J., Andrus, J.K. and Hosein, E.N. eds., 2016. *Introduction to global health promotion*. John Wiley & Sons. San Francisco, CA

Zoleikha, S., Mirzaei, R. and Roksana, M., 2017. Exposure to chemical hazards in petrol pumps stations in Ahvaz City, Iran. *Archives of Environmental & Occupational Health*, 72(1), pp.3-9.

Zollinger, S.A., Dorado-Correa, A., Goymann, W., Forstmeier, W., Knief, U., BastidasUrrutia, A.M. and Brumm, H., 2019. Traffic noise exposure depresses plasma corticosterone and delays offspring growth in breeding zebra finches. *Conservation Physiology*, *7*(1), p.coz056.

Zou, B., Li, S., Lin, Y., Wang, B., Cao, S., Zhao, X., Peng, F., Qin, N., Guo, Q., Feng, H. and Matthew, C.J., 2020. Efforts in reducing air pollution exposure risk in China: State versus individuals. *Environment International*, *137*, p.105504.

APPENDIX ONE
ETHICAL AND ACCESSIBILITY APPROVAL
PARTICIPANT INFORMATION SHEET
PARTICIPANT CONSENT FORM

Appendix 1A

Thursday, 20 July 2017
cshs/ethics /approved

Lawal, Abosede Hadizat
MPhil/PhD
Cardiff School of Health Sciences

Dear Applicant

Re: Application for Ethical Approval: Evaluation of air pollution caused by particulate matter from retail petrol stations in Ilorin, Kwara state. Pilot phase

Project Reference Number: 9264

Your ethics application, as shown above, was considered by the Applied Community Sciences Ethics Panel on 19/07/2017.

I am pleased to inform you that your application for ethical approval was **APPROVED.**

Minor issues may still need addressing before you commence any work – if so these will be listed below.

N/A

Where changes to the information sheet, consent form and/or procedures are deemed necessary you must submit revised versions to the relevant ethics inbox. If you are a student – your supervisor must do this on your behalf.

Note: Failure to comply with any issues listed abiove will nullify this approval.

Standard Conditions of Approval

1. Your Ethics Application has been given a Project Reference number as above. This **MUST** be quoted on all documentation relating to the project (E.g. consent forms, information sheets), together with the full project title.

2. All documents must also have the approved University Logo and the Version number in addition to the reference and project title as above

3. A full **Risk Assessment** must be undertaken for this proposal, as appropriate, and be made available to the Committee if requested.

4. Any changes in connection to the proposal as approved, must be referred to the Panel/Committee for consideration *without delay quoting your Project Reference Number.* Changes to the proposed project may have ethical implications so must be approved.

5. Any untoward incident which occurs in connection with this proposal must be reported back to the Panel *without delay.*

6. If your project involves the use of **human samples**, your approval is given on the condition that you or your supervisor **notify the HTA Designated Individual** of your intention to work

with such material by **completing** the form entitled *"Notification of Intention to Work with Human Samples"*. The form must be submitted to the PD (Sean Duggan), **BEFORE** any activity on this project is undertaken.

This approval expires on **19/07/2018** . It is your responsibility to reapply / request extension if necessary.

Yours sincerely

Huw Evans
Chair of Applied Community Sciences & Protection Ethics Panel
Cardiff School of Health Sciences

Tel : 029 20416887
E-mail : hdevans@cardiffmet.ac.uk

Cc: Karani, George

PLEASE RETAIN THIS LETTER FOR REFERENCE

Appendix 1B

KWASU/CEERMS/SAHES/001/Vol.1/003   28ᵗʰ Sept 2018

NOTICE OF EXPIDITED REVIEW AND REVIEW

ASSESSMENT OF QUALITY OF LIFE USING RAND 36-ITEM HEALTH SURVEY 1.0 QUESTIONNAIRE ON STAFF AND STUDENTS OF CENTER FOR ECOLOGICAL AND ENVIRONMENT RESEARCH MANAGEMENT AND STUDIES, ILORIN, KWARA STATE.

Name of Principal Investigator: ABOSEDE HADIZAT LAWAL

Co-investigator: DR. HENRY O. SAWYERR

Address of Ethical Approval: Department of
                                                                Environmental Health

                                                                Center for Ecological and
                                                                Environmental Research
                                                                Management and Studies

                                                                Kwara State University,
                                                                Malete. Kwara State

Date of receipt of Application: 24ᵗʰ Sept 2018

Date of Ethical Approval: 28ᵗʰ Sept 2018

This is to inform you that the Research described in the submitted Protocol, the Consent forms, advertisement and other participants information materials have been reviewed and given Expedited approval by the Health Research Ethics Committee (HREC).

If there is delay in starting the research or any changes, inform the HREC so that the dates of approval can be adjusted accordingly.

However, Researcher in kindly requested to submit a copy of his/her finding to the Center for Ecological and Environmental Research Management and Studies, please

Dr. Henry Sawyerr
Director

329

Appendix 1C

KWARA STATE UNIVERSITY, MALETE
COLLEGE OF PURE AND APPLIED

SCHOOL OF ALLIED HEALTH AND ENVIRONMENTAL SCIENCE

REF/KWASU/SAHES/EHS/002/02082017

The President
Major Petroleum Marketers Association of Nigeria
Ilorin, Kwara State
Nigeria

Dear Sir/Ma,

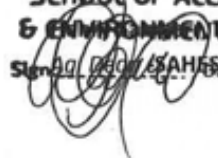INSTITUTIONAL RESEARCH ON ENVIRONMENTAL RISK FACTORS FROM PETROL STATION

The Department of Environmental Health Science, College of Pure and Applied Science, Kwara State University as part of its community service and social obligation to the citizen of Kwara State is planning to undertake an institutional research study on environment risk factors from petrol stations in florin metropolis in Kwara State.

The initiative is as a result of environmental and public health concern associated with the growth in construction of petrol station in the metropolis over the past three years.

I hereby write to seek your approval to enable our research team have access to the petrol station operators in Ilorin metropolis for their cooperation in carrying out this research study. Your assistance will be highly appreciated if you could graciously accord us all the necessary support in term of Information, facilities, and manpower to facilitate the realization of the set objectives of the research.

On behalf of the University, we hereby declare that the information released to the research students shall be used purely for the purpose of the research. Moreover, the integrity of your esteemed organization or your agency shall not be compromised in any way during the course of presenting the findings of this work.

Please, accept the assurance of my highest regards.

Yours faithfully,

KWARA STATE UNIVERSITY, MALETE
Henry Sawyerr, PhD
SCHOOL OF ALLIED HEALTH
Ag. Dean SAHES
& ENVIRONMENTAL SCIENCE

Sign:.............. Date:02/08/2017

TOTAL NIGERIA PLC
Customed Services Sentte
Ilorin

330

Appendix 1D

KWARA STATE UNIVERSITY, MALETE

COLLEGE OF PURE AND APPLIED

SCHOOL OF ALLIED HEALTH AND ENVIRONMENTAL SCIENCE

REF/KWASU/SAHES/EHS/005/02082017

Honorable Commissioner
Kwara State Ministry of Environment and Forestry
Ilorin, Kwara State
Nigeria

Dear Sir/Ma,

INSTITUTIONAL RESEARCH ON ENVIRONMENTAL RISK FACTORS FROM PETROL STATION

The Department of Environmental Health Science, College of Pure and Applied Science, Kwara State University as part of its community service and social obligation to the citizen of Kwara State is planning to undertake an institutional research study on environment risk factors from petrol stations in Ilorin metropolis in Kwara State.

The initiative is as a result of environmental and public health concern associated with the growth in construction of petrol station in the metropolis over the past three years.

I hereby write to seek your approval to enable our research team have access to the petrol station operators in Ilorin metropolis for their cooperation in carrying out this research study. Your assistance will be highly appreciated if you could graciously accord us all the necessary support in term of Information, facilities, and manpower to facilitate the realization of the set objectives of the research.

On behalf of the University, we hereby declare that the information released to the research students shall be used purely for the purpose of the research. Moreover, the integrity of your esteemed organization or your agency shall not be compromised in any way during the course of presenting the findings of this work.

Please, accept the assurance of my highest reg

Yours faithfully,
KWARA STATE UNIVERSITY, MALETE
SCHOOL OF ALLIED HEALTH
& ENVIRONMENTAL SCIENCE
Signed/ /SAHES Date: 22/08/2017

Appendix 1E

KWARA STATE UNIVERSITY, MALETE

COLLEGE OF PURE AND APPLIED
SCHOOL OF ALLIED HEALTH AND ENVIRONMENTAL SCIENCE

REF/KWASU/SAHES/EHS/004/02082017 .

The President .
Environmental Health Officers Association of Nigeria
Ilorin, Kwara State
Nigeria

Dear Sir/Ma,
INSTITUTIONAL RESEARCH ON ENVIRONMENTAL RISK FACTORS FROM PETROL STATION

The Department of Environmental Health Science, College of Pure and Applied Science, Kwara State University as part of its community service and social obligation to the citizen of Kwara State is planning to undertake an institutional research study on environmental risk factors from petrol stations in Ilorin metropolis in Kwara State.

The initiative is as a result of environmental and public health concern associated with the growth in construction of petrol station in the metropolis over the past three years.
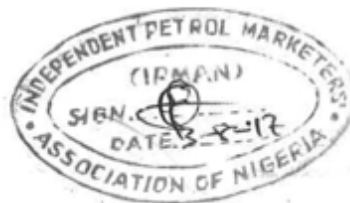
I hereby write to seek your approval to enable our research team have access to the petrol station operators in Ilorin metropolis for their cooperation in carrying out this research study. Your assistance will be highly appreciated if you could graciously accord us all the necessary support in term of Information, facilities, and manpower to facilitate the realization of the set objectives of the research.

On behalf of the University, we hereby declare that the information released to the research students shall be used purely for the purpose of the research. Moreover, the integrity of your esteemed organization or your agency shall not be compromised in any way during the course of presenting the findings of this work.

Please, accept the assurance of my highest regards.

Yours faithfully,
KWARA STATE UNIVERSITY, MALETE
SCHOOL OF ALLIED HEALTH
& ENVIRONMENTAL SCIENCE
Signal ___/SAHES. Date: 22/08/2017

Original copy
Received/Collected by me
Date: 3/8/2017

Appendix 1F

KWARA STATE UNIVERSITY, MALETE
COLLEGE OF PURE AND APPLIED
SCHOOL OF ALLIED HEALTH AND ENVIRONMENTAL SCIENCE

REF/KWASU/SAHES/EHS/006/02082017

State Coordinator
Department of Petroleum Resources
Ilorin, Kwara State
Nigeria

Dear Sir/ma,

INSTITUTIONAL RESEARCH STUDY ON ENVIRONMENTAL RISK FACTORS FROM PETROL STATION

The Department of Environmental Health Science, College of Pure and Applied Science, Kwara State University as part of its community service and social obligation to the citizen of Kwara State is planning to undertake an institutional research study on environmental risk factors from petrol stations in Ilorin metropolis in Kwara State.

The initiative is as a result of environmental and public health concern associated with the growth in construction of petrol station in the metropolis over the past three years.

I hereby write to seek your approval to enable our research team have access to the petrol station operators in Ilorin metropolis for their cooperation in carrying out this research study. Your assistance will be highly appreciated if you could graciously accord us all the necessary support in term of Information, facilities, and manpower to facilitate the realization of the set objectives of the research.

On behalf of the University, we hereby declare that the information released to the research students shall be used purely for the purpose of the research. Moreover, the integrity of your esteemed organization or your agency shall hot be compromised in any way during the course of presenting the findings of this work.

Please, accept the assurance of my highest regards.

KWARA STATE UNIVERSITY, MALETE
SCHOOL OF ALLIED HEALTH
& ENVIRONMENTAL SCIENCE
Sign: Henry Sawyer, PhD. Date: 02/08/2017.
Ag. Dean, SAHES

Appendix 1G

KWARA STATE UNIVERSITY, MALETE
COLLEGE OF PURE AND APPLIED
SCHOOL OF ALLIED HEALTH AND ENVIRONMENTAL SCIENCE

REF/KWASU/SAHES/EHS/002/02082017

The President
Independent Petroleum Marketers Association of Nigeria
Ilorin, Kwara State
Nigeria

Dear Sir/Ma,

INSTITUTIONAL RESEARCH ON ENVIRONMENTAL RISK FACTORS FROM PETROL STATION

The Department of Environmental Health Science, College of Pure and Applied Science, Kwara State University as part of its community service and social obligation to the citizen of Kwara State is planning to undertake an institutional research study on environment risk factors from petrol stations in Ilorin metropolis in Kwara State.

The initiative is as a result of environmental and public health concern associated with the growth in construction of petrol station in the metropolis over the past three years.

I hereby write to seek your approval to enable our research team have access to the petrol station operators in Ilorin metropolis for their cooperation in carrying out this research study. Your assistance will be highly appreciated if you could graciously accord us all the necessary support in term of Information, facilities, and manpower to facilitate the realization of the set objectives of the research.

On behalf of the University, we hereby declare that the information released to the research students shall be used purely for the purpose of the research. Moreover, the integrity of your esteemed organization or your agency shall not be compromised in any way during the course of presenting the findings of this work.

Please, accept the assurance of my highest regards.

Yours faithfully,

KWARA STATE UNIVERSITY, MALETE
Henry Sawyerr, PhD
SCHOOL OF ALLIED HEALTH
& ENVIRONMENTAL SCIENCE
Sign:............... Date: 02/08/2017

334

Appendix 1H

Participant Information for Quality of Life Assessment[a]

Study ID Reference Number: 9264

My name is Abosede Hadizat Lawal, a student doing PhD research study at Cardiff Metropolitan University on a project titled "Assessment of Environmental Risk Factors and Quality of Life of Employees in Retail Petrol Stations in Ilorin, Kwara State, Nigeria".

SF-36 questionnaire is usually used to provide an indication of the health status of a particular population, and it has been used around the world. Assessing the health related quality of life of population within an organisation is crucial to the general wellbeing and productivity in that organisation. The research will also help to identify the health effect of specific environment on its population.

The aim of the study is to assess the quality of life of staff employees of retail petrol stations in Ilorin Kwara State, Nigeria.

You have been selected because you work as an attendant or manager at a functioning retail petrol station in Ilorin, Kwara State Nigeria.

Any information given will be used anonymously in publications and further research.

If you have any questions, or you would like additional information, please email me

ablawal@cardiffmei.ac.uk

Or contact Dr Henry Sawyerr, henry.sawyerr@kwasu.edu.ng

Participant Information for Quality of Life Assessment[b]

Study ID Reference Number: 9264

My name is Abosede Hadizat Lawal, a student doing PhD research study at Cardiff Metropolitan University on a project titled "Assessment of Environmental Risk Factors and Quality of Life of Employees in Retail Petrol Stations in Ilorin, Kwara State, Nigeria".

SF-36 questionnaire is usually used to provide an indication of the health status of a particular population, and it has been used around the world. Assessing the health related quality of life of population within an organisation is crucial to the general wellbeing and productivity in that organisation. The research will also help to identify the health effect of specific environment on its population.

The aim of the study is to assess the quality of life of staff within the School of Allied Health and Environmental Science in Kwara State University, Ilorin.

You have been selected because you study as a student or work as an academic/administrative/technical staff in School of Allied Health and Environmental Science, Kwara State University, Ilorin.

Any information given will be used anonymously in publications and further research.

If you have any questions, or you would like additional information, please email me

ablawal@cardiffmet.ac.uk

Or contact Dr Henry Sawyerr, henry.sawyerr@kwasu.edu.ng

Appendix 1K

Cardiff
Metropolitan
University

Prifysgol
Metropolitan
Caerdydd

PARTICIPANT CONSENT FORM

Study ID Reference Number: 9264

Title of Project: Assessment of Environmental Risk Factors and Quality of Life of Employees in Retail Petrol Stations in Ilorin, Kwara State, Nigeria.

Name of Researcher: Abosede Hadizat Lawal

Participant to complete this section:	Please Initial each box

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions which, where I have requested, have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.

3. I agree to take part in the above study.

4. I agree to the use of anonymised quotes in publications

Name of participant: (please print)

_____   _____

Signature of Participant   Date

_____   _____

Name of person taking consent   Date

_____

Signature of person taking consent

_____

APPENDIX TWO
PILOT STUDY QUESTIONNAIRES

Appendix 2A

Cardiff Metropolitan University | Prifysgol Metropolitan Caerdydd

Study ID Reference Number: 9264

Questionnaire for Key Informant Group (Manager/Owner)

1. Name of Organization & Location:_____

2. Type of facility ownership: Conglomerate ☐ Independent Private Marketers ☐

3. Position/status of respondent_____

4. Age range of Respondent: 18-24 ☐ 25-31 ☐ >31 ☐

5. Age range of filling station: <5years ☐ 5-9 years ☐ 10-14years ☐
   >15 ☐

6. Educational Attainment: Primary ☐ Secondary ☐ Tertiary ☐

7. How long have you been working at this retail petrol station? _____

8. List of services offered at the retail petrol station _____
   _____

9. What are the types of petroleum product sold at the retail petrol station?
   _____

10. How many days of the week do the retail petrol station operates? _____

11. What time of the day are the petroleum products delivered to the retail petrol station? _____

12. How do you measure the level of fuel in the fuel storage tank? _____
   _____

13. How do you check for water in the fuel tanks in the station (Nigeria is known for heavy rainfall and base on the location of the storage tanks in the station)? ____
   _____

1

14. What is the operating time of the station? _____

15. What is the total number of employees and operators at the retail station? _____

_____

16. Fuel Storage tank type: Surface ☐   Underground ☐

17. Size of Fuel Storage Facility: _____

18. Numbers of Fuel Storage Tank: _____

19. Material used in Fabricating Fuel Storage Tanks: _____

20. Capacity of Gas Plant: _____

21. Source of Water: Well ☐   Borehole ☐   Tap ☐

22. Location of water source: Within Vicinity ☐   Outside ☐

23. Water Use categories: Drinking ☐   Ablution/Washing ☐   Others ☐

    If others, specify please: _____

24. Drainage Network System: Open gutters ☐   Soak away ☐

25. Any repair history for: - Fuel Dispenser/Pump ☐ Fuel Pipe Network ☐

    Fuel Storage Tanks ☐

26. Ever changed storage Tank?   Yes ☐   No ☐

27. 1f yes, how many years ago? _____

28. Pumps located close to the road?   Yes ☐   No ☐

29. Functioning lube bay/mechanic workshop in the vicinity: Yes ☐   No ☐

30. Hazard encountered in the station: Fire hazard ☐   Robbery ☐
    Car Accident ☐ Fuel spillage ☐   None ☐

31. Experience any fire incident? Yes ☐   No ☐

2

32. Types of Fire Extinguisher in the station: _____

33. Fire Extinguisher to dispenser ratio: Adequate ☐   non-Adequate ☐

34. Maintenance of fire extinguisher: < 6month ago ☐   >6month ago ☐

35. Types of Safety Measure? Fire Extinguisher ☐   No smoking sign ☐

    Switch off engine ☐   Sandbox ☐   Good Nozzle Handling ☐

    No phones   ☐   IN and EXIT sign ☐   None ☐

36. What type of emergency procedure does the station have in place? _____

_____

37. Setback from the Road: <30m ☐   >30m ☐

38. Distance from the Residential Area (left):   <30m ☐   >30m ☐

39. Distance from the Residential Area (Right): <30m ☐   >30m ☐

40. Distance from the Residential Area (Rear): <30m ☐   >30m ☐

41. Do you operate shift pattern?   Yes ☐   No ☐

42. if yes, how many hours/days? _____

43. Types of training given to employees? _____

44. Forms of Training?   Oral ☐   Demonstration ☐   None ☐

45. Duration of Training?   Less than 1 week ☐   greater than one week ☐
    No training ☐

46. Does the station have hospital where employees can be treated on work related

health concern?   Yes ☐   No ☐

47. How does the petrol station dispose their solid wastes (empty aerosol cans, used
papers, oils, furniture, latex, vehicles parts etc.)? _____

48. What are the present environmental issues of concern to the retail petrol station?

_____

THANKS FOR YOUR PARTICIPATION

3

Appendix 2B

Study ID Reference Number: 9264

Questionnaire for Employee

1. Name of Organization & Location: _____

2. Position/Status of Respondent: _____

3. Age range of Respondent: 18-24 ☐   25-31 ☐ >31 ☐

4. Marital status: Married ☐ Single ☐ Divorced ☐ Widowed ☐

5. Sex of respondent?   Male ☐   Female ☐

6. Educational Attainment: Primary ☐ secondary ☐ Tertiary ☐

7. How long have you been working at the retail petrol station? _____

8. How many days of the week do you work at the petrol station? _____

9. How many days of the week do the retail petrol station operates? _____

10. How far do you live from the retail petrol station? _____

11. Source of Water: Well ☐ Borehole ☐ Tap ☐

12. Location of water source: Within Vicinity ☐ Outside ☐

13. Water Use categories: Drinking ☐ Ablution/Washing ☐ Others ☐

    specify please: _____

14. Have you experienced any injury/accident at work? Yes ☐ No ☐

15. Hazard encountered in the station: Fire hazard ☐ Robbery ☐ Car Accident ☐

    Fuel spillage ☐ None ☐

pg. 1

16. Experienced any fire incident?   Yes ☐ No ☐

17. Do you know how to use a fire extinguisher?   Yes ☐ No ☐

18. What type of emergency procedure does the station have in place?

19. Are you given any training before the start of your work at the station?

   Yes ☐   No ☐

20. 1f yes, what type of training? _____

21. What forms of training? Oral ☐   Demonstration ☐   None ☐

23. Have you been retrained? Yes ☐   No ☐

24. Does the station have hospital where emp10%æs can be treated on work related

   health concern? Yes ☐   No ☐

25. What part of the petrol station do you eat lunch? _____

26. Do you wash your hand regularly before handling any edible food you eat?

   Yes ☐   No ☐

27. Do you make use of any personal protective equipment? Yes ☐   No ☐

28. Do you have any work related health concern? Yes ☐   No ☐

29. 1f Yes, what are the work related health concern? _____

THANKS FOR YOUR PARTICIPATION

pg. 2

Appendix 2C

Questionnaire for Residential Occupant

1. Position of respondent in the household? _____

2. Age range of Respondent: 18-24 ☐   25-31 ☐   >31 ☐

3. Marital status: Married ☐ Single ☐   Divorced ☐   Widowed ☐

4. How long have you lived in this house? _____

5. What is the total number of family member residing presently in this

   accommodation? _____

6. What are the number of children and adult residing in the accommodation? __

   _____

7. How many bedrooms does this accommodation have?

8. What type of fuel do you use for cooking in your house? _____

9. Have you had any fire incident in this house?   Yes ☐   No ☐

10. Do you have fire extinguisher in your house?   Yes ☐   No ☐

11. If yes, can any of the family member use the fire extinguisher during fire

   incident? Yes ☐   No ☐

12. Do you know what to in case of fire incident in your house? Yes ☐ No ☐

13. Do you use generator?   Yes ☐   No ☐

14. If yes, how often and what part of the house is the generator use? _____

_____

15. What are the health concerns you have based on how close your house is to

the petrol station? _____

16. Have you experience any form of discomfort for living in close proximity to the

petrol station? _____

17. What are the present environmental issue of concern to you as a result of living

close to a retail petrol station? _____

Thanks for your participation

Appendix 2D

Study ID Reference Number: 9264

Questionnaire for Shop Occupant

1. Name of organization & location: _____

2. Position/Status of respondent: _____

3. Age range of respondent: 18-24 ☐   25-31 ☐   >31 ☐

4. Marital status: Married ☐   Single ☐   Divorced ☐   Widowed ☐

5. Sex of respondent: Male ☐   Female ☐

6. What do you sell in your shop? _____

7. How long have you been using this shop? _____

8. How many workers do you have? _____

9. How many days of the week do you use your shop? _____

10. How many hours do you stay in your shop daily? _____

11. What is your source of water?   Well ☐   Borehole ☐   Tap ☐

12. Have you experience any fire incident in your shop?   Yes ☐   No ☐

13. Do you have fire extinguisher in your shop?   Yes ☐   No ☐

14. How far do you live from your shop? _____

15. Do you cook in your shop?   Yes ☐   No ☐

16. Do you make use of generator in your shop?   Yes ☐   No ☐

17. What part of the shop do you put your generator when on? _____

18. How do you dispose the waste from your shop?_____

19. Any health concern for having your shop close to a petrol station? _____

_____

20. What are the present environmental issue of concern to you as a result of

    having your shop close to a retail petrol station? _____

_____

21. Have you experience any form of discomfort for selling close to the petrol

    station? _____

Thanks for your participation

APPENDIX THREE
QUALITY OF LIFE QUESTIONNAIRES

Appendix 3A

Cardiff Metropolitan University | Prifysgol Metropolitan Caerdydd

Study ID Reference Number: 9264

Quality of Life Questionnaire for Retail Petrol Station Employee

1. Name of Organization & Location: _____

2. Position/Status of Respondent: _____

3. Age range of Respondent: 18-24 ☐   25-31 ☐   >31 ☐

4. Marital Status: Married ☐ Single ☐ Divorced ☐ Widowed ☐

5. Sex of respondent?   Male ☐   Female ☐

36-ITEM SHORT FORM SURVEY INSTRUMENT (SF-36)

Choose one option for each questionnaire item.

1. In general, would you say your health is:

☐ 1 - Excellent

☐ 2 - Very good

☐ 3 - Good

☐ 4 - Fair

☐ 5 - Poor

2. Compared to one year ago, how would you rate your health in general now?

☐ 1 - Much better now than one year ago

☐ 2 - Somewhat better now than one year ago

☐ 3 - About the same

☐ 4 - Somewhat worse now than one year ago

☐ 5 - Much worse now than one year ago

2 |

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○ 1	○ 2	○ 3
4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○ 1	○ 2	○ 3
5. Lifting or carrying groceries	○ 1	○ 2	○ 3
6. Climbing several flights of stairs	○ 1	○ 2	○ 3
7. Climbing one flight of stairs	○ 1	○ 2	○ 3
8. Bending, kneeling, or stooping	○ 1	○ 2	○ 3
9. Walking more than a mile	○ 1	○ 2	○ 3
10. Walking several blocks	○ 1	○ 2	○ 3
11. Walking one block	○ 1	○ 2	○ 3
12. Bathing or dressing yourself	○ 1	○ 2	○ 3

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
13. Cut down the amount of time you spent on work or other activities	○ 1	○ 2
14. Accomplished less than you would like	○ 1	○ 2
15. Were limited in the kind of work or other activities	○ 1	○ 2
16. Had difficulty performing the work or other activities (for example, it took extra effort	○ 1	○ 2

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
17. Cut down the amount of time you spent on work or other activities	O 1	O 2
18. Accomplished less than you would like	O 1	O 2
19. Didn't do work or other activities as carefully as usual	O 1	O 2

20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

  ○ 1 - Not at all

  ○ 2 - Slightly

  ○ 3 - Moderately

  ○ 4 - Quite a bit

  ○ 5 - Extremely

21. How much bodily pain have you had during the past 4 weeks?

  ○ 1 - None

  ○ 2 - Very mild

  ○ 3 - Mild

  ○ 4 - Moderate

  ○ 5 - Severe

  ○ 6 - Very severe

22. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

○ 1 - Not at all

○ 2 - A little bit

○ 3 - Moderately

○ 4 - Quite a bit

○ 5 - Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
24. Have you been a very nervous person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
25. Have you felt so down in the dumps that nothing could cheer you up?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
26. Have you felt calm and peaceful?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
27. Did you have a lot of energy?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
28. Have you felt downhearted and blue?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
29. Did you feel worn out?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
30. Have you been a happy person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
31. Did you feel tired?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6

32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- ( ) 1 - All of the time
- ( ) 2 - Most of the time
- ( ) 3 - Some of the time
- ( ) 4 - A little of the time
- ( ) 5 - None of the time

How TRUE or FALSE is each of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	1	2	3	4	5
34. I am as healthy as anybody I know	1	2	3	4	5
35. I expect my health to get worse	1	2	3	4	5
36. My health is excellent	1	2	3	4	5

ABOUT

The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier, and more prosperous. RAND is non-profit, nonpartisan, and committed to the public interest.

1776 Main Street
Santa Monica, California 90401-3208

Thanks for your participation

354

Appendix 3B

Quality of Life Questionnaire for Student

1. Age Range of Respondent: 18-24 ☐   25-31 ☐   >31 ☐

2. Gender: Female ☐   Male ☐

3. Marital Status: Single ☐ Married ☐ Divorced ☐ Widowed ☐

4. Student Identification Number: _____

5. Department _____

6. Level: _____

8. Number of Children If Applicable _____

36-ITEM SHORT FORM SURVEY INSTRUMENT (SF-36)

Choose one option for each questionnaire item.

1. In general, would you say your health is:

   ☐ 1 - Excellent

   ☐ 2 - Very good

   ☐ 3 - Good

   ☐ 4 - Fair

   ☐ 5 - Poor

2. Compared to one year ago, how would you rate your health in general now?

   ☐ 1 - Much better now than one year ago

   ☐ 2 - Somewhat better now than one year ago

   ☐ 3 - About the same

   ☐ 4 - Somewhat worse now than one year ago

   ☐ 5 - Much worse now than one year ago

2 |

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	◯ 1	◯ 2	◯ 3
4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	◯ 1	◯ 2	◯ 3
5. Lifting or carrying groceries	◯ 1	◯ 2	◯ 3
6. Climbing several flights of stairs	◯ 1	◯ 2	◯ 3
7. Climbing one flight of stairs	◯ 1	◯ 2	◯ 3
8. Bending, kneeling, or stooping	◯ 1	◯ 2	◯ 3
9. Walking more than a mile	◯ 1	◯ 2	◯ 3
10. Walking several blocks	◯ 1	◯ 2	◯ 3
11. Walking one block	◯ 1	◯ 2	◯ 3
12. Bathing or dressing yourself	◯ 1	◯ 2	◯ 3

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
13. Cut down the amount of time you spent on work or other activities	◯ 1	◯ 2
14. Accomplished less than you would like	◯ 1	◯ 2
15. Were limited in the kind of work or other activities	◯ 1	◯ 2
16. Had difficulty performing the work or other activities (for example, it took extra effort	◯ 1	◯ 2

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
17. Cut down the amount of time you spent on work or other activities	○ 1	○ 2
18. Accomplished less than you would like	○ 1	○ 2
19. Didn't do work or other activities as carefully as usual	○ 1	○ 2

20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

○ 1 - Not at all

○ 2 - Slightly

○ 3 - Moderately

○ 4 - Quite a bit

○ 5 - Extremely

21. How much bodily pain have you had during the past 4 weeks?

○ 1 - None

○ 2 - Very mild

○ 3 - Mild

○ 4 - Moderate

○ 5 - Severe

○ 6 - Very severe

22.   During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

○ 1 - Not at all

○ 2 - A little bit

○ 3 - Moderately

○ 4 - Quite a bit

○ 5 - Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
24. Have you been a very nervous person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
25. Have you felt so down in the dumps that nothing could cheer you up?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
26. Have you felt calm and peaceful?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
27. Did you have a lot of energy?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
28. Have you felt downhearted and blue?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
29. Did you feel worn out?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
30. Have you been a happy person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
31. Did you feel tired?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6

32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

1 - All of the time

2 - Most of the time

3 - Some of the time

4 - A little of the time

5 - None of the time

How TRUE or FALSE is each of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	1	2	3	4	5
34. I am as healthy as anybody I know	1	2	3	4	5
35. I expect my health to get worse	1	2	3	4	5
36. My health is excellent	1	2	3	4	5

ABOUT

The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier, and more prosperous. RAND is non-profit, nonpartisan, and committed to the public interest.

1776Main Street
Santa Monica, California 90401-3208

Thanks for your participation

Appendix 3C

Cardiff Metropolitan University | Prifysgol Metropolitan Caerdydd

Study ID Reference Number: 9264

Quality of Life Questionnaire for Staff

1. Age Range of Respondent: 18-24 ☐   25-31 ☐   >31 ☐

2. Gender of Respondent: Female ☐   Male ☐

3. Marital Status: Single ☐   Married ☐   Divorced ☐   Widow ☐

4. Education Attainment: primary ☐   Secondary ☐   Tertiary ☐

5. Job Type: Academic ☐   Administrative ☐   Technical ☐

6. Employment Contract Type: Permanent ☐   Part-time ☐

7. Length of Employment:
_____

8. Number of Children if Applicable:
_____

36-ITEM SHORT FORM SURVEY INSTRUMENT (SF-36)

Choose one option for each questionnaire item.

1. In general, would you say your health is:

☐ 1 - Excellent

☐ 2 - Very good

☐ 3 - Good

☐ 4 - Fair

☐ 5 - Poor

2. Compared to one year ago, how would you rate your health in general now?

☐ 1 - Much better now than one year ago

☐ 2 - Somewhat better now than one year ago

☐ 3 - About the same

☐ 4 - Somewhat worse now than one year ago

☐ 5 - Much worse now than one year ago

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○ 1	○ 2	○ 3
4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○ 1	○ 2	○ 3
5. Lifting or carrying groceries	○ 1	○ 2	○ 3
6. Climbing several flights of stairs	○ 1	○ 2	○ 3
7. Climbing one flight of stairs	○ 1	○ 2	○ 3
8. Bending, kneeling, or stooping	○ 1	○ 2	○ 3
9. Walking more than a mile	○ 1	○ 2	○ 3
10. Walking several blocks	○ 1	○ 2	○ 3
11. Walking one block	○ 1	○ 2	○ 3
12. Bathing or dressing yourself	○ 1	○ 2	○ 3

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	Yes	No
13. Cut down the amount of time you spent on work or other activities	○ 1	○ 2
14. Accomplished less than you would like	○ 1	○ 2
15. Were limited in the kind of work or other activities	○ 1	○ 2
16. Had difficulty performing the work or other activities (for example, it took extra effort	○ 1	○ 2

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	Yes	No
17. Cut down the amount of time you spent on work or other activities	$\bigcirc_1$	$\bigcirc_2$
18. Accomplished less than you would like	$\bigcirc_1$	$\bigcirc_2$
19. Didn't do work or other activities as carefully as usual	$\bigcirc_1$	$\bigcirc_2$

20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- 1 - Not at all
- 2 - Slightly
- 3 - Moderately
- 4 - Quite a bit
- 5 - Extremely

21. How much bodily pain have you had during the past 4 weeks?

- 1 - None
- 2 - Very mild
- 3 - Mild
- 4 - Moderate
- 5 - Severe
- 6 - Very severe

22.   During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

- ○ 1 - Not at all
- ○ 2 - A little bit
- ○ 3 - Moderately
- ○ 4 - Quite a bit
- ○ 5 - Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
24. Have you been a very nervous person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
25. Have you felt so down in the dumps that nothing could cheer you up?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
26. Have you felt calm and peaceful?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
27. Did you have a lot of energy?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
28. Have you felt downhearted and blue?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
29. Did you feel worn out?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
30. Have you been a happy person?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6
31. Did you feel tired?	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6

32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- ( ) 1 - All of the time
- ( ) 2 - Most of the time
- ( ) 3 - Some of the time
- ( ) 4 - A little of the time
- ( ) 5 - None of the time

How TRUE or FALSE is each of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	1	2	3	4	5
34. I am as healthy as anybody I know	1	2	3	4	5
35. I expect my health to get worse	1	2	3	4	5
36. My health is excellent	1	2	3	4	5

ABOUT

The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier, and more prosperous. RAND is non-profit, nonpartisan, and committed to the public interest.

1776 Main Street
Santa Monica, California 90401-3208

RAND® is a registered trademark. Copyright © 1994-2016 RAND Corporation.

Thanks for your participation

Appendix 3D

How to Score the Rand SF-36 Questionnaire

STEP 1: SCORING QUESTIONS:

QUESTION NUMBER	ORIGINAL RESPONSE	RECORDED VALUE
1, 2, 20, 22, 34, 36	1	100
	2	75
	3	50
	4	25
	5	0
3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1	0
	2	50
	3	100
13, 14, 15, 16, 17, 18, 19	1	0
	2	100
21, 23, 26, 27, 30	1	100
	2	80
	3	60
	4	40
	5	20
	6	0
24, 25, 28, 29, 31	1	0
	2	20
	3	40
	4	60
	5	80
	6	100
32, 33, 35	1	0
	2	25
	3	50
	4	75
	5	100

STEP 2: AVERAGING ITEMS TO FORM 8 SCALES:

SCALE	NUMBER OF ITEMS	AFTER RECORDING AS PER TABLE 1. AVERAGE THE FOLLOWING ITEMS
Physical functioning	10	3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Role limitations due to physical health	4	13, 14, 15, 16
Role limitations due to emotional problems	3	17, 18, 19
Energy/ fatigue	4	23, 27, 29, 31
Emotional well being	5	24, 25, 26, 28, 30
Social functioning	2	20, 32
Pain	2	21, 22
General health	5	1, 33, 34, 35, 36

STEP 3: FIGURING SCORES:

RAND recommends the following straightforward approach to scoring the RAND 36-Item Health Survey.

All questions are scored on a scale from 0 to 100, with 100 representing the highest level of functioning possible. Aggregate scores are compiled as a percentage of the total points possible, using the RAND scoring table (STEP I chart).

The scores from those questions that address each specific area of functional health status (STEP II chart) are then averaged together, for a final score within each of the 8 dimensions measured. (eg pain, physical functioning etc.)

For example, to measure the patients energy/fatigue level, add the scores from questions 23, 27, 29, and 31. If a patient circled 4 on 23, 3 on 27, 3 on 29 and left 31 blank, use table 1 to score them.

An answer of 4 to Q23 is scored as 40, 3 to Q27 is scored as 60, and 3 to Q29 is scored as 40. Q31 is omitted. The score for this block is 40+60+40 =140. Now we divide by the 3 answered questions to get a total of 46.7. Since a score of 100 represents high energy with no fatigue, the lower score of 46.7% suggests the patient is experiencing a loss of energy and is experiencing some fatigue.

APPENDIX FOUR

FIELD CHECKLIST

Study ID Reference Number: 9264

Field Checklist

Country _____

Date_____

City/Town _____

Retail petrol station _____

Prompting questions	YES	NO	Comments
Fire extinguisher			
No smoking			
Switch off engine			
Sandbox			
No phones			
IN and EXIT sign			
Alternative source of power (Generator)			
What is the composition of pavement of the forecourt? Concrete			

Tanker trucks earthed before starting and throughout products discharge?			
Is the tanker fill exclusion zone clearly marked on the forecourt?			
Do motor cyclists and their passengers dismount from their machines?			
Is there Sign of fuel spillage around pumps?			
Use of phone by attendants during petrol dispensing?			
Use of phone by customers during petrol dispensing?			
Do motor bike passenger dismount before dispensing?			
Is there pile of combustible refuse or pile of debris around the petrol station?			
Any type of personal protective worn by attendants (e.g., gloves, nose mask, safety goggle, safety boot)?			
Proper lighting around the dispensing pump?			
Is there fire safety assembly point?			
Do attendants practice proper handling of nozzle during dispensing?			
Is the dispensing nozzle stretched when used?			

APPENDIX FIVE

INTERVIEW AND FOCUS GROUP GUIDE

Appendix 5A

Focus Group Interview Guide (Retail petrol station owner)

Title: Environmental risk factor identification and assessment of health outcomes on selected subjects in and around the vicinity of petrol stations in Ilorin, Kwara State, Nigeria.

My name is Abosede Lawal, an academic researcher at Cardiff metropolitan university. I would like to thank you all for taking the time to participate in this focus group discussion. The objective of the focus group discussion is to explore the perception of retail petrol station owners of environmental and health risk factors associated with the operation of a retail petrol station. This study is for academic study only.

The focus group discussion should take 20 to 30 minutes. Ten questions will be asked. The session will be recorded for everyone's response to be accurately captured. Responses will be kept confidential and only be shared with members of the research team. You are free to withdraw at any time during the discussion.

Questions

1. Please can you briefly introduce yourself and the number of retails petrol stations owned?

2. How long have you been running the business of petrol station operations?

3. What are the challenges encountered in running a retail petrol station in Ilorin?

4. What are the financial challenges of operating a retail petrol station?

5. What are the hazards associated with operating a retail petrol station?

6. What is the salary range of retail petrol station attendants at your stations?

7. What is your view on the health impact of operating a retail petrol station on you as the owner?

8. What is your view on the health impact of the retail petrol station on attendants at the stations?

9. How can you improve the health and safety of your customers and workers?

10. What is your view on supporting government or research institutions on programs to promote the health of workers in retail petrol stations?

Thank you very much for your time and participation

Focus Group Interview Guide (Attendant)

Title: Environmental risk factor identification and assessment of health outcomes on selected subjects in and around the vicinity of petrol stations in Ilorin, Kwara State, Nigeria.

My name is Abosede Lawal, an academic researcher at Cardiff metropolitan university. I would like to thank you all for taking the time to participate in this focus group discussion. The objectives of the focus group discussion are to explore the perception of retail petrol station attendants on environmental and health risk factors associated with working in a retail petrol station. This study is for academic study only.

The focus group discussion should take 20 to 30 minutes. Fifteen questions will be asked. The session will be recorded for everyone's response to be accurately captured. Responses will be kept confidential and only be shared with members of the research team. You are free to withdraw at any time during the discussion.

Questions

1. Please can you briefly introduce yourself and your position at this retail petrol station?

2. How long have you been working as a retail petrol station attendant?

3. What are the reasons for taking up the job role of an attendant?

4. Where have you worked before working as a retail petrol station attendant?

5. How long do you see yourself working as a retail petrol station attendant?

6. What are your future career prospect?

7. What are the challenges you encounter as a retail petrol station attendant?

8. What are the hazards you have encountered as a retail petrol station attendant?

9. What are your health concern associated with working in a retail petrol station?

10. What is your general experience working as a retail petrol station attendant?

11. Based on your view, what are the things your company can do to improve the health of their employee?

12. What types of personal protective equipment are provided and used at the retail petrol station where you work?

13. What are your views on the correct use of personal protective equipment if provided by the retail petrol station?

14. What are your views on buying your personal protective equipment when not provided by the retail petrol station where you work?

15. What are the factors used for laying off an employee from their role as an attendant?

Thank you very much for your time and participation

Appendix 5C

Interview Guide (Manager)

Title: Environmental risk factor identification and assessment of health outcomes on selected subjects in and around the vicinity of petrol stations in Ilorin, Kwara State, Nigeria.

My name is Abosede Lawal, an academic researcher at Cardiff metropolitan university. I would like to thank you all for taking the time to participate in this focus group discussion. The objectives of this interview are to explore the perception of retail petrol station managers on environmental and health risk factors associated with working in a retail petrol station. This study is for academic study only.

The focus group discussion should take 10 to 20 minutes. Ten questions will be asked. The session will be recorded for everyone's response to be accurately captured. Responses will be kept confidential and only be shared with members of the research team. You are free to withdraw at any time during the discussion.

Questions

1. Please, kindly introduce yourself

2. What is your position and role at the retail petrol?

3. How long have you been a manager at this retail petrol station?

4. In total, how long have you worked in retail petrol stations?

5. Based on your working experience, what are your views on the effect of working in a retail petrol station on your health?

6. What are the emergency provision available for customers and employees at this retail petrol station?

7. What are your ideas on how the station can improve the safety and health of their employee?

8. How can the retail petrol station promote good hygiene among its employees?

9. What are the provisions for first aid equipment and trained personnel in this retail petrol station?

10. What are your views on your station supporting program or initiative that promote the health of worker across retail petrol station?

Thank you very much for your time and participation

Interview Guide (Public Health Officer)

Title: Environmental risk factor identification and assessment of health outcomes on selected subjects in and around the vicinity of petrol stations in Ilorin, Kwara State, Nigeria.

My name is Abosede Lawal, an academic researcher at Cardiff metropolitan university. I would like to thank you all for taking the time to participate in this focus group discussion. The objectives of the interview are to explore the awareness and perception of public health officer on environmental and health risk factors associated with retail petrol stations. This study is for academic study only.

The focus group discussion should take 10 to 20 minutes. Ten questions will be asked. The session will be recorded for your response to be accurately captured. Responses will be kept confidential and only be shared with members of the research team. You are free to withdraw at any time during the discussion.

Questions

1. Please, kindly introduce yourself and the position

2. What is your position and roles within the ministry of health.

3. How long have you work in the department of public health?

4. In a summary, kindly describe the function of the public health department?

5. What are the ongoing project been undertaking by the public health department?

6. What are the challenges encountered in delivering public health intervention in Ilorin?

7. What projects or activities are undertaken by the department of public health relating to retail petrol stations in Ilorin?

8. What are the identified health and environmental risk factors relating to retail petrol stations considered a public health issue.

9. How do you partner with other ministries and businesses in delivering public health intervention?

10. What are the provisions available for the department of public health to collaborate with the educational institution and research institution in tackling public health issues?

Thank you very much for your time and participation

Appendix 5E

Study ID Reference Number: 9264

Focus Group Interview Guide (Environmental Health Officer)

Title: Environmental risk factor identification and assessment of health outcomes on selected subjects in and around the vicinity of petrol stations in Ilorin, Kwara State, Nigeria.

My name is Abosede Lawal, an academic researcher at Cardiff metropolitan university. I would like to thank you all for taking the time to participate in this focus group discussion. The objectives of the focus group discussion are to explore the awareness and perception of environmental health officers on environmental and health risk factors associated with retail petrol stations and their recommendations on tackling identified issues. This study is for academic study only.

The focus group discussion should take 20 to 30 minutes. The research will give a presentation on the research project highlighting outcomes and potential recommendations for 30 mins. After the presentation, officers will be asked to briefly comment on the presentation and recommend possible ways or activities to tackle identified issues. The session will be recorded for everyone's response to be accurately captured. Responses will be kept confidential and only be shared with members of the research team. You are free to withdraw at any time during the discussion.

Questions

1. Please introduce yourself and the position held as an environmental health officer.

2. Briefly comment on the outcomes discussed in the presentation and recommend ways to tackle identified issues relating to the retail petrol station in Ilorin.

Thank you very much for your participation and recommendations

APPENDIX SIX

CONFERENCE POSTER, PAPER, AND PUBLISHED PAPER

Appendix 5A Conference Poster

Appendix 5B: Conference paper

A REVIEW ON APPLICATION OF AFRICAN INDIGENOUS KNOWLEDGE IN HEALTH

[1]ABOSEDE HADIZAT LAWAL, [2]GEORGE KARANI

[1]Cardiff School of Health Science, Cardiff Metropolitan University, Wales, UK CF5 2YB
Email:[1]ablawal@cardiffmet.ac.uk, [2]gkarani@cardiffmet.ac.uk,

Abstract: The focus of this paper is to discuss the application areas of African indigenous knowledge in twenty-two African countries. The review illustrates the application of indigenous knowledge and the associated benefit in health. Proper understanding of the African indigenous knowledge application in health, including the use of medicinal plants for the treatment of various diseases can provide a good foundation for scientific research for new drug discoveries that could be of great advantage to the entire world health care system.

Keywords: African Indigenous Knowledge, Health, Medicinal plant, Innovation.

I. INTRODUCTION

The broad interaction of different group of people all over the world to nature has been diverse and different thereby, creating a unique human–nature relationship peculiar to a group of people. People's religion, values and worldview have been identified as factors that determines their knowledge and understanding of nature. Various cultures all over the world reflect peoples experience based on their worldview (complexity of people's attitudes and beliefs about the structure origin and the interaction of the universe to its being particularly man). Understanding African's ecological construct, values, cultural heritage, and its world view is important because it helps us to understand and to answer various question regarding the human-nature relationship of the people [1].

Indigenous Knowledge (IK) can be defined as a distinctive long-standing body of knowledge, beliefs, skills including evolving technologies that have been developed by adaptive processes of human relationship to other living things and their environment outside formal education and handed down from one generation to another through cultural practice and traditions [1, 2, 3]. African Indigenous Knowledge is known as local Knowledge peculiar to certain indigenous people or local communities held by African people and it is unique to African society [2, 3]. IK is holistic and comprises of information in relation to both the physical and spiritual aspect of life and it combines both the secular and rational knowledge from intuition, spiritual knowledge and wisdom. IK are retained and has been verbally passed from one generations to another through subsistence practices, cultural myths, stories, legends, songs, arts, rituals and even law [2, 4, 5]. African indigenous knowledge (AIK) is rural and oral in nature, dynamic and a cultural specific knowledge generated within a local communities based on experimentation, adaptation and innovation which is used for survival strategies and decision making on the critical issue of animal life, management of natural resources, and human life. AIK is still been neglected and marginalized by modern western knowledge, ignorance, politics and dominant ideology that it is in accurate because of lack of written documentation [5, 6].

Africans are known for their diversity and colorful rich culture therefore, African indigenous knowledge which is unique to African people is used as an important tool to ensure cultural and community sustainability. AIK has been applied in different areas such as Agriculture, food preparation, storage and preservation, natural disaster management, Natural resource management and Health care. Africansare recognized to be very adaptive thereby making use of the readily available and affordable resources for solving their pressing needs.

II. METHODS

Literaturewas searched using online database, like Science Direct, Scopus, PubMed, MetSearch and google scholar using search terms as "indigenous knowledge", "African indigenous knowledge application", and "Medicinal plants", "indigenous health care" or "traditional medicine" for the years 2002 to 2017 due to limited publication prior to 2000.

III. APPLICATION AREAS OF AFRICAN INDIGENOUS KNOWLEDGE

3.1 Application in Agriculture:

Foresters, agriculturist, indigenous farmers have used Indigenous knowledge to develop various techniques used for plant cultivation, improving and maintaining soil fertility. Shift cultivation, bush fallow, mono-cropping, mixed cropping, and crop rotation are examples of various indigenous cropping system used in developing countries, particularly Africa. A multi-storey farming system was developed in Tanzania [7], which involves fallowing, intercropping and selective weeding. The canopy structure, nitrogen fixation through photosynthesis moderation, light penetration

of large trees such as Acacia are used in indigenous agrosilvo-pastoral system to ensure good crop productivity in Senegal. Farmers used AIK to determine the soil fertility, which is good for certain plants. Examples are in Zaire and the southern Sudan where farmers discovered that cowpea and sorghum grows particularly well on termite mounds sites. The harvested crops are well preserved and remain fresh till the end of consumption and plant seeds, which could last for more than five planting seasons and are stored in baskets, sack and clay pots. Cowpeas are stored by mixing them with *Capsicum annum* (chili pepper) [7, 8]. Indigenous knowledge is very important in production of local remedies use for livestock production and agriculture [9].

3.2 Application in Food Processing, Preservation and Storage:

Availability of food in the rural community in the period of food shortage is very crucial for their survival therefore, AIK has been used to provide nutritious, safe and inexpensive indigenous food during all season in the entire year. Indigenous foods serves as a basic need for survival in African rural communities because it provides the people with diet variety. Food processing, preservation and storage are usually considered as the responsibility of the African women. The indigenous knowledge of the rural women plays an important role in the method of food preservation and storage in order to protect the nutritive value and to ensure its availability when the need arises. Most Lomwe household in Malawi uses ms*anja* a constructed structure located in the middle of the kitchen that is used for storing nuts, sorghum, all local varieties of peas and maize cobs [10]. In Zimbabwe, Malawi and Botswana, for example, sun drying of food is usually done in two main ways. One method (commonly used for vegetables) is to immerse the fresh vegetables in salty boiling water for a few minutes to avoid nutrient loss. The vegetables are then dried in the sun for about three days and stored in a safe dry place [3]. This method is also applied for drying caterpillars, termites, white ants and other edible insects. Another method is to direct spread of food under the sun. Sun drying is an affordable technology requiring little or no intervention under most conditions and it avoids food wastage as a means of sustainability [4, 10].

Maize drying and storage method Fig.1 [11]

Sorghum drying method Fig.2 [12]

Indigenous food storage method in Ethiopia Fig.3 [13]

3.3 Application in Natural Resources Management:

Sacred forests in many African communities are designated as shrines. These forests are considered as a protected area due to the people's belief and culture. The protected forests serve as means of forest conservation, land use management and sustainability of environmental biodiversity. Therefore, the shrines serve as important frontiers for regeneration of flora and reproduction of fauna [5]. Also, there is a belief among the Zigua and Ndorobo tribes in Tanzania that the bark of a tree to be used for medicinal purpose should be removed from the tree sides facing the east and west only because, extracts from other sides of the tree are believed to be ineffective. This protects the tree from total destruction and hence it survives the extraction [3]

Entrance of a forest shrine in Nigeria Fig.4 [14]

3.4 Application in Natural Disaster Management:

The use of AIK was demonstrated by the Maasai herdsmen in Kenya who employ the use of goat condoms (*olor*) contraceptive to protect their precious herds of goat from an on-going drought. The *olor* is made from cowhide or a square piece of plastic, and is tied around the belly of the male goat. It prevents the bucks from mating with the female goats. The herdsmen used the device to limit the goat population and to ensure less number of animals is grazing on sparse vegetation as a means of dealing with the ten-year drought cycle in Kenya [15]. The elders in African rural communities are known for their ability to use indigenous knowledge in disaster prediction and the studying of its early warning sign through the observation of trees, vegetation, air, winds, birds, animals, insects, celestial bodies, earth movement, clouds and water temperature. The indicators for disaster prediction are unique to each African community [16]. Gully erosions have also been tackled with the use of Indigenous plant by local people in Nigeria [9].

384

Fig.5 [15]

3.5 Application in EthnoVeterinary Medicine:

Local farmers and nomadic herdsmen in African countries use traditional medicine to treat their animal and livestock. Utilization of traditional medicine as ethno veterinary treatment has been in practice for a long time in African rural communities because it is cheap, readily available and a sustainable alternative method for keeping animals healthy [17]. In most part of Malawi, the local farmers claimed that most community members have wide indigenous knowledge of veterinary medicine learnt from their ancestors and families and that why ethno veterinary treatment is considered as a common practice. The major material use in ethno veterinary treatment are plants due to the natural abundance and diverse variety in African vegetation although salt, soil and animal parts are also used. The local farmers in northern region of Malawi claimed to treat seventeen out of twenty-nine animal disease through the use of various plant parts- leaves, root, bark, and sometimes the whole plant parts. The African people expressed their love and care of animals by the use of their indigenous knowledge, practice, skills and beliefs in producing ethno veterinary medicine. The local farmers in northern region of Malawi prevented/ cure diarrhoea and Newcastle disease in chicken by mixing crushed local whole plant or parts into the livestock drinking water. *Tephrosia vogelii* and *Mucuna puriens* were also used as insecticide against chicken fleas. Plants are used for the treatment of worm infection in livestock and removal of pork tapeworm, which causes a deadly disease in human.

Kenya and Tanzanian farmers' uses indigenous plant such as lodwa (*Embelia schimperi*) to treat parasitic tissue infection (cysticercosis) in pigs [3]. Plant extracts are also used in Namibia as ethno veterinary medicine in livestock farming [18]. The African indigenous Knowledge has been reported to useful in wildlife management [19].The Maasai herdsmen in Kenya collected the blood of infected animals in neighboring village during the rinderpest outbreak to smear it on the nostrils of their local herds to test the herds' immunity to the disease. Animals that survived the immunity test were said to be free from risk of being re-infected by the rinderpest disease [20].

3.6 Application of African Indigenous Knowledge in Health Care

Africa is located in the tropical and subtropical climate and it is endowed with rich biodiversity which contain an estimated number of 40 to 45,000 species of plants with developmental potential and 5000 species of these plants are being used in medicine. Evidence has shown that through evolution, plants in hostile environments accumulate important secondary metabolites as a natural means of survival [21,22].According to [23], eighty percent of African population uses traditional medicines to solve their health care needs. Traditional medicine is defined as the total sum of practices, skills, beliefs, and knowledge of different indigenous cultures that are used to diagnose, treat, prevent or improve mental and physical problems for the main purpose of maintaining good health. Traditional medicine involves the use of animal parts/minerals and herbal medicine [23, 24]. African indigenous knowledge is used in African health care system to diagnose, treat and to prevent various health problem and conditions.
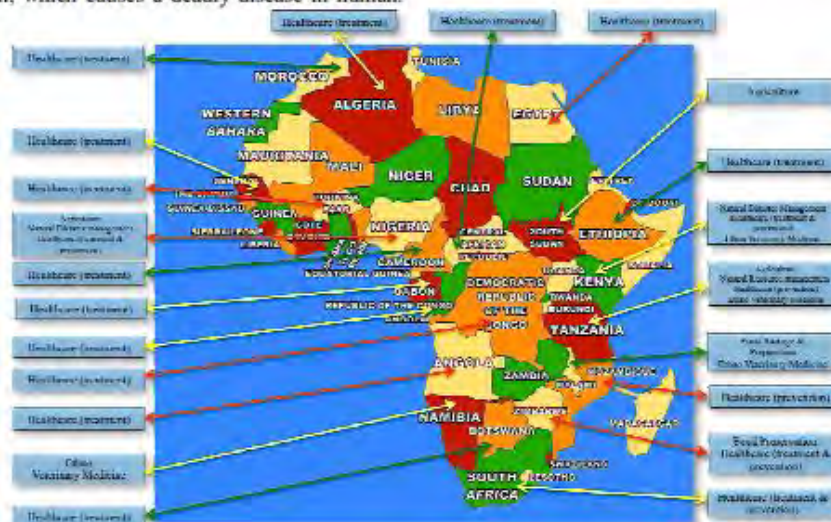
385

Fig 6: An African map showing examples of countries and Application areas of African indigenous knowledge.

Fig.6 above shows the twenty-two out of fifty-eight countries in Africa that are used as an example during this review. It shows the diverse application of AIK in different areas with emphasis on African health care system especially in the use of medicinal plant for the treatment and prevention of various diseases. It shows that the application of AIK is a vital part of the Africans culture, beliefs and way of life.

3.6.1 Application of AIK in diagnosis in African healthcare system.

In African healthcare, the indigenous healer / traditional doctor plays an important role. The African indigenous healing system uses two methods in diagnosing diseases;questioning and a careful examination of the patient by the traditional healer to determine the cause of the illness and to identify the type of disease caused carry out the first step. The second step of diagnosis is the practice of divination which is believed to be an indigenous way of accessing more information that are beyond human reasoning through deities, ancestors and spiritual communication. This understanding of divination by the African traditional healer makes divination an essential method of diagnosis diseases in African indigenous healing system [25]. Divination is defined as a technology used intentionally to initiate a possible method of gathering information by using analogical thinking capacity of the human brain to make an association that seems normally inaccessible through the use of randomly arranged symbols [26].The African indigenous healing system has a widespread belief that a strong spiritual aspects is needed to diagnose or treat any illness because, some African population relate the cause of their illness or sickness to the gods, witches and the spirit of the dead, that why the traditional healer considers their ability to diagnose any illness as a gift from the healers' ancestors and gods[27]. Furthermore, the in-depth understanding of the African culture and the indigenous environment-human relationship knowledge within a particular community by the traditional healers helps in identifying possible causes and the diagnosis of various health problems [25].

3.6.2 Application of AIK for treatment in African healthcare system.

The African traditional health care system is recognized as the oldest type of curative system and one of its fundamental components is the use of medicinal plants [21]. In most rural Africa, the use of medicinal plant is one of the most important aspects of their healthcare system because; it is readily available, accessible and affordable [22].

In South Africa, the leaves, small barks and roots of *AnnonasenegalensisPers*. known as Muembe in the

local name are used for different medicinal purpose. The roots are boiled and the mixture drank for the treatment of fever, infertility, stomach problems, pains during pregnancy and to improve sexual performance while the bark is boiled and drank for the treatment of stomach problems, oedema and for easy labor during baby delivery. The Zulu people in South Africa uses an indigenous African potato (*Hypoxis*) for the treatment bacterial and chronic viral diseases such cancer of the bladder and prostate, and sexually transmitted diseases [3,28].

Two medicinal plant species *Gnetum africanum* and *Gnetum buchholzianum* are known as *eru* in Anglophone Cameroon and as *koko* in Gabon, Central African Republic, Congo, Francophone Cameroon and Democratic Republic of Congo are used for medicinal purpose as a good source of protein, mineral elements and essential amino acids. *Gnetum* is considered to be an antidote to some form of poison and for the treatment of nausea in Ubangi area in the Democratic Republic of Congo. The leaves of *Gnetum africanum* and *Gnetum buchholzianum* are used for boils and warts dressing [29].Root of *Calotropis procera with local name Putrepuugu* and fruit of *Balanites aegyptiaca* (L) Del., known with local name *Kyeguelga* are used as a medicinal plant in Burkina Faso for the treatment of toothache and gingivitis [30].

In northwest of Ethiopia, *Clematis hirsute* with local name*Azo-hareg* and *sunki* is used for the treatment of, elephantiasis, Trachoma, wound, haemorrhoids and gastro-intestinal problems while *Plumbago zeylanica* with local name*Amira* is used to treat impotence, Tuberculosis, malaria, haemorrhoids and heart disease [31]*Achyranthes aspera Linn*. and local name as *Busino* is used for abdominal pain and tonsillitis for treatment and *Carphalea glaucescens* with local name *Wariamo* is used for the treatment of anaemia in Southern Ethiopia [32]. All the Moroccan thyme species have been used as medicinal plant for the treatment of fever, diarrhoea, cutaneous ulcers, coughs, infected skin area and various types of dermatitis. Artemisia has also been used in morocco for the treatment of vomiting, stomachache, headaches, bile problems, lung problems and toothache [33].

In Zimbabwe,*Ozoroa insignis Del*. With local name *Mubhedha* is prepared and used for the treatment of diarrhoea and STIs medicine while *Carisa edulis* and local name *Muruguru*is used to treat chest pains, pneumonia, Cough and tuberculosis. The Shona tribe in Zimbabwe, Zigua and Sambaa people in Tanzania use the leaves of *Rhus natalensis* locally known as *keyày* as medicine for bleeding and open wounds [3, 34]. The leaves of all varieties of *Hibiscusasper and Hibiscus sabdariffa* are used for the treatment of fever and cold in Senegal. It was also reported that the leaves and roots various species of amaranth in Senegal are used for the treatment of wounds, burns, ear infections, abscesses and pustules [35].

386

In Kenya, the leaves of *Aloe kedongensis* locally known as *Tengeretwet* are used to treat ear infection. The juice made from the pressed leaves of *Leucas calostachys* locally named as *N'gechebchat* is drunk to treat abdominal distension and tonsillitis/throat infections are treated with the mixture of honey and ground powder from the bark of *Myrica salicifolia* locally known as *Kabunbunit* [6]. Nigerians uses *Milicia excelsa, Chromolaena odorata, Aspilia africana, Manihot esculenta* for fast healing of cuts and wounds and leaf decoction of *Acalypha hispida* for the treatment of skin rashes in infants [36]. The flower top of *Anthemis nobilis L.* Locally called *Babounje* is used for anti-inflammatory, sedative, eczema medicine and the leaves of *Zizyphus lotus L.* locally named *Sedra* is also used as anti-inflammatory, wound healing and eczema medication in Algeria [37]. The leaves of *Amaranthus graecizans L.* is used for treating Constipation and the seed of *Cuscuta sp.* is used for the treatment of premature ejaculation, impotence and frequent urination in Egypt [38].

3.6.3 Application of AIK for prevention in African healthcare system

Africa Indigenous Knowledge has been used in various ways in different communities to protect the health of their people. The use of a special gourd by community members in central and eastern Zimbabwe and western Mozambique for fetching water from the community water source as method of infection control and way of protecting their water source has been a part of their cultural from ancient time. Also, moral order was strictly observed in traditional Igbo society in Nigeria where children were taught not to defecate near the village stream where drinking water was fetched and violation of this moral order would attract some severe sanctions from the deity who owns the stream [1]. The Sambaa and Zigua in Tanzania and Zulu people in South Africa use plant-based contraceptive methods dating from ancient times. This plant-based medicine is used by women who have just given birth to assist their recovery and for the practice of child spacing. A number of elderly women in these ethnic groups have been the keepers of this knowledge for generations [3]. Rural people in African countries uses Indigenous knowledge in the identification of local plants used for insect repellants, an example is *Cymbopogon nardus* used as mosquito repellant in Tanzania and Kenya[39].

CONCLUSION

African Indigenous Knowledge plays an important role in the health of people in Africa. Therefore, the understanding of the African worldviews, cultural heritage, values and myths that explains the different cultural practices of African people, helps to identify the various roles of AIK in African health and to recognize that it is an essential factor that contributes to the general well-being of the entire African population. Understanding the African Indigenous Knowledge in the use of medicinal plant to treat various illnesses creates the foundation that a scientific research can be conducted for the discovery of new drugs and treatment of various diseases across the world. The integration of the traditional health practices alongside the western health care practices has been helpful and highly beneficial. The trade of traditional medicine has been of financial benefit in some African countries and most importantly, the use of indigenous knowledge has been a source of empowerment to local communities. African Indigenous Knowledge is an essential factor needed for further development in Africa.

REFERENCES

[1] Obiora, CA, Emeka, EE. African Indigenous Knowledge System and Environmental Sustainability. International Journal of Environmental Protection and Policy. 2015

[2] Johansen EB. Indigenous peoples and environmental Issues: An Encyclopaedia 2003

[3] Kaya, OH. Care using African indigenous knowledge systems and implications for IPRS: experiences from southern and eastern Africa. 2007

[4] Ibnouf OF. The Value of Women's Indigenous Knowledge in Food Processing and Preservation for Achieving Household Food Security in Rural Sudan. Journal of Food Research. 2012; 1 (1).

[5] Makinde, OO, Shorunke, AO. Exploiting the Values of Indigenous Knowledge in Attaining Sustainable Development in Nigeria: The place of the Library. Library Philosophy and Practice.2013

[6] Kigen G, Some F, Kibosia J, Rono H, Kiprop E. Ethnomedicinal Plants Traditionally Used by the Keiyo Community in Elgeyo Marakwet County, Kenya. J Biodivers Biopros Dev. 2014; 1(132): 2.

[7] Adedipe NO, Okuneye PA, Ayinde IA. The relevance of local and indigenous knowledge for Nigerian agriculture. InA paper presented at the International Conference on Bridging Scales and Epistemologies: Linking Local Knowledge with Global Science in Multi-Scale Assessments 2004 Mar 16.

[8] Rankoana SA. The Use of Indigenous Knowledge in Subsistence Farming: Implications for Sustainable Agricultural Production in Dikgale Community in Limpopo Province, South Africa. 2017.

[9] Iloka NG. Indigenous knowledge for disaster risk reduction: an African perspective: original research. Jàmbá: Journal of Disaster Risk Studies. 2016 Jan 1; 8(1): 1-7.

[10] Kamwendo G, Kamwendo J. Indigenous Knowledge-Systems and Food Security: Some Examples from Malawi. Search Results Journal of Human Ecology. 2014; 48(1): 97-101

[11] Croley AV. Old-time methods of preserving food. Mother earth new.com. 1970

[12] Cernansky R. Could traditional plants hold the secret to saving crops from pests? Greenbiz.com. 2015.

[13] National parks-worldwide.info. Traditional houses of Ethiopia.

[14] Titiwanderlust.com. Osun-Oshogbo scared grove, Oshogbo, Osun State. 2013

[15] Nesoba R. Goat 'condoms' save Kenyan herds. BBC news, Nairobi. 2008

[16] United Nations Environment Programme. Indigenous Knowledge in Disaster Management in Africa. 2008

387

[17] Sanhokwe M, Mupangwa J, Masika PJ, Maphosa V, Muchenje V. Medicinal plants used to control internal and external parasites in goats. Onderstepoort Journal of Veterinary Research. 2016; 83(1):1-7.

[18] Chinsembu KC, Negumbo J, Likando M, Mbangu A. An ethnobotanical study of medicinal plants used to treat livestock diseases in Onayena and Katima Mulilo, Namibia. South African Journal of Botany. 2014 Sep 30; 94:101-7.

[19] Ocholla GO, Mireri C, Muoria PK. Application of indigenous knowledge systems in wildlife management: a case study of the Samburu pastoral community in Kenya.2016

[20] Mwaura P. Indigenous knowledge in disaster management in Africa. Nairobi: United Nations Environment Programme. 2008.

[21] Gurib-Fakim A. Medicinal plants: traditions of yesterday and drugs of tomorrow. Molecular aspects of Medicine. 2006; 27 (1): 1-93.

[22] Mahomoodally MF. Traditional medicines in Africa: an appraisal of ten potent African medicinal plants. Evidence-Based Complementary and Alternative Medicine. 2013

[23] World Health Organization.WHO Traditional Medicine Strategy. WHO, Geneva, Switzerland. 2002

[24] World Health Organization Fact sheetN°134, 2008, http://www.who.int/mediacentre/factsheets/2003/fs134/en/

[25] White P. The concept of diseases and health care in African traditional religion in Ghana. HTS Theological Studies. 2015; 71(3):01-7.

[26] Omonzejele PF. African concepts of health, disease, and treatment: an ethical inquiry. Explore: The Journal of Science and Healing. 2008 Mar 31; 4(2):120-6.

[27] Shizha E, Charema J. Health and wellness in Southern Africa: Incorporating indigenous and western healing practices. International Journal of Psychology and Counselling. 2011; 3(9).

[28] Mahwasane, T.S, Middleton, L, Boaduo, N. An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa. South African Journal of Botany. 2013; 88: 69–75.

[29] Eyong, TC. Indigenous Knowledge and Sustainable Development in Africa: Case Study on Central Africa. Tribes and Tribals. Special Volume No. 1: 121-139, 2007.

[30] Tapsoba H, Deschamps JP. Use of medicinal plants for the treatment of oral diseases in Burkina Faso. Journal of Ethnopharmacology. 2006; 104:68-78.

[31] Giday M, Teklehaymanot T, Animut A, Mekonnen Y. Medicinal plants of the Shinasha, Agew-awi and Amhara peoples in northwest Ethiopia. Journal of Ethnopharmacology. 2007; 110 (3): 516-25.

[32] Tolossa K, Debela E, Athanasiadou S, Tolera A, Ganga G, Houdijk JG. Ethno-medicinal study of plants used for treatment of human and livestock ailments by traditional healers in South Omo, Southern Ethiopia. Journal of ethnobiology and ethnomedicine. 2013; 9(1): 32.

[33] Montanari, B. Aromatic, Medicinal plants and Vulnerability of Traditional Herbal Knowledge in a Berber Community of the High Atlas Mountains of Morocco.Plant Diversity and Resources. 2014; 36 (3): 388-402.

[34] Maroyi A. Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives. Journal of Ethnobiology and Ethnomedicine. 2013 May 4; 9(1): 31.

[35] Gueye M, Diouf M. Traditional leafy vegetables in Sénégal: diversity and medicinal uses. African Journal of Traditional, Complementary and Alternative Medicine. 2007; 4: 469–475.

[36] El-Ghani MMA. Traditional medicinal plants of Nigeria: an overview. 2016.

[37] Boudjelal A, Henchiri C, Sari M, Sarri D, Hendel N, Benkhaled A, et al. Herbalists and wild medicinal plants in M'Sila (North Algeria): An ethnopharmacology survey. Journal of ethnopharmacology. 2013; 148(2): 395-402.

[38] Mahmoud T, Gairola S. Traditional knowledge and use of medicinal plants in the Eastern Desert of Egypt: a case study from Wadi El-Gemal National Park. Journal of Medicinal Plants. 2013; 1(6).

[39] Maia MF, Moore SJ. Plant-based insect repellents: a review of their efficacy, development and testing. Malaria Journal. 2011 Mar 15; 10(1): S11.

★★★

388

Appendix 5C: Published Paper

GIS-Based Location Analyses of Retail Petrol Stations in Ilorin, Kwara State, Nigeria

Oluwaseun Odipe, Abosede Lawal, Zulkarnaini Adio, George Karani, Henry Sawyerr

Abstract— The increasing demand for petroleum products in Nigeria has led to the increase in retail petrol stations construction all over the country. The study therefore assessed these stations within Ilorin with the objectives of determining the age range, functionality status, total number of pumps and identifying premises of public concern that are within close proximity to these stations. Data for the study were obtained through field surveys; where the coordinates of the stations were acquired using handheld Global Positioning System (GPS) device, and other information through administration of questionnaires to owners and workers in each petrol station. Spatial analysis was done using the ArcGIS 10.4 by ESRI on an OpenStreet Map database, while simple descriptive analysis used Excel 2016 package. Results were presented in maps, tables and charts. The findings revealed 297 retail petrol stations were in Ilorin, of which 112 (38%) of these stations were above 15 years of age. The study also revealed that 224 (75%) of the stations were functioning at the time of study while 73 (25%) were either abandoned or under construction. The number of dispensing pumps per station varies but 215 (72%) stations has 4-6 operating pumps. Most of the stations were found at close proximities to public premises such that 10 (3%) were in close proximities to school, 226 (76%) to shops, 192 (65 %) to residential houses and 11 (4%) were close to hospitals. The research concludes that retail petrol stations are highly congested within the metropolis forming cluster pattern which poses a great threat to the densely populated region of the town.

Index Terms— Environment, Geographic Information System (GIS), Ilorin, Nigeria, Retail Petrol Stations.

——————————— ◆ ———————————

1 INTRODUCTION

A retail petrol station is a facility where petroleum products such as gasoline, diesel and dual purpose kerosene are kept for the purpose of selling to end users [1]. These retail petrol stations are called by different names such as service stations, fuelling station, petrol station, petrol bunk, filling station, garage, gas station etc. in different countries all over the world [2]. The sprawl and proliferation of petrol stations across Nigeria has resulted in rapid increase over the years as a result of the dependency of the country's economy on crude oil and other petroleum resources. Other factors such as increase in population (growth) yielding a higher demand on automobile use, lack of stable electricity aiding a generalized use of petrol-fuel generators, and also petroleum products like dual purpose kerosene (DPK) and liquefied petroleum gas (LPG) for cooking has also promoted the construction of dispensing retail petrol stations at every corner of the country and at close proximities to the end users [3], [4], [5], [6].

Previous studies such as [4], [5], [7], [8] all attest to the fact that the siting of retail petrol stations in various towns across Nigeria is drastically on the rise and there are several irregularities in its location with respect to residential settlements and other infrastructures. The location of these stations poses high risk to both the environment and human health [9]. Globally, petrol

stations have been reported to significantly contribute to pollution of water resources, outdoor air, fire disasters and

explosion leading to loss of lives and properties [6], [10], [11], [12].

Fig. 1: A typical Retail Petrol Station

Thus, this study is geared towards assessment of the locations and distribution of retail petrol stations in Ilorin, with specific objectives such as: determining of the age ranges of these stations; their functionality status, total number of pumps and identifying premises of public concern that are in close proximity to these stations.

2 METHODOLOGY
2.1 Study Area

This study was carried out in Ilorin, the capital of Kwara State,

- *Oluwaseun Odipe, Zulkarnaini Adio, & Henry Sawyerr are affiliated to Department of Environmental Health Science, School of Allied Health and Environmental Sciences, Kwara State University, Kwara State, Nigeria;*
- *Abosede Lawal, & George Karani are affiliated to Cardiff School of Health Science, Cardiff Metropolitan University, Wales, UK CF5 2YB*
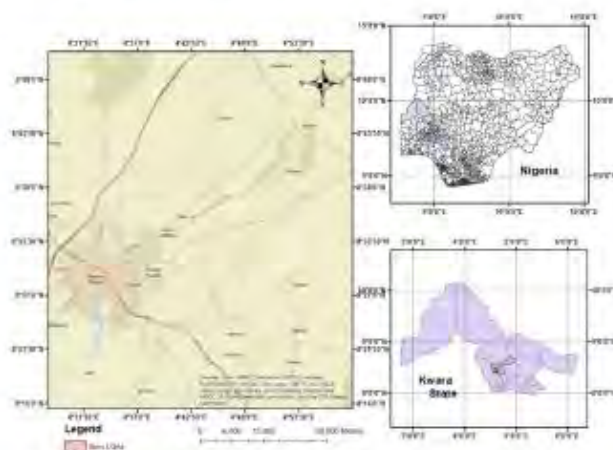
For correspondence: odipe@yahoo.com

North-Central, Nigeria. It lies within Latitude 8° 24'N to 8° 34'N and Longitude 4° 28'E to 4° 39'E respectively as shown in figure 2 below. Ilorin is a fast growing town that is geographically divided into three Local government areas namely Ilorin East, Ilorin South and Ilorin West, with

populations at 204,310, 208,691, 364,666 respectively given a total of 777,667 as at the 2006 nationwide census [13], and geopolitically subdivided into 35 wards.

Fig. 2: Map showing the Study Area

2.2 Materials and Method

The coordinates of the retail petrol stations were determined primarily using handheld Global Positioning System (GPS) device, while attribute information such as age of stations, number of pumps, petroleum products sold, functionality status of each petrol station and distance of stations to other infrastructure were assessed through field survey and administration of questionnaires to owners and workers in each stations. Meetings where held with the independent and major petrol marketers to explain what the research entails and to obtain permission to visit and administer questionnaire to their workers. The meeting was very important in other to gain easy access to the stations, and to rule out any misconception by the petrol station owners.

The coordinates were captured by travelling to each of the retail petrol stations in the three local government in Ilorin. During the visit to the stations, field checklist was used to record name, functionality status and presence of shops, hospital, schools and residential houses around the retail petrol stations. The retail petrol station coordinates and the functionality status data were integrated into ArcGIS 10.4 by ESRI on an OpenStreet Map of the study area showing road networks and local government area boundaries. Questionnaire were administer to all functioning retail petrol station during the second visit to each of the stations using the data obtained with the handheld GPS and field checklist.

Spatial analysis using the GPS coordinate of the retail petrol stations and other attribute data were used for map production using ArcGIS 10.4 by ESRI on an OpenStreet Map database, while tables and charts were developed using Excel 2016 package.

3 RESULTS AND DISCUSSION

The study revealed that there were a total of two hundred and ninety-seven (297) retail petrol stations within Ilorin as at the time of the survey which were mostly sited along major roads in the area. The total number of 297 which included the functioning and the non-functioning retail petrol stations in Ilorin was higher in number by 72 than the total number of filling station in Ilorin of 225 reported by Oloko-oba et al., 2016 [5], the high increase in the number shows the rapid increase in the establishment of retail petrol station in Ilorin within a short period of time. In figure 3 below, it shows an appreciable percentage of the stations are within the metropolis showing a haphazard distribution pattern [5] and the possible reasons includes accessibility and marketability [14]

3.1 Age ranges of these stations

The data from the survey as shown in table 1 below shows the number and the percentage of the retail petrol stations and their years of establishment. Stations in existence above 15 years have the highest percentage of 38% followed by stations 6 to 10years, 11 to 15 years, less than 5years and the N/A with 21%, 20%, 17% and 4% respectively. The stations classified under not available include the newly established stations, the stations under construction and abandon station with no means of getting information. The survey shows that most stations owned by major petroleum marketers are sold to private owners also, the newly established stations are owned by independent petroleum marketers. The independent private marketers' retail stations has been on the increase since its introduction into the petroleum sector in 1978 [15]. These indicates the trend in retail petrol stations construction as 185 of the 297 stations (62%) were less than 15 years old and almost 70% of this fraction are less than 10years. The map in
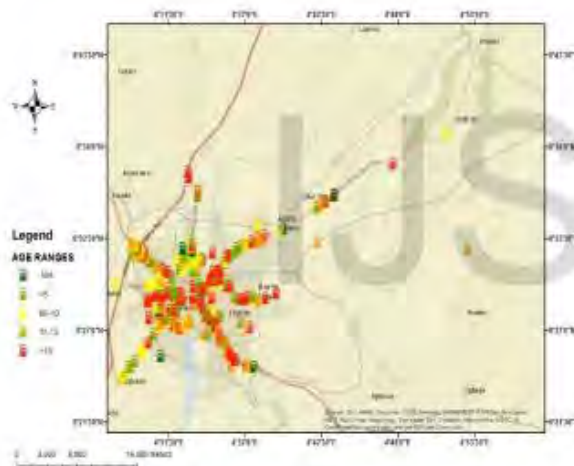
Fig. 4 below shows that all the stations above 15 years are located mainly along major road which indicates the importance of road network to petrol retail stations and easy access to travelling vehicles.

Fig. 3: Map showing the distribution pattern of Retail Petrol Stations within the Study Area [13]

Table 1 showing the frequency of retail petrol stations with various age ranges

Age Ranges	Frequency
N/A	12
Less than 5	52
Within 6 to 10	62
Within 11 to 15	59
above 15	112

N/A includes petrol stations under construction and those without information on age

Fig. 5: Pie chart showing the functionality status of the Retail Petrol Stations in Ilorin
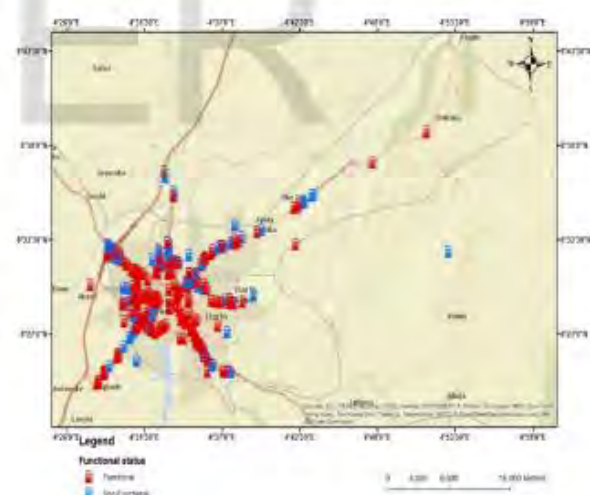

Fig. 4: Map showing distribution of retail petrol stations and their various age ranges in Ilorin

3.2 Functionality Status

The functioning petrol retail stations were all stations actively dispensing any of the three or all three major petroleum products (gasoline, diesel and dual purpose kerosene) commonly sold in Nigeria to consumers while the non-functioning stations were all stations previously active in service but are closed down, those under construction and those newly completed but not yet in use at the time of the survey. The result of the study revealed that 224 of the stations were functioning at the time of study (i.e. 75%) while the remaining 73 (25%) were either abandoned, newly completed or under construction (Fig. 5 & 6).

Fig. 6: Map showing the functionality status of the Retail Petrol Stations in Ilorin

From Fig. 6 above, it shows that most of the stations in the heart of the metropolis are functioning which poses a great threat to the environs and populace through its contribution to the increasing air pollution from the continuous emission of vapour, release of toxic gases and constant traffic thereby endearing the health of the people [16], [17].

3.3 Number of Pumps in Use

In assessing the possible threat these stations could pose during its activities, it was required that the number of pumps in each station was assessed, 35 stations had < 3 pumps, 215 stations had 4 – 6 pumps, 41 stations had 7 – 9 pumps, while 6 stations operated with more than 10 pumps. Furthermore, large number of this petrol retail stations lack appropriate safety measure in terms of their waste management, location and fire safety precaution and evacuation plans [18]. Also, it been indicated by Health and Safety Authority that retail petrol stations are associated with the risk of explosion or fire than other types of business outlets because of the high flammable properties of petrol vapours [19]. Knowing the numbers of pumps at the different petrol stations could be considered an important information to the fire safety and the health service department in case of emergency because, the more pumps at a petrol station, the likelihood of large fire when ignition happens.

The maximum pump at any station within the metropolis was 13 as shown in Table 2 and Fig. 7.

Table 2: showing the Frequency of Stations with respect to number of pumps in use

Number of Pumps	Number of Stations	Percentage
0-3	35	12%
4 to 6	215	72%
7 to 9	41	14%
> 10	6	2%
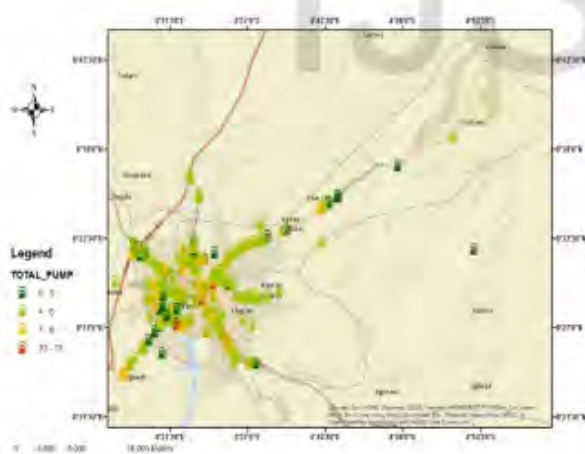
Fig. 7: Map showing the number of pumps used at each stations within Ilorin

3.4 Public Premises of close proximity to Retail Petrol Stations

According to [2], [16], [17], & [18], it has been reported that large number of retail petrol stations in different state of Nigeria has not adhere to approved distance between residential buildings, public places (schools, hospitals and markets) as stated in the department of petroleum resources guidelines. Large number of retail petrol station in Ilorin are located in close proximity to residential building during the survey thereby showing the same trend as reported by other article. At the end of the study, it shows that 273 (92%) premises (shop, houses, school, hospital) are in close proximity to retail petrol station in Ilorin. The total number of stations not located close to any premises are only 24 (8%) and this shows that large percentage of the petrol station are potential risk to the premises within their vicinity. Table 3 below shows the frequency of petrol stations in close proximity to the selected premises. Therefore, these indicates that the location of most retail petrol stations within Ilorin poses great risk to shops and houses.

Table 5: Frequencies of stations at close proximity to public premises

Premises	Numbers in Close proximity
Shop	77
House	41
School	1
Hospital	1
Shop & House	137
House & Hospital	2
Shop, House & Hospital	8
Shop, House & School	5
House, School & Hospital	1
Total	273

4 CONCLUSION

From the study, it can be concluded that retail petrol stations are highly congested within the metropolis forming cluster pattern which poses a great threat to the densely populated region of the town. The assessment revealed over 40% of these stations were constructed within the last ten years which indicates the creation of more stations in years to come is possible owing to the fact that the economy of Nigeria still depends chiefly on petroleum products and the investment remains lucrative. The study recommends further researches to look into the environmental pollution that could arise from these stations as it was revealed that 75% of the stations are functioning, and over 88% actively dispense various petroleum products from over 3 pumps at public areas close to shops, houses, hospitals and schools.

ACKNOWLEDGMENT

REFERENCES

[1] A.A. Adejare, "Guide for Petrol Satation Buyers & Effective Management". Published by Divine Way Limited, Okota, Nigeria. Pp 5, 2010

[2] A.M. Mshelia, A. John, & D.D. Emmanuel, "Environmental effects of

petrol stations at Close proximities to residential buildings in Maiduguri and Jere, Borno State, Nigeria". *IOSR Journal of Humanities and Social Science*, 20, pp.1-8, 2015.

[3] C.S. Marxsen, "Costs of remediating underground storage tank leaks exceed benefits" *Oil and Gas Journal* 97:21-22, 1999.

[4] S.B. Arokoyu, O. Mark, & A.O Jochebed, "Petrol filling stations location and minimum environmental safety requirements in Obio Akpor LGA, Nigeria". *International Journal of Scientific Research and Innovative Technology*, 2(11), 19, 2015.

[5] M. Oloko-Oba, R. Badru, O.S Popoola, S.A. Samson, T.A. Alaga, & S.A. Ogunyemi, "Assessment of Filling Station in Ilorin, Kwara State, Nigeria Using Geospatial Techniques". *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, 1(2), 7, 2016.

[6] E.O. Olukoya, G.R.E.E Ana, & E.O. Oloruntoba, "Assessment of Soil Contamination with Monocyclic Aromatic Hydrocarbons and Heavy Metals in Residential Areas Sited Close to Fuel Filling Stations in Ibadan Metropolis". *Journal of Environment Pollution and Human Health*, 4(3), 60–65, 2016. https://doi.org/10.12691/jephh-4-3-1

[7] M.U. Mohammed, I.J. Musa, & D.N. Jeb, "GIS-based analysis of the location of filling stations in metropolitan Kano against the Physical Planning Standards". *American Journal of Engineering Research* (AJER), 3(9), 147-158, 2014.

[8] D.S. Tah "GIS-based locational analysis of petrol filling stations in Kaduna Metropolis". *Science World Journal*, 12(2), 2017.

[9] J.A. Samuel, "Spatial Location of Filling stations in Kaduna. Kaduna" 2011: Scribid Inc.

[10] E.C.P. do Rego, & A.D.P. Netto, "PAHs and BTEX in groundwater of gasoline stations from Rio de Janeiro City, Brazil". *Bulletin of environmental contamination and toxicology*, 79(6), 660-664, 2007.

[11] A.M.Z. Ramalho, H.L. de Aquino Sobrinho, H.L. dos Anjos, T.N de Castro Dantas, & D.R. da Silva, "Study of contamination by benzene due to diesel and gasoline leaks at a gas station in Natal/Brazil". *Int J Eng Technol*, 14(2), 49-54, 2014.

[12] Q. Wu, X. Zhang, & Q. Zhang, "Current situation and control measures of groundwater pollution in gas station". *IOP Conference Series: Earth and Environmental Science*, 94, 012005, 2017. https://doi.org/10.1088/1755-1315/94/1/012005

[13] National Population Commission, State population figures, Nigeria. https://web.archive.org/web/20120305101910/http://www.nigeria nstat.gov.ng/nbsapps/Connections/Pop2006.pdf

[14] J.E. Odeh "Spatial analysis of the petrol stations in Khan-Younis city using Geographic Information System (GIS) Techniques" 2017.

[15] C. Ehinomen and A. Adeleke, "An assessment of the distribution of petroleum products in Nigeria". *Journal of Business Management and Economics*, 3(6), pp.232-241, 2012.

[16] A.M. Anakwue, R. Anakwue, M. Okeji, F. Idigo, K. Agwu and U. Nwogu, "Sonographic assessment of petroleum-induced hepatotoxicity in Nigerians: does biochemical assessment underestimate liver damage?" *African Health Sciences*, 17(1), pp.270-277, 2017.

[17] T.M. Sangotola, P.A. Fasanmade, W.A. Ayanrinde, I.O. Olatinwo and H.F. Olaniran, "On the Effects of Petrol Stations in Nigeria". *International Journal of Science, Engineering and Technology Research (IJSETR)* (4)4, 2015.

[18] O.T. Afolabi, "Assessment of safety practices in filling stations in Ile-Ife, South Western Nigeria". *Journal of Community Medicine and primary Health care*, 23(1-2), pp.9-15, 2011.

[19] Health and Safety Authority, "Fire & Explosion Risks in Service Stations" 2018. https://www.hsa.ie/eng/Your_Industry/Petrol_Stations/Fire_and_Explosion_Risks_at_Service_Stations.pdf