

Title Page

(1) Manuscript Title: Distinguishing characteristics between high and low adherence patients following anterior cruciate ligament reconstruction: A qualitative examination

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Abstract

The purpose of this study was to identify factors that distinguished between injured athletes who displayed high compared to low levels of rehabilitation adherence following anterior cruciate ligament reconstructive (ACL) surgery. In order to gain an in-depth understanding of these factors, semi-structured qualitative interviews were conducted with six high adherers, six matched low adherers and for each injured athlete, a significant other. Thematic analysis was used to identify the themes that distinguished between high and low adherers. Three themes were generated based on the findings: (1) preparation for post-operative rehabilitation; (2) an active versus passive approach to rehabilitation; and (3) the threat of a poor outcome. Each theme comprised a number of sub-themes that further elucidated the participants' rehabilitation experiences and adherence behaviors. The findings have important implications for medical professionals, sport psychology consultants, coaches and athletes with a vested interest in expediting recovery following ACL reconstructive surgery.

Key words: Psychosocial factors, rehabilitation adherence, anterior cruciate ligament, significant other.

Distinguishing characteristics between high and low adherence patients following anterior cruciate ligament reconstruction: A qualitative examination.

Of all the musculoskeletal injuries sustained during sport, a rupture to the anterior cruciate ligament (ACL) is one of the most severe (Walker et al., 2020). Often incurred by young, active individuals for whom a return to unrestricted activity is of primary importance, ACL surgery followed by an evidence-based rehabilitation program (cf. van Melick et al., 2016) is the current clinical standard to provide mechanical joint stability and facilitate a return-to-sport (Nagelli & Hewett, 2017). Yet, while the number of ACL reconstructions performed annually continue to rise, patient recovery outcomes remain poor (Culvenor & Barton, 2018). At 12 months post-surgery, when most injured athletes expect to return-to-sport, only 60% of non-elite athletes and 83% of elite athletes (Lai et al., 2017) do so. Individuals who do return within this period have a doubled chance of re-injury in the affected knee (Kyritsis et al., 2016). In addition to these shorter-term consequences, a rupture to the ACL can have lasting longer-term effects, including accelerated osteoarthritis, lasting depressive symptoms, and reduced quality of life (Filbay et al., 2017).

Mitigating against these detrimental outcomes, is to a large extent, contingent on engaging with an evidenced-based post-surgery rehabilitation program to restore sufficient muscle function and strength (Ebert et al., 2018; Grindem et al., 2015). Unfortunately, reports of an “alarming underutilisation” of rehabilitation post-ACL reconstruction (Grindem et al., 2018), because patients are prematurely discharged from supervised physiotherapy (<3 months following surgery), the rehabilitation content is inadequate, or they fail to adhere to their rehabilitation program, are widespread (Ebert et al., 2018). While significant advances have been made in the development of evidence-based rehabilitation protocols to facilitate a safe return-to-sport (van Melick et al., 2016), sub-optimal adherence rates continue to be a pervasive problem post-ACL surgery (Walker et al., 2020).

Defined across the injury, medical, and health literature, as “an active, voluntary collaborative involvement of the patient in a mutually acceptable course of behaviour to produce a desired preventative or therapeutic result” (Meichenbaum & Turk, 1987; p. 20), the importance of patients’ voluntary action in following professional recommendations is central to adherence behaviors. While patients are often highly adherent to their

rehabilitation program during the early stages (i.e., first 8 weeks), adherence appears to wain beyond 12 weeks post-ACL surgery (Niven et al., 2012). Given the importance of rehabilitation adherence to a safe return-to-sport, it is unsurprising that a significant amount of research attention within the psychology of sport injury literature has been devoted to the identification of psychosocial predictors of rehabilitation adherence.

Guided by the application of a number of established models and theoretical perspectives (e.g., integrated model of psychological response, Williams et al., 2020; protection motivation theory, Brewer et al., 2003; self-determination theory, Chan et al., 2009; theory of planned behavior, Niven et al., 2012; integrated theoretical model, Lee et al., 2020), a multitude of personal and situational predictors have been associated with adherence to sport injury rehabilitation programs (for a review see Goddard et al., 2020). However, comparatively few studies have examined predictors of adherence to post-operative ACL rehabilitation programs (Brewer et al., 2013). Those studies that have focused on ACL injuries have predominantly been underpinned by the integrated model of psychological response to sport injury (Wiese-Bjornstal et al., 1998), which suggests that rehabilitation behaviors, such as adherence to treatment are influenced by personal, situational, cognitive and emotional factors. In support of these propositions, individuals who reported higher scores of agreeableness, conscientiousness and openness to experience (Hilliard et al., 2013), optimism (Williams et al., 2020), and self-motivation (Brewer et al., 2000) pre-ACL surgery have demonstrated higher adherence. Similarly, patients with stronger intentions to adhere to their rehabilitation within the first week following surgery reported significantly higher adherence at 4, 6, and 8 weeks post-surgery (Niven et al., 2012). At 5 weeks post-surgery, patients who reported stronger perceptions of treatment efficacy, self-efficacy, and susceptibility (Brewer et al., 2003) and less daily stress and mood disturbance also reported higher levels of home- and clinic-based adherence (Brewer et al., 2013). At 9 weeks post-surgery, athletes who used more instrumental coping strategies demonstrated higher levels of rehabilitation adherence (Udry, 1997). Further, several program (e.g., rehabilitation length, lack of equipment) and physiotherapist-specific factors

(e.g., autonomy-supportive behaviors) have also been associated with rehabilitation behaviors (Chan et al., 2009; Pizzari et al., 2002).

Beyond these, however, little is known about which psychosocial factors are associated with rehabilitation adherence after 3 months post-surgery. Indeed, identifying psychosocial factors associated with rehabilitation adherence and outcomes later in the post-ACL rehabilitation period represents a key priority for those with a vested interest in expediting athletes' safe return-to sport (Williams et al., 2020). This is especially important given recent recommendations that structured rehabilitation should continue for more than 6 months (ideally 9–12 months) post-surgery (Walker et al., 2020). For some athletes, the psychosocial challenges throughout the middle (e.g., slowness of progress, setbacks, and/or monotony of rehabilitation exercises) and latter stages (e.g., internal and external pressures to compete, risk of re-injury) of lengthy rehabilitation programs, will contribute to suboptimal levels of adherence, but in others they may not. What distinguishes between adherent and non-adherent athletes in the face of these challenges remains of particular interest to medical professionals involved in the treatment of injured athletes' post-ACL reconstruction. Although comparisons between high and low adherers would help “illuminate subtle nuances in the drivers of adherence behaviour that may represent important targets for behavioral intervention” (Durand et al., 2019, p. 2), we are only aware of two such studies (Fields et al., 1995; Pizzari et al., 2002), and only one focused on ACL injuries (Pizzari et al., 2002).

In Pizzari et al.'s (2002) interview study with five adherent (>80% completion of home exercises), one moderately adherent (60% to 70% completion of home exercises), and five non-adherent (<60% home-exercise completion) ACL reconstructed patients, greater organization, the prospect of a return-to-sport being motivating and exciting as opposed to a fearful, enjoyment, and being motivated throughout the rehabilitation process differentiated between adherers and non-adherers. Given these are the only studies that have differentiated between adherers and non-adherers, and that this line of enquiry could be crucial in identifying whether different psychological factors characterize adherent as

compared to non-adherent behavior (Goddard et al., 2020), further examination appears timely.

Therefore, the purpose of this study was to elicit an in-depth understanding of factors that distinguished between individuals who displayed high and low levels of adherence to rehabilitation following ACL reconstruction. In doing so, we sought to explore injured athletes', and their significant others', perceptions of factors that influenced athletes' attitudes towards, engagement with, and adherence to rehabilitation.

Method

Philosophical Position

Given that the aim of this study was to identify distinguishing characteristics between high and low adherers' following ACL surgery, a semi-structured interview design, grounded within a critical realist (Bhasker, 1975) paradigm was selected to address the central aim of the study, gather data from multiple sources (i.e., injured athletes' and their significant others), and inform the data analysis (thematic analysis). In line with a realist ontology that a universal reality exists, and a constructivist epistemology which recognises that human knowledge is socially constructed, theory-laden, and fallible, we conducted this study under the proviso that while distinguishing characteristics between high and low adherers exist, what constitutes this reified entity (i.e., through interpretations of certain behaviors), for one individual will be different to that of another. Thus, while an objective examination of rehabilitation adherence can never be perfectly achieved, it can be approached by triangulating multiple (fallible) perspectives and exercising judgemental rationality in the hope of gaining a better grasp of what this reality is or might be (Coulter et al., 2016; Wiltshire, 2018).

Participant Selection

Participants comprised a purposeful sample of primary ACL reconstruction patients ($n = 115$) from XXXX [author names withheld to maintain the integrity of the review process] who were between 6-9 months post ACL reconstruction, along with a patient's significant other. A number of criteria were employed for sampling purposes. Firstly, patients who were

categorised as 'high adherence' (attendance ratio $\geq 90\%$ completion) and 'low adherence' (attendance ratio $\leq 70\%$ completion) were identified based on their attendance ratio to their scheduled physiotherapist appointments. Secondly, participants were matched across high and low adherence groups on age, gender, competitive level, and time since surgery. These sampling criteria reduced the potential confounding effect of a number of variables reported to influence athletes' adherence to rehabilitation programs, in addition to the effect of memory decay and recovery status. In line with our critical realist philosophical position (i.e., multiple fallible perspectives), and to make an original contribution to the literature, the perceptions of a significant other was also elicited to explore beyond simply an intrapersonal (the injured athlete's) perspective of the sport injury process (Wadey et al., 2018). Each injured athlete nominated a significant other who they considered were influential in, and had insight into, their post-ACL reconstruction rehabilitation experience.

Participants. The final sample comprised 12 injured athletes and 11 significant others. Both high and low adherence groups ($n = 6$) consisted of three females and three males, with a mean age of 30 years ($SD = 8.22$) and 28 years ($SD = 6.29$), respectively. Three injured athletes in the high adherence group had completed all the pre-surgery and post-surgery measures employed in XXXX, while the other three had only completed the pre-surgery measures. Four of the six low adherence group had completed all post-surgery measures. Across groups, participants represented a number of team and individual sports (e.g., rugby, hockey, cycling), and ranged from recreational to national levels of competition. All participants underwent reconstructive surgery with the same orthopaedic surgeon. Full participant information is provided in Table 1. Significant other interviews were conducted for 11 ACL participants (for one participant it wasn't possible). Significant others included parents ($n = 2$), partners ($n = 4$), coach ($n = 1$), friends ($n = 3$), and a teammate ($n = 1$).

Interviews

Interview preparation booklet. Individual preparation booklets consisting of three sections facilitated participant interviews. Section one outlined the study purpose and structure and focus of the upcoming interview. Section two provided individual feedback on

the participant's data derived from XXXX, according to four time-phases: (1) pre-surgery, (2) early rehabilitation, (3) mid rehabilitation, and (4) late rehabilitation.

Pre-surgery participant information consisted of the data from the Life Orientation Test-Revised (LOT-R; Scheier et al., 1994), and the Coping with Health Injuries and Problems (CHIP; Endler et al., 1998). Early, mid, and late rehabilitation results were derived from the LOT-R, CHIP, Sport Injury Rehabilitation Beliefs Survey (SIRBS: Taylor & May, 1996), Sport Injury Appraisal Inventory (SIAI; Waters, 2005), and five items measuring cognitive appraisal (cf. Chang, 1998). The third section provided a space for participants to reflect and make notes on their results as well as their rehabilitation experiences as a whole.

ACL participant interview guide. An interview guide was developed from four principal sources: (1) data from the aforementioned measures; (2) sport-injury literature (e.g., Wiese-Bjornstal et al., 1998); (3) first author's personal experience of ACL rehabilitation; and (4) guidelines on qualitative interviewing (e.g., Patton, 2002). The interview guide represented more of an *aide memoire* (Minichiello et al., 1990), and a checklist, which included the key themes and stages of rehabilitation, as opposed to specific interview questions. This approach was adopted to allow the participants to raise new topics and move the conversation in directions they believed to be of most importance. The first author encouraged participants to relate their experiences to the aims of the study, and used the checklist to encourage a certain degree of consistency across interviews. For example, in response to participants' discussing how they coped with the period around surgery, questions such as "how, if at all, did the way you cope change as rehabilitation progressed?" followed. Interwoven within these questions, were clarification and elaboration probes to ensure an accurate and in-depth understanding of participants' experiences.

Procedure

Following University ethical approval, pilot interviews with three ACL participants and one significant other not involved in the final study, were conducted to increase the effectiveness of the interview process. Each pilot interview was recorded and listened to by

the second author who provided feedback pertaining to the language, wording, and relevance of each question, and the coverage of the themes of interest across interviews.

Participants who met the sampling criteria were contacted by telephone and explained the purpose of the study. They were asked to confirm the accuracy of their attendance at physiotherapy appointments and that they had not received additional physiotherapy support of which we were unaware. Upon agreement, a mutually convenient time was arranged to conduct the interview. Participants were sent their preparation booklet one week prior to the interview. Before the interview began participants were reminded of the study purpose, their participant rights, and that anonymity would be upheld. To begin each interview, participants were asked to describe how their injury happened. The first author then followed the participant's narration of their experience with questions based on their responses that aligned with the study purpose. At the end of the interview, participants were asked whether they wished to elaborate on anything, thanked for their time and asked to provide the contact details of their significant other. ACL participant interviews lasted between 50 and 80 minutes ($M = 68.3$, $SD = 8.56$), and were recorded in their entirety.

Before conducting the significant other interview, the ACL participant interview was listened to repeatedly to determine the content and structure of the upcoming interview. Specifically, key points of interest raised by the participants that merited further exploration, and/or would benefit from additional insight were identified. Despite the content of the interview being primarily constructed based on the ACL participant interview, great care was taken not to divulge confidential ACL participant information. The mean time between ACL participant and significant others interview was 20 days ($SD = 13$). Significant other interviews lasted between 45 and 75 minutes ($M = 62.4$, $SD = 9.47$).

Data Analysis and Methodological Rigor

We followed Braun and Clarke's (2006) six-phase thematic analysis procedure to identify, organise, and offer insights into the data. Firstly, author one transcribed each interview before reading and re-reading each transcript thoroughly. Secondly, author one generated initial codes based on meaningful ideas within the data for high adherers and their

significant others, and then low adherers and their significant others. Once there were sufficient codes to capture the diversity and patterns in the data, themes were formed by collapsing or clustering codes that shared common feature(s). The themes and data extracts were then presented to the second author who, as a critical friend, encouraged reflexivity and challenged the construction of the initial themes (Smith & McGannon, 2018). Once consensus had been reached on the overarching themes and sub-themes, the first author reviewed the original transcripts and themes relative to the entire data set, to ensure they meaningfully captured the data. The fifth phase involved defining and labelling the themes to ensure their fit into the overall story was clear. To ensure the narrative provided a concise, logical, coherent, and interesting account and that interviewees' "voices" resonate with the reader (Braun & Clarke, 2006) direct quotes are embedded within an analytic narrative.

Consistent with Ronkainen & Wiltshire's (2021) principles of ontological plausibility (using plausible theories to make claims about 'real world' events), empirical adequacy (gathering sufficient observational data to support the claims made), and practical utility (generating findings that can be used in 'real world' practice), the methodological rigor of this study was enhanced by: (a) examining a clinically meaningful, complex, and under-researched area; (b) selecting an appropriate sample (e.g., high and low adherers); (c) conducting pilot interviews; (d) adopting multiple methods (e.g., preparation booklet and semi-structured interviews); (e) triangulating ACL participants and their significant others' experiences; (f) enlisting a critical friend; and (g) interconnecting the literature reviewed with the research foci, methods, and findings.

Results and Discussion

The thematic analysis of the ACL participant and significant other data highlighted three main themes that distinguished between high and low adherers: (1) preparation for post-operative rehabilitation; (2) an active versus passive approach to rehabilitation; and (3) the threat of a poor outcome. The commonalities and differences between high and low adherers are discussed in a combined results and discussion according to the three themes. In order to distinguish between participants, each high and matched low adherer was

assigned the same letter from A to F, followed by either “-High”, for high adherers (e.g., A-High), or “-Low”, for low adherers (e.g., D-Low). The label for their respective significant other then followed. For example, F-Low-Parent denoted the parent of a participant in the low adherence group.

Preparation for Post-Operative Rehabilitation

The first theme that distinguished between high and low adherers was how prepared they were for the post-operative period. This theme emanated from three interconnected sub-themes: (1) *level of understanding*, (2) *pre-rehabilitation program*, and (3) *a mismatch between expectations and reality*.

Level of understanding. High adherers appeared to have a greater understanding of the injury, the rationale for surgery, the rehabilitation program, and as expressed by E-High, the physical and mental challenges of rehabilitation:

I knew the fact that these [negative] feelings or thoughts, they may come in, but then, they're not relevant, they will ease...I knew what was coming, and you can prepare yourself for it, and say, “alright, I'm just going to grind this through”...If I didn't have this knowledge to fall back on, I think rehab would have been very...difficult for me just to motivate myself to do it.

This knowledge was a source of motivation for E-High, whereas, according to B-High-Partner, it helped B-High's focus during rehabilitation:

You can get a little bit lost in the jargon if you're a lay person which doesn't help... you focus, because you don't know what you're supposed to be focusing on. Having an idea of how a joint works, what this can mean, and why you're doing these exercises, actually really helps to focus and to make you think...I know why I'm doing that, so I'm going to do it well.

In contrast, low adherers often expressed sentiments such as, “Perhaps I should have looked into it more” (B-Low), “I didn't really know what to expect” (F-Low), and “I didn't really understand what he [the surgeon] was talking about” (C-Low). For A-Low, this lack of knowledge appeared to influence how she coped with a setback:

I think that a lot of people, if they've got the knowledge that something might potentially happen, it's a lot easier to cope with than something that just comes out of the blue... I know you can't predict these things but A-Low would have coped a lot better if she was prepared for it [issue with her hamstring]. (A-Low-Partner)

A lack of knowledge of the recovery process is a prominent stressor experienced by injured athletes (Evans et al., 2012). However, those injured athletes with an understanding of the requirements, benefits, and relevance of rehabilitation are more likely to cope with these stressors and in-turn adhere to rehabilitation (Niven, 2007). The high adherers suggested this enhanced understanding was fostered through the use of more instrumental forms of coping compared to their low-adherence counterparts.

Instrumental coping, which involves task-orientated strategies such as finding out more about the injury to alleviate the source of stress (Endler et al., 1998), has been associated with adherence previously (e.g., Udry, 1997). Indeed, the high adherers frequently asserted, "I'd also done a ton of research online as well as what they [medical team] were giving me" (F-High), and "I made contact with lots of physios to get their opinions" (E-High); sentiments echoed by their significant others. According to C-High-Friend:

She researched everything, and would look up various different things, scientific and non-scientific, blogs from different people, NHS stuff, journals, what the surgery was actually going to involve...The pros and cons of surgery, risks of the surgery...Which medication she was on... She wanted to know everything...She knew what was happening which made her more comfortable knowing, right this is what they are doing, this is what's going to happen, this is what could go wrong.

In contrast, the low adherers appeared to utilise less instrumental forms of coping, instead turning to others who had had the same injury to supplement information they had received from medical professionals. E-Low-Teammate stated:

Two of the other lads in the house had [had] ACL injuries...when he had a check-up and the doctor told him a certain thing it was quite often one of those two would say,

“that happened to me, that happens, or that just means this and you just need to do this exercise a bit more or something like that.”

Similarly, D-Low-Coach pointed out, “I talked to him about his rehab and how it will feel painstakingly slow...actually giving him advice that wasn’t given to me.” For D-Low, this was invaluable:

The lack of information could have had a massive impact on my rehabilitation, because if I didn’t have the knowledge [of my coach] around me, who told me “have a look at doing these, have a look at doing this”... I’d have been on my own with it. Generally, the low adherers appeared satisfied with the information when they received it, however, some encountered difficulties when this support wasn’t readily available.

In contrast, E-High suggested, “I didn’t really see the physio very many times within the first three, four weeks, but, I think my knowledge of rehab [from my university degree] helped me progress myself.” Pizzari et al. (2002) identified a lack of information regarding the injury and rehabilitation process, particularly in the initial stages of rehabilitation, was associated with non-adherence. However, the high adherers responses suggested their knowledge and understanding from their own instrumental forms of coping before surgery helped to safeguard their rehabilitation in the event of a lack of post-surgery information.

Pre-rehabilitation program. Five high adherers used the time between injury and surgery to engage in a pre-rehabilitation program to overcome some of the negative thoughts and emotions (Clement et al., 2015; Johnston & Carroll, 1998), improve their outcome expectancy, and develop effective rehabilitation behaviors. B-High said:

I was frustrated at the long time [between injury and surgery], but I felt the best thing was to use it to try and get my leg and knee as strong as possible. I’d read that it’s a much better outcome when you do the exercises before, so I had physio for about 3-4 months, and then I was on my own but I got into a routine... I feel that that really paid off actually. It was good. It just gave me something to focus on while I was waiting.

For E-High, pre-rehabilitation not only provided an opportunity to develop effective rehabilitation behaviors but also served as an emotional 'outlet':

I got into the routine of going to the gym before I had my operation, so it was just something I carried on through. That was much easier than developing an exercise regime from scratch. I think it also helped me to cope with not being able to play sport, gave me something else to focus on. It was kind of an outlet of different types of emotions...from the negative force of being like, "oh I'm injured, I can't do sport."

D-Low, one of only two low adherers who highlighted the importance of a pre-surgery rehabilitation program, expressed similar sentiments:

I think some people think, "I'm injured, I'm laid off now until my operation", which I didn't want. Everybody probably deals with it [waiting for surgery] differently... It's dealing with the mental side of it...For me the stuff I did previous to my operation helped after. I think that's the piece of advice I'd give to anybody, the work you put in beforehand will be what you get out after.

In essence, high adherers appeared to view pre-rehabilitation as a necessary first step in their rehabilitation 'journey'. In contrast, most low adherers viewed surgery as the start of their recovery. For E-Low it was a case of, "You can get told and comforted as much as you want, but...you need the operation before you can even start." For A-Low, it was more so a lack of awareness of the potential benefits of pre-rehabilitation:

I could have done so much more strengthening, building my hamstrings up, so that my rehab would have gone a lot better. There was no advice about how I should be managing it, or pre-physio, nothing...It didn't ever occur to me to ask if there was anything I could do to strengthen it before surgery.

Numerous studies have shown that pre-rehabilitation can lead to significant improvements in knee function before surgery and improved outcomes 2 years post-surgery (e.g., Grindem et al., 2015). Indeed, Grindem et al. concluded there was "untapped potential for improving knee function prior to ACL surgery" (p. 388). Our findings support these propositions, but also suggest that injured athletes can obtain psychological benefits (e.g.,

increase outcome-expectancy, deal with emotions, develop rehabilitation habits) by engaging in a pre-rehabilitation program.

A mismatch between expectations and reality. According to the high adherers, greater understanding of the rehabilitation process and investment in a pre-surgery rehabilitation program, contributed to them experiencing less mismatches in their expectations early after surgery. These mismatches primarily centred on two facets: (a) patients' physical symptoms following surgery; and (b) the provision of early post-operative treatment.

Notably, low adherers reported more adverse physical symptoms following surgery including greater levels of pain, swelling, and tenderness. Most commonly, physical symptoms were associated with the hamstring tendon autograft procedure. For example, D-Low said, "I struggled with [my hamstring] because I had the graft, it was really tight for a long period of time, which I underestimated probably." Although high-adherers also reported experiencing hamstring issues after surgery, they appeared better prepared for them, as F-High said, "The biggest issue for me was the pain and the stiffness in the hamstring and down the calf. I vividly remember asking [surgeon] about that though, which made it easier to cope with, knowing it was normal."

Previous investigations have also demonstrated a positive relationship between pain tolerance and adherence (e.g., Levy et al., 2009), with participants' experience of pain leading to concerns about their injury worsening, and non-adherence. Our findings suggest a realistic understanding of the likely (painful) symptoms post-surgery can enable injured athletes to re-appraise pain as a 'normal' part of recovery.

The second mismatch, which both high and low adherers experienced, was in their treatment expectations. As E-High suggested, "I just thought, surgery done, I'll nail rehab, but then seeing a physio two times in like five weeks, it was a bit like, this is not what I expected." Similarly, A-Low-Partner explained, "It [physiotherapy] definitely wasn't what she expected...She didn't feel like she was gaining anything from going there. She felt like she could do exactly the same amount at home, she wasn't getting any specialist attention."

A number of previous studies have highlighted the role of factors associated with the rehabilitation environment, including the convenience of rehabilitation scheduling (e.g., Pizzari et al., 2002), autonomy support from the physiotherapist (e.g., Chan et al., 2009), and a belief in the efficacy of the treatment (e.g., Niven, 2007) on rehabilitation adherence. However, these mismatches appeared to have a far more significant impact on low adherers' subsequent rehabilitation, as conveyed by E-Low:

I wasn't sure what to expect, but when I got there the rehab classes felt like a waste of time...I got to about week three of a six-week program before I stopped going...I was finding the circuits so easy and there were so many people, it didn't feel personalised.

In contrast, the three high adherers who referred to a mismatch in their treatment expectations, were better able to rationalise it. For example, D-High suggested, "I wasn't that impressed with it [treatment] at all, but I told myself to stick with it, that it would get better, and even if it didn't I was still doing something that would help towards getting better."

A number of studies from other orthopaedic domains have shown that patients' pre-operative treatment expectations are associated with treatment satisfaction, but that patients often have unrealistic pre-surgery expectations (Mannion et al., 2013). Collectively, these findings highlight the importance of patients developing realistic post-operative expectations, which will no doubt include some of the potentially negative aspects, such as painful symptoms and less than expected physiotherapy support.

An Active versus Passive Approach to Rehabilitation

The second main theme that distinguished between high and low adherers was their approach towards rehabilitation. For A-High this represented "taking responsibility" for her rehabilitation, while F-High suggested:

I'm responsible for me, so I have to do it. I adopted that sort of approach [with rehabilitation], I'm not looking for somebody else to fix it for me...My sense [is]...if people were a little bit more active and engaged then they'd be far better off.

Within this theme were two sub-themes that emphasised this active approach to rehabilitation: (1) *action planning and routines*, and (2) *utilising their social support network*.

Action planning and routines. Five out of six high adherers identified “being organised”, “having set routines”, and “making sure I planned my exercises” as strategies that increased rehabilitation adherence. These strategies served a number of purposes, including avoiding getting into bad habits and overcoming the boredom. A-High suggested:

I've managed it [rehabilitation] well. I'm organised and I write down all the exercises, and have checklists to get through it. It also helps me manage the stress quite well. I don't tend to worry too much, because I think I've always been organised. I like to know where I'm going, and what I'm doing today. I like to plan ahead, plan my time.

A perceived lack of time is a common barrier to completion of rehabilitation exercises, but individuals with better organisation and planning skills are more likely to overcome these barriers (Niven, 2007). Only two out of six low adherers appeared to plan their rehabilitation program. However, for D-Low, making rehabilitation a part of his everyday routine helped him progress:

I tried to make my physio a part of my everyday routine. So, like sitting in front of the telly and just doing it. Physio can be painful and it can be irritating, and boring but I just tried to include it as part of my everyday life. I'd sit here and watch telly and do my leg raises and do my quads and all that, so you're not even thinking about it, you're doing it and you're benefiting in the long run.

For the low-adherers, periods of uncertainty, including how well they were progressing often led to an inconsistent approach to their rehabilitation, including both under- and over-adherence. A-Low suggested, “When you don't see progress early on it's difficult. You start questioning things, which probably affected how much I stuck to the plan. I wasn't consistent with my rehabilitation, I didn't get into that routine with it.” Similarly, for F-Low:

It [the period between surgery and his first physiotherapy appointment] seemed to be a hell of a long time...I felt like I was in limbo really, I didn't have a plan to follow. I

wasn't sure if I should be doing 2, 3, 4 sets of these things. I didn't have a set routine, sometimes I'd do quite a lot, other times I'd basically do nothing.

The beneficial effects of self-regulatory planning strategies, such as action planning and having rehabilitation routines, have been reported for a number of different health-behaviors (e.g., Zhang et al., 2019). Participants' responses from this study also support the efficacy of these strategies. Specifically, planning helped the high adherers' foster stronger perceptions of control, which ultimately led to less stress and more adaptive thoughts and behaviors during rehabilitation.

Utilising their social support network. The second sub-theme reflected the way all ACL participants utilised their social support network. Social support is one of the most influential psychosocial factors on health outcomes (Uchino, 2009), and, if support exchanges are successful, can enhance the well-being of injured athletes by reducing distress and perceptions of isolation, and increasing motivation, self-confidence and adherence (e.g., Johnston & Carroll, 1998). To increase the likelihood of these successful support exchanges, high adherers identified the types of support they required, and who in their social support network was best placed to meet their needs. This was possible for A-High because of the size and responsiveness of her support network: "I'm lucky, I've got lots of people around me, to support me, and they all have different skills and experiences...different people have different strengths and you have to utilise that." C-High expressed similar sentiments:

I've had a lot of different people helping with my recovery, I haven't been reliant on one person. Mum's always been on the end of the phone if I've needed to talk about anything. I've had mates on my course for lifts and stuff, and then the physio is there for anything I need to know about my rehab.

Although the size of an injured athlete's support network is important, it doesn't necessarily mean the support they require will be forthcoming, or achieve the desired effect (Bianco & Eklund, 2001). Instead, the successful exchange of support is dependent upon whether the support providers are able to provide support that meets the athlete's needs.

In contrast, the low adherers didn't appear to utilise their social support network to the same extent. Three of the low adherers appeared reluctant to ask for, or accept support, in an attempt to show themselves, and others, that they were still able to cope. For example, C-Low suggested, "Perhaps I could have used it [support from significant other] a bit more but I wanted to show people that I was still able to look after myself." C-Low-Friend commented, "The amount of times I told her to go and sit down, I'll do the washing and stuff, and she was like, "no, it's fine I'll do it, I need to do this." For B-Low-Friend, B-Low's stubbornness was born out of a reluctance to show "weakness", which hindered her progress.

This notion of saving face and not showing weakness has been reported previously within the social support literature (e.g., Bianco & Eklund, 2001), and is synonymous with injured athletes' having low self-esteem (Bolger & Amarel, 2007), and as a result being less inclined to seek the support in a bid to avoid feelings of embarrassment, weakness, and incompetence.

Rather than being reluctant to accept support, the three other low adherers appeared reliant on a small support network to meet their needs, which was sufficient for A-Low:

I've been lucky that constant support has come from [A-Low-Partner]. We live together so she was driving me around, lifting me up off the sofa, rescuing me from the bath! I've had somebody one-on-one who's been there throughout, from day one of the injury all the way through to the present day.

For E-Low, a reliance on his housemates for multiple support types failed to meet his needs:

"To begin with my housemates were really sympathetic, bringing me cups of tea, cooking, giving me lifts, helping with my exercises, but as it [time] wore on they started getting more and more annoyed with me." There have been mixed findings regarding the provision of social support during rehabilitation. In two sport injury studies (Johnston & Carroll, 2000; Udry, 1997), support provision remained stable during rehabilitation. However, this is at odds with previous health research, which has shown that social support typically declines when it is required for extended periods of time (e.g., Tomberg et al., 2007).

The Threat of a Poor Outcome

The third distinguishing theme between high and low adherers was the threat of a poor or compromised long-term rehabilitation outcome. Within this theme were two sub-themes: (1) *the strength and valence of the threat*, and (2) *a belief in the treatment*.

The strength and valence of the threat. High adherers identified a number of threats to attaining positive outcomes following ACL reconstruction. For some, this represented the potential of being unable to return to pre-injury levels of participation. For others, this threat was the prospect of re-injury. For example, D-High said, “Mentally I’m still scared to play a full game because I still think it’s just going to go, so I’m trying to do everything to make sure that doesn’t happen.” B-High was concerned about the impact on her long-term quality of life:

[The surgeon] managed to straighten it during the ACL reconstruction, [so] I’m really desperate not to lose that. Range of movement is something you have to work on because it’s a risk after ACL reconstruction...I’ve worked with patients who are suffering a lot with range of movement, which has had a huge impact on their lives.

Despite these concerns being present throughout recovery, high adherers discussed their facilitative effect and as being key “drivers” for the completion of rehabilitation exercises. For example, B-High-Partner commented, “Her biggest fear was not getting back her full range of movement. That was a big driver for her throughout the physio.” For D-High, this drive came from his teammates’ re-injury experience:

I saw one of my teammates who didn’t really do as much physio as he should have done and then his knee went again. That’s why I always said I was never going to end up like that, that’s what properly pushed me to be more disciplined in the sense of doing my rehab better...If I hadn’t have seen that I probably would have been like, “I’m fine, I feel fine” and stopped doing it [rehabilitation].

The motivation to protect oneself from a perceived threat and the desire to avoid the potentially negative outcome which accompanies that threat is a central tenant of the protection motivation theory (Maddux & Rodgers, 1983), and has been associated with

rehabilitation behavior across a number of health domains, including sport injury (Brewer et al., 2003; Taylor & May, 1996).

In contrast, the low adherers often reported the threat associated with compromised outcomes, such as a failure to return to their pre-injury levels of participation, was highest at injury onset and early after surgery because of the visual swelling and physical vulnerability of the knee, but diminished as rehabilitation progressed. F-Low commented:

When you see your knee like that you get really worried, like, "Is it ever going to be the same again?", so you make sure you're icing it, resting it, doing the exercises. But then as time goes on, and your knee gets stronger, you can go to work, do normal things, it becomes less of a concern.

D-Low, suggested, "It [the knee] isn't 100%, but I can do what I need to, so I'm not as worried about the long-term anymore. That also means I probably haven't done as much [rehabilitation] as I should though." These findings suggest an important distinguishing feature between high and low adherers is the extent to which they experience threat appraisals throughout the rehabilitation period, not just within the early stages of rehabilitation.

A belief in the treatment. Participants' responses suggested that their belief in the treatment might influence the strength of the relationship between threat appraisals and rehabilitation adherence. That is, high adherers who experienced heightened threat appraisals, coupled with a strong belief in their treatment, typically displayed high levels of adherence. For example, E-High said: "Of course you're worried about it, but I had confidence in what they were prescribing. I didn't want to overdo it, I didn't want to underdo it...I just pretty much fully adhered to what they said." Similarly, A-High-Parent suggested, "She was worried about it, but because she had a lot of trust in [physiotherapist] she'd do exactly what she said...If [physiotherapist] said don't do this she wouldn't do it." However, sometimes these high levels of threat, coupled with good rehabilitation progress was the catalyst for over-adherence.

In contrast, and consistent with previous research, low adherers often expressed a lack of treatment efficacy (e.g., Levy et al., 2008). E-Low said, "Trust is massively important because if you don't trust them you have doubts in your mind and your like, is this really helping me?". Similarly, B-Low said, "I ended up discharging myself", because B-Low-Friend said, "She wasn't entirely sure maybe how much they [physiotherapists] could help, what they could do, or whether they were actually any good at their job."

This lack of belief in their treatment, coupled with lower levels of threat appraisals, was associated with under-adherence. For example, A-Low commented, "I don't know what the long-term implications will be, but I waited so long for surgery, then you get to physio where you don't think it's doing anything for you. Why would I keep going when it's like that?" Similarly, C-Low-Friend suggested:

At the start she was all up for doing the rehab, doing the right number of sets, show me how her strength had built up, she'd be really proud of herself. But now she doesn't do any of that. Now she just does the odd bit here and there, because she's like, if it hasn't done anything now how's the next few months going to change anything?

However, as participants approached the end of their formalised rehabilitation, high threat appraisals and a lack of treatment efficacy, for some, was associated with thoughts of returning prematurely to unrestricted activity. Indeed, this was the case for two low and high adherers. E-Low-Teammate suggested, "I think deep down he knows it's too soon, they've told him as much, but I don't think he really trusts their advice anymore, he's just desperate to play again." These findings contradict Johnston and Carroll's (1998) suggestions that athletes who risk a premature return underestimate injury severity and focus on short-term goals, ignoring the long-term consequences of early participation.

Summary and Conclusion

This study examined the factors that distinguished between athletes who displayed high, compared to low, levels of rehabilitation adherence. Three main themes distinguished between the two groups: (1) preparation for post-operative rehabilitation; (2) an active versus passive approach to rehabilitation; and (3) the fear associated with a poor outcome. The

high adherers were better prepared for the rehabilitation period, primarily for three reasons. Firstly, they had a greater understanding of the rehabilitation process because they utilised instrumental coping skills to a greater extent than their low adherent counterparts. Secondly, more high adherers engaged in a pre-rehabilitation program, which appeared to have psychological (e.g., increased outcome-expectancy), tangible (e.g., develop effective rehabilitation habits), and physical (e.g., strength and range of motion) benefits. Thirdly, the high adherers were less susceptible to mismatches between their expectations and the reality of the post-operative period.

Secondly, the high adherence group adopted a more active versus passive approach to their rehabilitation. Two self-regulatory strategies exemplified this. Firstly, the high adherers engaged in rehabilitation routines and action planning, which increased control appraisals and reduced distress, especially when individuals perceived a lack of time to complete their rehabilitation. Secondly, the high adherers identified the inherent strengths within their social support network and mobilised this support to meet their needs. Whether this was possible due to a larger social support network per se, the support better meeting their needs, or a higher perceived responsiveness on the part of the recipient to seek and accept support, is difficult to extrapolate from the findings. Either way, successful support exchanges throughout rehabilitation appeared to be contingent on a breadth of social support providers.

With regard to the final theme, high adherers experienced a heightened level of threat throughout rehabilitation, and overall, reported more satisfaction with the treatment they had received. Together these were associated with higher levels of adherence, albeit at times, the levels of adherence were synonymous with over-adherence. In contrast, the low adherers generally reported heightened perceptions of threat before and early after surgery, which diminished as rehabilitation progressed. Coupled with lower levels of treatment satisfaction, this often led to under-adherence. However, for some participants', high threat appraisals and low coping appraisals also encouraged thoughts of a premature return to unrestricted activity.

While a number of these findings echo those previously reported within the psychology of sport injury literature (e.g., Chan et al., 2009; Niven et al., 2012; Mannion et al., 2013), there are also some novel and insightful findings which extend those that have previously been reported. Firstly, in relation to the pre-surgery period and patients' preparation or 'psychological readiness' for ACL surgery, our findings highlight the importance of this period in the development of effective post-surgery rehabilitation behaviors, with implications on patients' outcome-expectancy, treatment satisfaction, and adherence. The only other study within the psychology of sport injury literature that has examined patients' psychological readiness for ACL surgery (Udry et al., 2003), demonstrated that participants had relatively high levels of self-efficacy before surgery, perceived more pros than cons for surgery, and reported greater use of behavioral as compared with cognitive processes of change. However, it failed to examine the relationships between these indices of psychological readiness and post-surgery rehabilitation adherence. Our findings provide some preliminary support for this relationship, as well as highlighting an important implication for clinical practice. There has been much debate within the clinical literature as to whether patients benefit from early (i.e., within 3 weeks of injury), or delayed (i.e., greater than 3 weeks following injury) reconstructive surgery. Given that the most recent meta-analysis suggested that the timing of surgery had no influence on functional outcome, risk of re-tears, or residual instability (Deabate et al., 2020), a patient's psychological readiness for surgery should be carefully assessed to determine the merits of early versus delayed surgery.

The second notable finding from this study highlights the prominent role that threat and coping appraisals continue to exert throughout the rehabilitation period, and therefore the potential of protection motivation theory as a theoretical framework to develop our understanding of influential psychosocial factors in the latter stages of post-ACL surgery rehabilitation to facilitate a safe return-to-sport, and also the prevention of a second ACL injury thereafter (i.e., the period following an initial return-to-sport). While protection motivation theory suggests that an awareness of the severity of a threat that they are

susceptible to will initiate protection motivation, it is actually athletes' perceptions of coping appraisals (self-efficacy and treatment efficacy) that will dictate the nature of motivation (intentions and behaviour; Maddux & Rodgers, 1983). Previous research has demonstrated that coping appraisals (i.e., treatment efficacy and self-efficacy) at 5 weeks post-surgery were more strongly associated with adherence than threat appraisal (i.e., susceptibility and severity) (Brewer et al., 2003), whereas the findings from this study support a potential moderating effect between threat and coping appraisals that extends throughout the rehabilitation period (Plotnikoff et al., 2009). Evidently, these preliminary findings require further empirical examination, preferably with repeated measures designs that capture temporal variations within threat and coping appraisals. Replication of these findings could highlight a number of interesting ways to improve athletes' recovery outcomes following surgery. For example, which personal (e.g., personality traits) and situational factors (e.g., team culture) influence the facilitative use of threat appraisal that are prevalent during the return-to-sport period, and how these central tenets can be incorporated into injury prevention programs to reduce the likelihood of a second ACL injury.

Practical Implications

These findings have important implications for practice at both an intra- and interpersonal level. For example, orthopaedic surgeons should make injured athletes aware of the prominent stressors (e.g., Evans et al., 2012) and potentially negative psychosocial responses (e.g., Clement et al., 2015) they are likely to encounter during the different stages of the recovery process. This information should supplement that which they already typically receive, such as information about the injury, surgery, rehabilitation exercises, and broad recovery timelines. With this awareness athletes can adopt a proactive approach in readiness for surgery by identifying the types of support they might require and who in their support network best meets these needs. Furthermore, athletes can use this knowledge to develop coping (e.g., "what if") plans before encountering these post-surgery stressors. In doing so, athletes will not only develop a more realistic understanding of the rehabilitation process (and thus experience less mismatches in their treatment satisfaction), but also

increase their secondary appraisals about how much control they have and how effective they are at dealing with the post-surgery period. Physiotherapists should be cognisant that individuals who begin to display diminishing levels of adherence as time progresses may in fact be experiencing reduced threat appraisals associated with their injury. That is, they may feel less susceptible to the injury re-occurring or worsening, and underestimate the long-term implications of their ACL injury. In such circumstances, physiotherapists can intervene by educating patients about the prevalence of re-injury (Nagelli & Hewett, 2017), lower than expected return-to-sport rates (Lai et al., 2017), and implications for long-term quality of life (Filbay et al., 2017) to encourage (re)engagement in the rehabilitation process. Importantly, this should be supplemented with efficacy-enhancing strategies (e.g., goal-setting, repeated functional testing, sport-specific exercises) to increase patients' belief in their own ability and that of the program (Culvenor & Barton, 2018).

Finally, while heightened threat appraisals (e.g., re-injury anxiety) are a reason why some athletes won't return-to-sport following an ACL injury, for other athletes, they may in fact exacerbate thoughts of a premature return to unrestricted activity. These athletes may be particularly at risk of a second ACL injury, and so coaches, in a shared decision-making process with the physiotherapist and athlete, should identify situations where modifying training can facilitate a safe return. Through mutual or shared understanding (Cavallero et al., 2016), coaches and athletes can ensure they are "on the same page" with regards to the return period. In doing so, athletes are also more likely to feel valued by coaches.

Strengths, Limitations and Future Research

This study has a number of strengths. To overcome the effect of confounding variables, a sample with an homogenous injury (i.e., primary ACL rupture) were matched on a number of important demographic variables, including age, gender, and competitive level. Furthermore, the inclusion of a significant other, something that hasn't previously been done in the psychology of sport injury literature, developed enhanced understanding of the rehabilitation experience. Triangulating participants' responses and perceptions, and facets of rehabilitation, ultimately increased the rigor and the meaningfulness of the findings.

Despite these strengths there were some limitations within the study. Firstly, retrospective studies are susceptible to recall bias, in that participants' perceptions of their rehabilitation experiences are heavily influenced by the status of their knee at the time of the interview. In order to mitigate against this, a preparation booklet with participants' responses to a number of measures completed as part of XXXX was produced for seven out of the twelve ACL participants. However, this was not possible for the remaining five ACL participants which may have influenced their responses. Secondly, despite all participants undergoing surgery with the same orthopaedic surgeon, they did not all see the same physiotherapist. Finally, while the rehabilitation adherence ratio used to distinguish between high and low adherers in this study provides an objective measure of rehabilitation, it is in effect a measure of 'compliance' (conforming to professional recommendations with regard to prescribed dosage, timing and frequency of rehabilitation) as opposed to 'adherence' (for a discussion see McKay & Verhagen, 2015), and it doesn't account for the quality, intensity or vigour with which participants approached their rehabilitation.

This study has highlighted some interesting findings which we believe will resonate with other individuals' experiences of ACL rehabilitation. However, empirical replication is required in order to increase the naturalistic generalizability (Stake, 1995) of these findings beyond the current sample and rehabilitation context. Next, our understanding of the role of psychosocial factors and patients' psychological readiness prior to surgery is extremely limited. Previously, the length of time between injury and surgery has been identified as a factor that distinguishes between those who do and do not return to pre-injury levels of competition (Arderin et al., 2014). One might speculate this to be linked to a diminished outcome expectancy as the length of time they wait for surgery increases. At present this remains speculative and warrants future research attention.

Finally, it is evident that threat appraisals are key drivers of rehabilitation adherence, but, for some, will fluctuate throughout the recovery process. Currently, our understanding of these fluctuations is limited, predominantly because threat appraisals have been measured in a cross-sectional manner (e.g., Brewer et al., 2003; Taylor & May, 1996). Instead,

repeated measures designs and within-person variations should be explored in a bid to understand how medical professionals can safely induce threat appraisals to reap the motivational benefits without compromising an individual's health and well-being.

References

- Ardern, C. L., Taylor, N. F., Feller, J. A., & Webster, K. E. (2014). Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: An updated systematic review and meta-analyses including aspects of physical functioning and contextual factors. *British Journal of Sports Medicine*, 48, 1543-1552. <https://doi.org/10.1136/bjsports-2013-093398>
- Bhaskar, R. (1975). *A realist theory of science*. Routledge.
- Bianco, T., & Eklund, R. C. (2001). Conceptual considerations for social support research in sport and exercise settings: The case of sport injury. *Journal of Sport and Exercise Psychology*, 23, 85-107. <https://doi.org/10.1123/jsep.23.2.85>
- Bolger, N., & Amarel, D. (2007). Effects of social support visibility on adjustment to stress: Experimental evidence. *Journal of Personality and Social Psychology*, 92, 458-75. <https://doi.org/10.1037/0022-3514.92.3.458>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101.
- Brewer, B. W., Cornelius, A. E., Van Raalte, J. L., Petitpas, A. J., Sklar, J. H., Pohlman, M. H., Krushell, R. J., & Ditmar, T. D. (2003). Protection motivation theory and adherence to sport injury rehabilitation revisited. *The Sport Psychologist*, 17, 95-103. <https://doi.org/10.1123/tsp.17.1.95>
- Brewer, B. W., Cornelius, A. E., Van Raalte, J. L., Tennen, H., & Armeli, S. (2013). Predictors of adherence to home rehabilitation exercises following anterior cruciate ligament reconstruction. *Rehabilitation Psychology*, 58, 64-72. <https://doi.org/10.1037/a0031297>

- Brewer, B. W., Van Raalte, J. L., Cornelius, A. E., Petitpas, A. J., Sklar, J. H., Pohlman, M. H., Krushell, R. J., & Ditmar, T. D. (2000). Psychological factors, rehabilitation adherence, and rehabilitation outcome following anterior cruciate ligament reconstruction. *Rehabilitation Psychology, 45*, 20-37. <https://doi.org/10.1037/0090-5550.45.1.20>
- Cavallerio, F., Wadey, R., & Wagstaff, C. R. D. (2016). Understanding overuse injuries in rhythmic gymnastics: A 12-month ethnography. *Psychology of Sport and Exercise, 25*, 100-109. <https://doi.org/10.1016/j.psychsport.2016.05.002>
- Chan, D. K., Lonsdale, C., Ho, P. Y., Yung, P. S., & Chan, K. M. (2009). Patient motivation and adherence to postsurgery rehabilitation exercise recommendations: The influence of physiotherapists' autonomy-supportive behaviors. *Archives of Physical Medicine and Rehabilitation, 90*, 1977–1982. <https://doi.org/10.1016/j.apmr.2009.05.024>
- Chang, E. C. (1998). Dispositional optimism and primary and secondary appraisal of a stressor: Controlling for confounding influences and relations to coping and psychological and physical adjustment. *Journal of Personality and Social Psychology, 74*, 1109-1120. <https://doi.org/10.1037/0022-3514.74.4.1109>
- Clement, D., Arvinen-Barrow, M. M., & Fetty, T. (2015). Psychosocial responses during different phases of sport-injury rehabilitation: A qualitative study. *Journal of Athletic Training, 50*, 95–104. <https://doi.org/10.4085/1062-6050-49.3.52>
- Coulter, T., Mallett, C., & Singer, J. (2016). A subculture of mental toughness in an Australian Football League club. *Psychology of Sport and Exercise, 22*, 98-113. <https://doi.org/10.1016/j.psychsport.2015.06.007>
- Culvenor, A. G., & Barton, C. J. (2018). ACL injuries: The secret probably lies in optimising rehabilitation. *British Journal of Sports Medicine, 52*, 1416–1418. <https://doi.org/10.1136/bjsports-2017098872>
- Deabate, L., Previtali, D., Grassi, A., Filardo, G., Candrian, C., & Delcogliano, M. (2020). Anterior cruciate ligament reconstruction within 3 weeks does not increase stiffness and complications compared with delayed reconstruction: A meta-analysis of

- randomized controlled trials. *The American Journal of Sports Medicine*, 48, 1263–1272. <https://doi.org/10.1177/0363546519862294>
- Durand, H., Casey, M., Glynn, L. G., Hayes, P., Murphy, A. W., & Molloy, G. J. (2019). A qualitative comparison of high and low adherers with apparent treatment-resistant hypertension. *Psychology, Health and Medicine*, 21, 1-14. <https://doi.org/10.1080/13548506.2019.1619788>
- Ebert, J. R., Edwards, P., Yi, L., Joss, B., Ackland, T., Carey-Smith, R, Buelow, J.-U., & Hewitt, B. (2018). Strength and functional symmetry is associated with post-operative rehabilitation in patients following anterior cruciate ligament reconstruction. *Knee Surgery Sports Traumatology Arthroscopy*, 26, 2353–2361. <https://doi.org/10.1007/s00167-017-4712-6>
- Endler, N. S., Parker, J. D., & Summerfeldt, L. J. (1998). Coping with health problems: Developing a reliable and valid multidimensional measure. *Psychological Assessment*, 10, 195-205. <https://doi.org/10.1037/1040-3590.10.3.195>
- Evans, L., Wadey, R., Hanton, S., & Mitchell, I. (2012). Stressors experienced by injured athletes. *Journal of Sports Sciences*, 30, 917–927. <https://doi.org/10.1080/02640414.2012.682078>
- Fields, J., Murphey, M., Horodyski, M., & Stopka, C. (1995). Factors associated with adherence to sports injury rehabilitation in college-age recreational athletes. *Journal of Sport Rehabilitation*, 4, 172–180. <https://doi.org/10.1123/jsr.4.3.172>
- Filbay, S., Ackerman, I., Russell, T., & Crossley, K. (2017). Return to sport matters—longer-term quality of life after ACL reconstruction in people with knee difficulties. *Scandinavian Journal of Medicine and Science in Sports*, 27, 514–524. <https://doi.org/10.1111/sms.12698>
- Goddard, K., Roberts, C-M., Byron-Daniel, J., & Woodford, L. (2020). Psychological factors involved in adherence to sport injury rehabilitation: a systematic review. *International Review of Sport and Exercise Psychology*, 13, 1-23. <https://doi.org/10.1080/1750984X.2020.1744179>

- Grindem, H., Arundale, A. J., & Ardern, C. L. (2018). Alarming underutilisation of rehabilitation in athletes with anterior cruciate ligament reconstruction: four ways to change the game. *British Journal of Sports Medicine*, 52, 1162–1163.
<https://doi.org/10.1136/bjsports-2017-098746>
- Grindem, H., Granan, L. P., Risberg, M. A., Engebretsen, L., Snyder-Mackler, L., & Eitzen, I. (2015). How does a combined preoperative and postoperative rehabilitation programme influence the outcome of ACL reconstruction 2 years after surgery? A comparison between patients in the Delaware-Oslo ACL Cohort and the Norwegian National Knee Ligament Registry. *British Journal of Sports Medicine*, 49, 385–389.
<https://doi.org/10.1136/bjsports-2014-093891>
- Hilliard, R. C., Brewer, B. C., Cornelius, A. E., & Van Raalte, J. L. (2013). Big five personality characteristics and adherence to clinic-based rehabilitation activities after ACL surgery: a prospective analysis. *Open Rehabilitation Journal*, 7, 1-5.
<https://doi.org/10.2174/1874943701407010001>
- Johnston, L. H., & Carroll, D. (1998). The context of emotional responses to athletic injury: A qualitative analysis. *Journal of Sport Rehabilitation* 7, 206–220.
- Johnston, L. H., & Carroll, D. (2000). The psychological impact of injury: Effects of prior sport and exercise involvement. *British Journal of Sports Medicine*, 34, 436–439.
- Kyritsis, P., Bahr, R., Landreau, P., Miladi, R., & Witvrouw, E. (2016). Likelihood of ACL graft rupture: not meeting six clinical discharge criteria before return to sport is associated with a four times greater risk of rupture. *British Journal of Sports Medicine*, 50, 946-951. <https://doi.org/10.1136/bjsports-2015-095908>
- Lai, C. C. H., Ardern, C. L., Feller, J. A., & Webster, K. E. (2017). Eighty-three per cent of elite athletes return to preinjury sport after anterior cruciate ligament reconstruction: A systematic review with meta-analysis of return to sport rates, graft rupture rates and performance outcomes. *British Journal of Sports Medicine*, 52, 128-138.
<https://doi.org/10.1136/bjsports-2016-096836>

- Lee, A. S. Y., Yung, P. S-H., Mok, K-M., Hagger, M. S., Chan, D. K. (2020). Psychological processes of ACL-patients' post-surgery rehabilitations: A prospective test of an integrated theoretical model. *Social Science & Medicine*, 244, 112646.
<https://doi.org/10.1016/j.socscimed.2019.112646>
- Levy, A. R., Polman, R. C. J., & Clough, P. J. (2008). Adherence to sport injury rehabilitation programs: An integrated psycho-social approach. *Scandinavian Journal of Medicine and Science in Sports*, 18, 798-809. <https://doi.org/10.1111/j.1600-0838.2007.00704.x>
- Levy, A. R., Polman, R. C. J., Nicholls, A. R., & Marchant, D. C. (2009). Sport injury rehabilitation adherence: Perspectives of recreational athletes. *International Journal of Sport and Exercise Psychology*, 7, 212-229.
<https://doi.org/10.1080/1612197X.2009.9671901>
- Maddux, J. E., & Rogers, R. W. (1983). Protection motivation and self-efficacy: A revised theory of fear appeals and attitude change. *Journal of Experimental Social Psychology*, 19, 469-479. [https://doi.org/10.1016/0022-1031\(83\)90023-9](https://doi.org/10.1016/0022-1031(83)90023-9)
- Mannion, A. F., Impellizzeri, F. M., Naal, F. D., & Leunig, M. (2013). Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. *Osteoarthritis and Cartilage*, 21, 44-50. <https://doi.org/10.1016/j.joca.2012.09.013>
- Maxwell, J. (1992). Understanding and validity in qualitative research. *Harvard Educational Review*, 62, 279-301. <https://doi.org/10.17763/haer.62.3.8323320856251826>
- Maxwell, J. A. (2012). *A realist approach for qualitative research*. Sage.
- Meichenbaum, D., & Turk, D. C. (1987). *Facilitating treatment adherence*. Plenum.
- Minichiello, V., Aroni, R., Timewell, E., & Alexander, L. (1990). *In-depth interviewing: Researching people*. Longman Cheshire.
- McKay, C. D., & Verhagen, E. (2015). 'Compliance' versus 'adherence' in sport injury prevention: Why definition matters. *British Journal of Sports Medicine*, 0, 1–2.
<https://doi.org/10.1136/bjsports-2015-095192>

- Nagelli, C. V., & Hewett, T. E. (2017). Should return to sport be delayed until 2 years after anterior cruciate ligament reconstruction? Biological and functional considerations. *Sports Medicine*, 47, 221-232. <https://doi.org/10.1007/s40279-016-0584-z>
- Niven, A. G. (2007). Rehabilitation adherence in sport injury: Sport physiotherapists' perceptions. *Journal of Sport Rehabilitation*, 16, 93–110. <https://doi.org/10.1123/jsr.16.2.93>
- Niven, A., Nevill, A., Sayers, F., & Cullen, M. (2012). Predictors of rehabilitation intention and behavior following anterior cruciate ligament surgery: An application of the Theory of Planned Behavior. *Scandinavian Journal of Medicine & Science in Sports*, 22, 316–322. <https://doi.org/10.1111/j.1600-0838.2010.01236.x>
- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Sage.
- Pizzari, T., McBurney, H., Taylor, N. F., & Feller, J. A. (2002). Adherence to anterior cruciate ligament rehabilitation: A qualitative analysis. *Journal of Sport Rehabilitation*, 11, 90-102. <https://doi.org/10.1123/jsr.11.2.90>
- Plotnikoff, R. C., Rhodes, R. E., & Trinh, L. (2009). Protection motivation theory and physical activity: A longitudinal test among a representative population sample of Canadian adults. *Journal of Health Psychology*, 14, 1119–1134. <https://doi.org/10.1177/1359105309342301>
- Ronkainen, N. J., & Wiltshire, G. (2021). Rethinking validity in qualitative sport and exercise psychology research: A realist perspective. *International Journal of Sport and Exercise Psychology*, 19, 13-28. <https://doi.org/10.1080/1612197X.2019.1637363>
- Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A re-evaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, 67, 1063-1078. <https://doi.org/10.1037//0022-3514.67.6.1063>
- Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport and Exercise Psychology*, 11, 101–121. <https://doi.org/10.1080/1750984X.2017.1317357>

- Stake, R.E. (1995). *The art of case study research*. Sage.
- Taylor, A. H., & May, S. (1996). Threat and coping appraisal as determinants of compliance with sports injury rehabilitation: An application of protection motivation theory. *Journal of Sport Sciences*, 14, 471-481. <https://doi.org/10.1080/02640419608727734>
- Tomberg, T., Toomela, A., Ennok, M., & Tikk, A. (2007). Changes in coping strategies, social support, optimism and health-related quality of life following traumatic brain injury: A longitudinal study. *Brain Injury*, 21, 479-488.
- Uchino, B. N. (2009). Understanding the links between social support and physical health: A life span perspective with emphasis on the separability of perceived and received support. *Perspectives on Psychological Science*, 4, 236–255.
<https://doi.org/10.1111/j.1745-6924.2009.01122.x>
- Udry, E. (1997). Coping and social support among injured athletes following surgery. *Journal of Sport and Exercise Psychology*, 19, 71-90. <https://doi.org/10.1123/jsep.19.1.71>
- Udry, E., Shelbourne, D. K., & Gray, T. (2003). Psychological readiness for anterior cruciate ligament surgery: Describing and comparing the adolescent and adult experiences. *Journal of Athletic Training*, 38, 167-171.
- van Melick, N., van Cingel, R. E., Brooijmans, F., Neeter, C., van Tienen, T., Hullegie, W., & Nijhuis-van der Sanden, M. W. (2016). Evidence-based clinical practice update: Practice guidelines for anterior cruciate ligament rehabilitation based on a systematic review and multidisciplinary consensus. *British Journal of Sports Medicine*, 50, 1506–1515. <https://doi.org/10.1136/bjsports-2015-095898>
- Wadey, R., Day, M., Cavallerio, F., & Martinelli, L. (2018). The multilevel model of sport injury: Can coaches impact and be impacted by injury? In R. Thelwell & M. Dicks (Eds.), *Professional Advances in Sports Coaching: Research and Practice*. Routledge.
- Walker, A., Hing, W., & Lorimer, A. (2020). The influence, barriers to and facilitators of anterior cruciate ligament rehabilitation adherence and participation: a scoping review. *Sports Medicine*, 6, 32. <https://doi.org/10.1186/s40798-020-00258-7>

- Waters, A. G. (2005). *The role of confidence in rehabilitation and the recovery of motor performance*. (Unpublished doctoral dissertation). University of Wales, Bangor.
- Wiese-Bjornstal, D. M., Smith, A. M., Shaffer, S. M., & Morrey, M. A. (1998). An integrated model of response to sport injury: Psychological and sociological dynamics. *Journal of Applied Sport Psychology*, 10, 46-69. <https://doi.org/10.1080/10413209808406377>
- Williams, T., Evans, L., Robertson, A., Hardy, L., Roy, S., Lewis, D., & Glendinning, F. (2020). The role of optimism and psychosocial factors in athletes' recovery from ACL injury: A longitudinal study. *Frontiers in Sports and Active Living*, 2, 116. <https://doi.org/10.3389/fspor.2020.00116>
- Wiltshire, G. (2018). A case for critical realism in the pursuit of interdisciplinary and impact. *Qualitative Research in Sport, Exercise and Health*, 10, 525-542. <https://doi.org/10.1080/2159676X.2018.1467482>
- Zhang, C.-Q., Zhang, R., Schwarzer, R., & Hagger, M. S. (2019). A meta-analysis of the Health Action Process Approach. *Health Psychology*, 38, 623-637. <https://doi.org/10.1037/hea0000728>

1 Table 1

2 *Demographic Characteristics of High and Low Adherers*

| Label | Adherence | Age | Gender | Sport | Competitive Level | Time since surgery | Significant other | Completed XXXX Study Surveys |
|---------------|------------------|------------|---------------|--------------|--------------------------|---------------------------|--------------------------|-------------------------------------|
| A-High | High | 26 | Female | Football | National | 9 months | Parent | Yes |
| B-High | High | 38 | Female | Cycling | Recreational | 8 months | Partner | Yes |
| C-High | High | 23 | Female | Netball | County | 8 months | Friend | Yes |
| D-High | High | 33 | Male | Rugby | County | 6 months | Partner | No |
| E-High | High | 20 | Male | Football | Club | 8 months | Parent | No |
| F-High | High | 40 | Male | Running | Club | 7 months | Partner | No |
| A-Low | Low | 29 | Female | Hockey | National | 9 months | Partner | Yes |
| B-Low | Low | 32 | Female | Netball | Recreational | 9 months | Friend | Yes |
| C-Low | Low | 20 | Female | Rugby | County | 8 months | Friend | No |
| D-Low | Low | 30 | Male | Rugby | County | 7 months | Coach | Yes |
| E-Low | Low | 21 | Male | Hockey | Club | 9 months | Teammate | No |
| F-Low | Low | 36 | Male | Hockey | Club | 6 months | - | Yes |

3