Psychological Factors Involved in Adherence to Sport Injury Rehabilitation: A Systematic Review

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Abstract

The objective of this article is to review the extant literature on the psychological factors related to adherence to sport injury rehabilitation among athletes. Published English language articles were identified using electronic databases. The quality of the identified articles was assessed using a hybrid quality assessment tool based on the Effective Public Health Practice Project tool and the Health Technology Assessment Programme for evaluating non-randomised intervention studies. Seventeen papers - one using a treatment intervention, two qualitative articles and 14 descriptive studies fulfilled the inclusion criteria and were systematically reviewed. The results suggested that there were two categories of factors that determine adherence to rehabilitation in this population: person and situational. Person-specific factors included the impact of the injury, justification for adherence, motivation, confidence/self-efficacy, coping, social support, locus of control, cognitive appraisal, coping and psychological skills. Situational factors included the characteristics, strategies and effectiveness of the physical therapist and treatment efficacy. Due to the scant nature and quality of the studies included in this review we conclude that research of strong design, is required to provide a greater evidence-base and to help inform the role that sport psychologists could play in designing interventions to improve adherence to rehabilitation.

Key words: *injury, psychological skills, physical therapist, motivation*

A range of authors have reported the societal (Brewer et al., 2003; Duda, Smart, & Tappe, 1989; Murphy, Foreman, Simpson, Molloy, & Molloy, 1999), psychological and emotional impact (e.g., Rees, Mitchell, Evan, & Hardy, 2010) and the substantial financial costs of sport injury (e.g., Hickey, Shield, Williams, Opar, 2014; Hupperets, Verhagen, Heymans, Bosmans, van Tulder, van Mechelen, 2010; Krist, van Beijsterveldt, de Wit, & Backx, 2013; Marshall, Lopatina, Lacny, & Emery, 2016; Parkkari, Kujala, & Kannus, 2001). Due to the high cost of these incidences, non-adherence to rehabilitation amongst athletes is reported to be a key issue in the eyes of practitioners and sport administrators (Brewer, Jeffers, Petitpas, & Van Raalte, 1994; Hamson-Utley, Martin, & Walters, 2008; Ninedek & Kolt, 2000) which further exacerbates its impact. Early research in adherence to sport injury rehabilitation led scholars to label it as "atheoretical" (Levy, Polman & Clough, 2008, p.798) and call for the use of psychosocial theoretical frameworks to help advance knowledge. Since this suggestion, psychosocial frameworks have been applied to the study of rehabilitation adherence, for example: The Integrated Model for Response to Sport Injury (Wiese-Bjornstal, Smith, Shaffer & Morrey, 1998) and the Adapted Planned Behaviour Model (e.g., Levy et al., 2008). The Integrated Model for Response to Sport Injury (Wiese-Bjornstal et al., 1998) purports to explain how athletes respond psychologically to injury and is considered the most comprehensive attempt to represent psychological responses to sport injury and their antecedents conceptually (Brewer, Cornelius, Van Raalte, & Tennen, 2017). This model splits the factors relating to injury and injury rehabilitation adherence into personal and situational (Marshall, Donovan-Hall, & Ryall, 2012). Personal factors include injury characteristics (e.g., severity, type) and individual difference variables in the psychological (e.g., personality, motivation, identity), demographic (e.g., age, gender), and physical (e.g., health status, eating behaviour) domains. Situational factors pertain to aspects of the sport (e.g., level of competition, time of the competitive season), social (e.g., family

dynamics, social support), and physical (accessibility to rehabilitation, comfort of rehabilitation sessions) environments. For a critical review of this model, please see Walker, Thatcher and Lavallee's (2007) article.

The Adapted Planned Behaviour Model (Levy et al., 2008) is based on the Theory of Planned Behaviour (Ajzen, 1991) and identifies several psychosocial variables such as attitude, goal orientation and threat appraisals that dictate intentions to engage in injury rehabilitation. These theories attempt to conceptualise the cognitive processes that underpin attitudes that influence health behaviours. They propose that the greatest predictor of (in this case), engaging in rehabilitation is the individual's intention. Intention is comprised of three distinct factors: (1) the individual's attitude towards the behaviour in question which is based on their prediction of the expectation of the outcome (e.g., that successful rehabilitation is required to return to sport); (2) perceptions of subjective norms (e.g., a belief regarding the attitude of people important to the individual in question); (3) an estimation of the amount of control the individual can exert over the behaviour (Ajzen, 1988; Ajzen & Fishbein, 1980; Fishbein, 1967; Fishbein & Ajzen, 1975; Schiffer & Ajzen, 1985).

In terms of context, adherence to sport injury rehabilitation is seen as having two components: home- and clinic-based (Marshall et al., 2012). Understanding the common factors relating to context that influence adherence is likely to be important in understanding how to affect greater adherence to rehabilitation as an outcome variable. However, Horvath, Birrer, Meyer, Moesch and Seiler (2007) observed that adherence is often seen as the outcome variable and an assumption is made that the independent variables remain stable during the course of rehabilitation. The nature and significance of the impact of sport injury may vary depending on the level of sport participated in. For example, at a recreational level it may be an inconvenience to the individual and impact on their daily lives, but for elite

athletes who rely on sport for their livelihood, or are hoping to do so in the future, the stakes are potentially much higher and therefore the impact of injury may be substantially different (Levy, Polman, Nicholls, & Marchant, 2009). Forsdyke, Smith, Jones and Gledhill (2016) conducted a systematic review into studies investigating the relationship between psychosocial factors and rehabilitation outcomes in competitive athletes (they focused on the perceived success of rehabilitation rather than adherence to rehabilitation per se). This review reported that a range of psychosocial factors were associated with rehabilitation outcomes, specifically cognitive, emotional and behavioural. The authors' interpretation of rehabilitation success was undefined. Additionally, research by Clement, Arvinen-Barrow and Fetty (2015) documents the psychosocial response athletes go through when in rehabilitation, with frustration initially being experienced, then moving to nervousness and fear of re-injury. These cognitive appraisals of the injury led to participants seeking out social support from a range of people (family, significant others, support staff) in order to manage their emotions through the different phases of their rehabilitation. A further series of studies conducted by Arvinen-Barrow and colleagues (e.g., Arvinen-Barrow, Massey, & Hemmings, 2014; Arvinen-Barrow et al., 2015; Arvinen-Barrow & Clement, 2017) have investigated many dimensions and factors related to the complex issue of adherence to rehabilitation in athletes. For example, Arvinen-Barrow, Massey and Hemmings (2014) found that despite athletes accepting injuries as part of their 'job', common feelings associated with rehabilitation included feelings of frustration and self-doubt throughout the process, as well as rehabilitation professionals being primarily seen as being there to address physical concerns, with any psychological intervention needing to be subtle and indirect. It has also been reported that some athletes appear to use mental skills such as goal setting, imagery and self-talk to aid the rehabilitation process, although significantly more do not (Arvinen-Barrow et al., 2015). Few of the psychological skills are taught to athletes by a sport psychologist.

Expectations of rehabilitation, the type of sport, and the ability for sports rehabilitation professionals to take a holistic approach to athlete rehabilitation could also be important in rehabilitation success (Arvinen-Barrow & Clement, 2017). Throughout the body of this recent work (e.g., Arvinen-Barrow & Clement, 2017) investigating rehabilitation and sport injury a common theme is the need to understand psychosocial processes that underpin rehabilitation success. However, when considering the body of research on rehabilitation to sport injury, the research design in such studies is likely to present a challenge. For example, initial searches highlighted a dearth of randomised control trials or experimental designs in this domain. However, given the absence of a systematic review in this area it is scientifically prudent to consider what research is present regardless of research design. To our knowledge, no researchers to date have systematically reviewed the psychological factors used to investigate adherence to sport injury rehabilitation specifically. The aim of this article is therefore to conduct a review of the extant literature of this area in order to gain insights into what psychological factors are being considered and used in adherence to sport injury rehabilitation and thus what may inform the potential role that sport psychologists could play in designing interventions to improve adherence to rehabilitation.

Methodology

Inclusion and Exclusion Criteria

Studies were included in the review if they met the following criteria: (a) they involved or were based on psychological factors, psychological interventions or psychological investigations of sport injury rehabilitation; (b) they were focused on adherence/compliance (used interchangeably, acknowledging the semantic difference); (c) the context was related to sport injury; (d) the focus was regarding rehabilitation/ treatment; (e) the population was athletes/competitors/sport players.

Search Strategy

A literature search was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009; see Figure 1). Initially an electronic search of three databases was conducted: PsychInfo, SPORTDiscus and ScienceDirect, these were selected to give the greatest scope for capture across contexts and are recognised in the top of research databases. Keyword combinations included "Psychological" OR "Psychology" OR "Psycholo", OR "Intervention" AND "Sport Injury" OR "Injury", OR "Rehabilitation", AND "Athlete" OR "Competitor". The term "Adherence/Compliance" was deliberately omitted on the initial search as it was felt it might overly restrict the search return. Secondly, reference lists of eligible articles were examined in order to identify any additional research papers that had been missed on the initial electronic search. Finally, a 'grey-literature' search was conducted by contacting authors who had published their contact details in the papers included. Of the initial 2005 abstracts identified, after removal of duplicates and irrelevant abstracts 60 abstracts were then screened, 31 were excluded with 29 full papers screened, with 17 being retained for inclusion in the review with the remainder (12 papers) not meeting inclusion criteria. In order to maintain the integrity of the study a 10% quality assurance check at the abstract and paper review stage was conducted by a systematic review expert.

Inclusion and Exclusion Criteria

Abstracts were subjected to the following inclusion/exclusion criteria: Included abstracts had to contain the terms Psychological/ Psychology AND Adherence/compliance AND Injury or Sport Injury AND Rehabilitation (treatment) AND Athletes/ Competitors/ Players. At this stage of abstract review, a certain amount of latitude was given in order not to reject

inadvertently papers that would adhere to the criteria in the body of the article but not in the abstract.

Data Extraction, Quality Assessment and Synthesis

It was necessary to use a quality assessment tool given the mixture of experimental, non-experimental, cohort, descriptive and qualitative designs of the research reviewed. Whilst accepting that quality assessment tools are generally designed for experimental studies and meta-analyses (Deeks, et al., 2003) and that this current review was likely to use narrative synthesis given the early search revealed few experimental designs, it was likely that the use of such a tool would add a further layer of rigour to the review. The Effective Public Health Practice Project tool (Thomas et al., 2004), PRISMA (Moher et al., 2009) and the Health Technology Assessment Programme for evaluating non-randomised intervention studies (Deeks et al., 2003) were used to guide the construction of a quality assessment tool for use in this review. Details on randomisation, response rates, validity of measures etc.. were therefore used in the template that was created, which also extracted data regarding the population, level of participation in sport, the type of sport, the type of injury, intervention type, control/comparison, psychological factors/intervention, outcome measures, psychological measures/tools used, and underpinning psychological theory.

Results

Table 1 shows a summary of included studies with quality ratings. Of the 17 studies selected for the final review no study was rated strong overall, eight studies were rated moderate, four were rated moderate to weak and five were rated weak. Most studies were quantitative, the exception being two qualitative. There were no experimental design studies and the vast majority of the studies (bar one) did not have a treatment or intervention as such

- most were therefore descriptive, with one using a cohort design. As could be expected from the nature of these studies, no study reported the use of a control or comparison group. Only two studies endeavoured to use mixed measures to triangulate data on either the independent or dependent variables (Albinson & Petrie, 2003 and Chan et al,. 2011). Across the 17 studies there was a mix of prospective, retrospective and cross-section designs. None of the articles reported on blinding, excluding Murphy et al., (1999). The majority of studies bar one (Albinson, 2003) did not report on withdrawals. All studies excluding one (Fields et al. 1995) were rated moderate on the use of psychological theory in the quality assessment rating. All studies bar two (Mahoney & Hanrahan 2011 and Daly et al. 1995) were rated weak on the 'participants/population' aspect of the quality assessment.

Table 1 about here

Participants

No studies scored strongly on the level of detail provided on participants, thus limiting or restricting the identification of selection bias and confounding factors. Largely, the type of injuries were reported in sufficient detail. These were predominantly sprains, strains and ligament injuries. The type of sports was not always reported (eight studies) and for five studies the number and range of types of sports included within each study were large, especially in comparison to the sample size. Only one study (Chan, Hagger, & Spray, 2011) included a power rating for the study within the statistical analysis. There was limited evidence across the studies that authors had tried to identify potential confounding variables within their sample. Overall, the studies appeared to feature convenience samples, even though the nature of the sample was rarely reported, one study reported the aim of having a purposive sample but due to poor response they adopted a convenience sample (Fields,

Milledge, Horodyski, & Stopka, 1995). Across the studies reviewed limited information was provided on how participants were selected.

Psychological Factors/Theories/Models

There was no distinct consistency between the studies with regard to the theory or model used, apart from the overarching use of a psychosocial perspective. There were some recurring themes across the studies, however these were in part generated by the same groups of authors publishing different papers on the same subject (Chan et al., 2011; Chan & Hagger, 2012; Chan, Lonsdale, Ho, & Chan, 2009). Another recurring theme was that of attributions and locus of control; whilst the two are conceptually different (attributions backward looking and locus of control forward looking), four causal dimensions (Locus of Control Causation, Stability, Personal Control, External Control) were explored (Brewer, et al., 2000); others considered the three factor conception of Locus of Control (Internal, Powerful Others and Chance) (Murphy, et al., 1999). Two studies (Albinson & Petrie, 2003; Horvath, et al., 2007) were based on the Integrated Model of Psychological Responses to Sport Injury (Wiese-Bjornstal et al., 1998) which covers a range of psychological dimensions; however, the two studies did not measure the same dimensions and the dimensions that were consistent were not measured in the same way. Another recurring theme was cognitive appraisal and emotional response/control, which was implicit in Wiese-Bjornstal and colleagues' model (Wiese-Bjornstal et al.,1998) and implicit within Protection Motivation Theory (Rogers, 1975) utilised by Brewer et al., (2003). One study focused on cognitive appraisal as the primary model (Daly, Brewer, Van Raalte, Petitpas, & Sklar, 1995). Self-efficacy was also a focus of a number of studies, either as the main focus (Milne, Hall, & Forwell, 2005) or implicit within the main theory/model used, for example Duda et al., (1989) in their use of Personal Investment Theory (Maehr & Braskamp, 1986) and Levy

et al., (2008) in their use of the Adapted Planned Behaviour Model. Goal orientation, self-motivation, intention, attitude and social support were themes that occurred within some of the overarching theories or models used.

The vast majority of studies (bar two) were descriptive by design and none focused on causality. Mahoney and Hanrahan (2011) was the only study reviewed that had a specific psychological intervention or treatment to affect adherence, the study used Acceptance Commitment Theory as an educational intervention to improve adherence to sport injury rehabilitation. With the exception of the latter study the focus was on considering the relationship between the independent variables and the dependent variables of adherence or re-measurement of the independent variables. Most of the studies reviewed focused on measuring adherence (three had no measure of adherence) and associating this with variance in various descriptive factors/characteristics related to the participants. Two of the studies were purely explorative (Levy, et al., 2009; Marshall, et al., 2012) looking at identifying the nature of adherence from the athlete's perspective. The descriptive studies relied on self-report measures only on the independent variables, one exception to this was the use of semi-structured interviews as well as the psychometrics (Mahoney & Hanrahan, 2011).

Outcomes

Mahoney and Hanrahan (2001) did not include a measure of adherence in their education intervention, which would have added value to the study as it was the one study that had a treatment intervention. Similarly, in Albinson and Petrie's (2003) study, whilst there was a measure of adherence, the results found that there was insufficient variability in adherence scores to warrant their use. Horvath and colleagues (2007) intended to use a measure of clinic rehabilitation adherence but the physical therapists refused to use it, and hence the study had no measure of adherence. Chan and Hagger (2012) and Chan et al.

(2011) both used a hypothetical injury scenario and had no adherence measure; in another study by the same main author (Chan et al., 2009) participants were asked to recall retrospectively their adherence based on an adapted adherence questionnaire that had not been psychometrically validated. There was some consistency in the measurement of adherence across the studies with regard to clinic adherence: eight studies used the Sports Injury Rehabilitation Adherence Scale questionnaire (SIRAS: Brewer, et al., 2000). Practitioners rate injured athletes on three items (five point Likert scale): (1) Intensity (min effort/max effort), (2) frequency of following instruction and advice (never/always), (3) receptivity to changes in previous weeks' programme (unreceptive/very receptive), and the items were summed. Generally, a frequently used measure of adherence in clinic reported by third parties was attendance ratio, which was defined as the number of attended sessions divided by the number of scheduled sessions and represented as a percentage.

One study employed a group differences design (Fields et al., 1995) whereby they differentiated between adherers and non-adherers and looked at group differences. Another study deployed a cohort design (Mahoney & Hanrahan, 2011). Four studies were prospective and repeated measures by design, and they utilised the change in scores on the measures used as outcomes as well as reporting these against adherence measures. Whilst the quality assessment of the included literature revealed no strong studies and a number of weak studies, the findings of the studies are worth considering in detail as many of the results are statistically significant. A review across these studies may reveal patterns and themes relating to the psychological factors used by researchers and those potentially important in adherence.

Athletes' view of adherence. Levy et al.'s (2009) inductive study involving recreational athletes identified five themes as potentially affecting their adherence to rehabilitation: motivation, confidence, coping, social support and pain. Less motivation and

less confidence were both highlighted as negatively affecting home-based rehabilitation; adherence in clinics was posited as being affected by inefficient coping strategies, over-support, and pain; effective coping strategies and varied social support were seen as likely aiding rehabilitation adherence. Marshall et al. (2012) in their inductive research with competitive athletes, found a number of factors that could potentially affect adherence: impact of injury (psychological and physical), justification of adherence (mixed factors in their criteria) and the strategies used; the characteristics of physiotherapists and the strategies they used were seen as potentially impacting on adherence.

Self-efficacy. Levy et al. (2008), found that self-efficacy predicted (sic) clinic-based adherence, home-adherence and attendance but did not predict (sic) rehabilitation intention. Labelled as 'self-belief' it accounted for 32-36% of the variance within the Personal Investment Model as used by Duda et al. (1989). Task self-efficacy accounted for 11.5% of the variance in adherence (Milne, et al., 2005); they concluded that both task and coping efficacy appear to be key aspects in rehabilitation adherence. Brewer et al. (2003) found that self-efficacy was related to clinic adherence, home exercise adherence and home cryotherapy.

Cognitive appraisal and emotional regulation. Levy et al. (2008) found that coping was related to attendance and adherence: distraction coping was related to clinic adherence, home adherence and attendance; instrumental coping was related to clinic adherence, home adherence and attendance; and palliative coping was inversely related to clinic adherence, home adherence and attendance. Horvath et al. (2007) found that anxiety was the least stable across rehabilitation stages with large individual fluctuations. Cognitive appraisal was found to be inversely correlated with emotional response, emotional response was inversely related to attendance, but not to clinic adherence ratings (Daly, et al., 1995). Susceptibility appraisal

was related to clinic adherence, home exercise adherence and home cryotherapy adherence; severity appraisal was not associated with adherence (Brewer, et al., 2003).

Self-motivation. Self-motivation was found to predict (sic) clinic based adherence, home based adherence and attendance (Levy, et al., 2008). Self-motivation was found to be a differentiator between adherers and non-adherers (Fields, et al., 1995). Autonomous sport motivation was related to treatment motivation, control sport motivation was related to autonomous treatment motivation, control sport motivation was related to control treatment motivation, autonomous-supportive behaviours from the physical therapist was related to autonomous treatment motivation (Chan, et al., 2011). Duda et al.'s (1989) use of Personal Investment Theory indicated that those less self-motivated were less likely to complete prescribed exercises and not exert maximal effort.

Intention. As part of planned behaviour (Theory of Planned Behaviour and the Adapted Planned Behaviour Model), intention was found to relate to clinic attendance (r= .41) and clinic adherence and home adherence (Levy et al., 2008). It was also found that it fully mediated the effects of perceived severity, learning goal orientation and attitude, with regard to clinic based adherence. Horvath et al. (2007) reported that, unusually, intention remained stable through the three phases of rehabilitation. According to Chan and Hagger (2012), an unexpected finding in their study was that control motivation (as part of Self Determination Theory; Ryan & Deci, 2000) was positively related to intention, but reported no other findings related to intention. Chan and colleagues (2011) found that autonomy treatment motivated was related to intention.

Motivation. A number of studies (Chan & Hagger, 2012; Chan, et al., 2011; Chan, et al., 2009) have focused on looking at the potential influence that motivation has on adherence in rehabilitation through Self-Determination Theory (Ryan & Deci, 2000). Some of these

studies did not directly measure adherence, but looked at athletes' behaviour with regard to rehabilitation. Chan and Hagger (2012) in their combined Self-Determination Theory and Theory of Planned Behaviour model, reported that autonomous motivation was positively associated with intention as mediated by attitude, subjective norms and perceived behavioural control. Chan et al. (2009) found an indirect relationship with autonomy supportive behaviours on adherence and it accounted for 82% of the total effect. In addition, the study also reported that autonomous-support behaviours positively predicted (sic) treatment motivation and adherence was positively predicted (sic) by autonomous treatment motivation but was negatively predicted (sic) by controlled motivation.

Psychological skills. Goal setting accounted for 22% of the variance in adherence was related to home adherence and 14% in clinic adherence; self-talk was related to home adherence (Scherzer, et al., 2001). Imagery predicted task efficacy (1.8% of variance) which in turn predicted the quality of exercises (Milne, et al., 2005). Acceptance and Commitment Therapy (ACT) was used in a cohort study where an educational intervention based on ACT was used to aid rehabilitation and adherence. The authors found limited change as a result of the intervention but they did not measure adherence even though they intended to (Mahoney & Hanrahan, 2011).

Treatment efficacy. Brewer et al., (2003) reported in their study of using Protection Motivation Theory (Duda, et al., 1989) that treatment efficacy demonstrated the strongest association with clinic adherence and home adherence. Horvath et al. (2007) noted in their study that, over time, differences occurred between physiotherapist's and patient satisfaction. In their study around Personal Investment Theory (Duda, et al., 1989) the authors noted that up to 36% of the variance in adherence was accounted for by perceived options. Marshall et

al. (2012) reported the importance of the characteristics of physical therapists and the strategies used in impacting on adherence, as perceived by athletes.

Social support. The thematic phenomenological approach of one the studies (Levy, et al., 2009) identified that recreational athletes saw social support as an important factor in their adherence. Levy et al. (2008) noted that social support was related to attendance, clinic adherence and home adherence. Horvath et al. (2007) noted that social support satisfaction remained stable during the different phases of rehabilitation (acute, partial stress and total stress). Social support was seen as the best predictor of attendance (Duda, et al., 1989). Whilst Fields et al. (1995) and Albinson and Petrie (2003) both had social support as a variable they did not report any significant findings.

Discussion

This systematic review and narrative synthesis summarised the findings from 17 research papers which considered the psychological factors that may affect adherence to sport injury rehabilitation. Most of the studies were descriptive in nature and as such no causal factors regarding adherence were identified. Two studies employed a phenomenological inductive approach identifying a number of themes regarding how athletes give meaning to the context of sport injury rehabilitation. However, only one study sought to apply a specific psychological treatment to affect adherence. Fourteen of the quantitative studies used established psychological theories, models or single factors or they adapted them for the purpose of their investigation, many of which were based on psychosocial theory. Overall, the studies reviewed had a number of common methodical issues and none of the studies were rated as strong on the quality assessment.

Research Design Issues

The following were identified as the main issues for concern in these studies: (1) limited use of true experimental design to identify causality; (2) sampling and participant selection in order to identify and reduce confounding variables as well as understanding the potential transferability of findings due to homogenous or heterogeneous samples; (3) sample size in quantitative studies when a large number of variables have been used and a range of different sports are covered; (4) whilst the aim of qualitative studies is not to use large sample sizes, very small sample sizes are unlikely to be representative; (5) variability in the identification of psychometric properties of measures used to assess the psychological factors (the independent and dependent variables), as well as the modification of measures without consideration of retesting their psychological properties; (6) limited fidelity testing of interventions; over-reliance on self-report measures and limited use of triangulation (especially when non-experimental designs are used); (7) limited use of qualitative research designs or mixed methods; (8) limited control of inter-rater reliability when a number of different raters are used for assessing in the same study; (9) the use of retrospective designs.

Adherence

There appears to be a consistency of measurement of adherence to clinic rehabilitation in the form of SIRAS. However, whether studies have used this with a view to expediency and convenience or used it because of its psychometric properties and through a refined appreciation of which aspects of adherence are more or less important, is unclear. Similarly, it has been noted by researchers that there could be a difference in how patients view and rate adherence compared to practitioners and this is likely to have a bearing on the measures of adherence used.

In this review some researchers considered the study variables in light of three stages of rehabilitation - acute, partial stress, and full stress (Horvath, et al., 2007). Similarly,

history of injury and successful/unsuccessful rehabilitation could be a factor that needs to be considered, establishing patterns and themes at an individual level could be as informative as looking at the population level. Some studies have considered the perception of injury and the psychological impact and reaction to injury and how this may affect adherence (Daly, et al., 1995; Levy, et al., 2008). Some researchers have applied the grieving process (Kübler-Ross, 1969) to the stages of injury rehabilitation (Evans & Hardy, 1995). Trying to treat and motivate an athlete to adhere to a programme whilst they are still in shock and perhaps grieving may require a different approach and perhaps a different attitude from practitioners. In addition, treatment efficacy was seen as relating to adherence (Brewer, et. al., 2003). The inductive study of Marshall et al., (2012) highlighted that athletes saw the characteristics of physiotherapists and the strategies used by them as being key to their adherence. With this in mind, it is clear that all studies examined have focused on the personal factors of athletes with regard to adherence, yet perhaps a fruitful direction of future research could be to consider the characteristics of practitioners that achieve the best adherence results.

It is fairly well cited and accepted that there are two key components of adherence, personal and situational. However, it is unclear how much consideration has been given to the combinations of these two variables that may affect or mediate adherence behaviour; as well as the psychological factors involved in each and both. Similarly, how one athlete views visiting a practitioner may be different from another athlete and therefore exploring how athletes give meaning to rehabilitation environments and visiting clinics per se could be central to advancing our knowledge of what psychological factors (and therefore interventions) may facilitate adherence to sport injury rehabilitation, especially across levels of participation.

Scherzer et al. (2001) highlighted from their study the need to understand the difference between psychological traits and psychological skills in adherence. They saw that goal setting was related to adherence, but they stated that it was not clear whether the participants were innately driven (self-motivated) or had learned to work towards their rehabilitation goals. Similarly, they found the use of self-talk to be related to rehabilitation adherence at home, but they had not controlled for personality factors that may or may not predispose individuals to need to use self-talk or be able to. Perhaps understanding the dispositional factors or antecedents of adherence behaviours may allow for a more refined and accurate bespoke psychological intervention for successful adherence to rehabilitation.

Changing Behaviour

Only one study compared adherers and non-adherers. This line of study could be crucial to identifying whether there are fundamentally different psychological factors that cause adherence or non-adherence. With this in mind, although one study identified habit formation as being important it neglected to explore it fully. Certainly, the efficacy of using rewards or sanctions (or a combination of both) to encourage habitual adherence to injury rehabilitation appears to be a fruitful line of future research attention. Additionally, as the characteristics of physical therapists and the strategies they use have been identified by athletes as being potentially important to the athlete's adherence it is perhaps important for future research to consider practitioners' skills and athletes' education in habit formation, for example being clear on the target behaviour, the cue or trigger for this and how this is reinforced.

Pattern and Themes of Psychological factors

It is evident from the quality assessment of the research reviewed that there are a range of methodological issues that are likely to limit the generalisability and use of the findings. However, there were a number of statistically significant findings regarding the relationship between psychological factors and adherence to sport injury rehabilitation. Following the psychosocial overarching theme they appear to fall into two broad categories, person factors and situational factors. For example, person factors: Locus of control; self-efficacy and confidence; cognitive appraisal and coping; self-motivation and intent; motivation (could also be situational); and psychological skills. For situational factors the following were recurring themes: Treatment efficacy; social support; physical therapist characteristics. However, a difficulty in identifying actual patterns and themes was that some studies used models that incorporated a number of factors, some studies adapted these, or combined models and some studies used single or definitive factors. However, interestingly some of the themes identified above were reflective of the findings of the two qualitative studies which used a phenomenological inductive approach to identify how athletes give meaning the context of sport injury rehabilitation and what factors are likely to be important to adherence. Levy et al., (2009) identified five psychological factors: Motivation; confidence; coping; social support; pain. Marshall et al., (2012) summarised their findings as: impact of injury (psychological and physical); justification of adherence; strategies used; characteristics of the physical therapist; and the strategies used by the physical therapist. Both of these studies, similar to the quantitative studies identified personal and situational factors.

Limitations of this review

Whilst this systematic review largely followed guidance of PRISMA, HTA and EPHPP there are some limitations that should be considered when interpreting its findings.

Only three main databases were used in the literature search and it should be kept in mind that additional research papers may be identified by using additional databases. Only English language studies were included. Finally, it was the intention of this systematic review to look specifically at the psychological factors that may affect sport injury rehabilitation; it was clear from the literature search that there was more research on rehabilitation adherence outside of the sport domain than within it; however, potentially using this research could cause issues of generalisability whilst being informative around psychological factors important in other contexts.

Implications for Practitioners

For physical therapists, sport psychologists, coaching or sport governance staff, all have different motivations for an emphasis on successful injury rehabilitation. The present review suggests that there are a number of psychosocial variables for consideration when assessing an athlete's approach to adherence to rehabilitation. Although primarily there to address the physical nature of injuries, physiotherapists, medics and physical therapists are advised to work closely with a sport psychologist to gain an insight into the mental dimension of rehabilitation. If properly trained and briefed these personnel may be useful deliverers or reinforcers for psychological interventions (e.g., goal setting, imagery) that could enhance the rehabilitation experience. In more broad terms, there is certainly a need for physiotherapists, medics and physical therapists to be trained in the personal and situational factors that have been shown to impact on adherence to injury rehabilitation – if only to enhance their collective contextual intelligence in this domain.

Future Recommendations

A more stringent research design for studies investigating adherence to injury rehabilitation is recommended to improve: (1) the ability to understand the causal factors; (2) to reduce confounding variables; (3) to enhance the transferability of findings and (4) to generate some consistency at least with the use of standard measures. In addition, a better triangulation of data, longitudinal studies and a more stringent testing of interventions is likely to generate a body of work to help us understand more comprehensively how to continue to meet the physical and psychological needs of injured athletes.

Conclusion

In conclusion, whilst there is some consistency in the psychological factors researched as seen above, the findings of the research are somewhat fragmented both across studies and within studies in addition psychological factors or variables were often embedded within different psychological theories/theoretical frameworks/models as well as being measured differently by using different psychometric tools/measures. Combined with the research methodological issues of the studies, as outlined earlier, it is difficult to present a definitive conclusion based on such an eclectic set of studies investigating this issue.

References

Ajzen, I. (1988). *Attitudes, personality, and behaviour*. Chicago: Dorsey Press.

Ajzen, I. (1991). The theory of planned behaviour. *Organisation Behavior and Human Decisions, 50*, 179-211.

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behaviour. Englewood Cliffs, NJ: Prentice-Hall.

Albinson, C. P. T. (2003). Cognitive appraisals, stress and coping: Preinjury and postinjury factors influencing psychological adjustment to sport injury. *Journal of Sport Rehabilitation, 12*, 306-322.

Albinson, C. B., & Petrie, T. A. (2003). Cognitive appraisals, stress, and coping: Preinjury and postinjury factors influencing psychological adjustment to sport injury. *Journal of Sport Rehabilitation, 12*, 306-322.

Arvinen-Barrow, M., & Clement, D. (2017). Preliminary investigation into sport and exercise psychology consultants' views and experiences of an interprofessional care team approach to sport injury rehabilitation. *Journal of Interprofessional Care, 31*, 66-74.

Arvinen-Barrow, M., Clement, D., Hamson-Utley, J. J., Zakrajsek, R. A., Lee, S.- M., Kamphoff, C.,… Martin, S. B. (2015). Athletes' use of mental skills during sport injury rehabilitation. *Journal of Sport Rehabilitation, 24*, 189-197. https://doi.org/10.1123/jsr.2013-0148

Arvinen-Barrow, M., Massey, W. V., & Hemmings, B. (2014). Role of sport medicine professionals in addressing psychosocial aspects of sport-injury rehabilitation: Professional athletes' views. *Journal of Athletic Training, 49*, 764–772. http://dx.doi.org/10.4085/1062-6050-49.3.44

Brewer, B., Cornelius, A., Van Raalte, J., Petitpas, A., Sklar, J., Pohlman, M.,…Ditmar, D. D. (2000). Attributions for recovery and adherence to rehabilitation following anterior cruciate ligament reconstruction: A prospective analysis. *Psychology & Health, 15*, 283-291. https://doi.org/10.1080/08870440008400307.

Brewer, B., Cornelius, A., Van Raalte, J., Petitpas, A., Sklar, J., Pohlman, M., et al. (2003). Protection motivation theory and adherence to sport injury rehabilitation revisited. *The Sport Psychologist, 17*, 95-103.

Brewer, B., Cornelius, A., Van Raalte, J., & Tennen, H. (2017). Adversarial growth after anterior cruciate ligament reconstruction. *Journal of Sport & Exercise Psychology, 39*, 134–144. http://dx.doi.org/10.1123/jsep.2016-0210

Brewer, B., Jeffers, K., Petitpas, A., & Van Raalte, J. (1994). Perceptions of psychological interventions in the context of sport injury rehabilitation. *The Sport Psychologist, 8*, 176-188.

Chan, D., & Hagger, M. (2012). Self-determined forms of motivation predict sport injury prevention and rehabilitation intentions. *Journal of Science and Medicine in Sport*, 5, 398-406. https://dx.doi.org/10.1016/j.jsams.2012.03.016

Chan, D., Hagger, M., & Spray, C. (2011). Treatment motivation for rehabilitation after a sport injury: Application of the trans-contextual model. *Psychology of Sport and Exercise, 12*, 83-92.

Chan, D., Lonsdale, C., Ho, P. Y., & Chan, K. (2009). Patient motivation and adherence to post-surgery rehabilitation exercise recommendations: The influence of physiotherapists' autonomy-supportive behaviours. *Archive of Physical Medicine Rehabilitation, 90*, 1977-1982. https://dx.doi.org/10.1016/j.apmr.2009.05.024.

Clement, D., Arvinen-Barrow, M., & Fetty, T. (2015). Psychosocial responses during different phases of sport-injury rehabilitation: A qualitative study. *Journal of Athletic Training, 50*, 95–104. https://dx.doi.org/10.4085/1062-6050-49.3.52

554 Daly, J., Brewer, B., Van Raalte, J., Petitpas, A., & Sklar, J. (1995). Cognitive appraisal,
555 emotional adjustment, and adherence to rehabilitation following knee surgery.
556 *Journal of Sport Rehabilitation,* 4, 23-30.

557 Deeks, J., Dinnes, J., Di'Amico, R., Sowden, A., Sakarovitch, C., Song, F., et al. (2003).
558 Evaluating non-randomised intervention studies. *Health Technology Assessment, 7,* 1-
559 173.

560 Duda, J., Smart, A., & Tappe, M. (1989). Predictors of adherence in rehabilitation of athletic
561 injuries: An application of personal investment theory. *Journal of Sport & Exercise*
562 *Psychology, 11,* 367-381.

563 Evans, L., & Hardy, L. (1995). Sport injury and grief responses: A review. *Journal of Sport*
564 *& Exercise Psychology, 17,* 227-245.

565 Fields, J., Milledge, M., Horodyski, M., & Stopka, C. (1995). Factors associated with
566 adherence to sport injury rehabilitation in college-age recreational athletes. *Journal of*
567 *Sport Rehabilitation, 4,* 172-180.

568 Fishbein, M. (1967). A behaviour theory approach to the relation between beliefs about an
569 object and the attitude toward the object. In M. Fishbein (Ed.), *Readings in attitude*
570 *theory and measurement*. New York: John Wiley.

571 Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behaviour: An introduction to*
572 *theory and research*. Reading: Addison-Wesley.

573 Forsdyke, D., Smith, A., Jones, M., & Gledhill, A. (2016). Psychosocial factors associated
574 with outcomes of sports injury rehabilitation in competitive athletes: a mixed studies

575 systematic review. *British Journal of Sports Medicine, 50,*
576 http://dx.doi.org/10.1136/bjsports-2015-094850

577 Hamson-Utley, J., Martin, S., & Walters, J. (2008). Athletic trainers' and physical therapists'
578 perceptions of the effectiveness of psychological skills within sport injury
579 rehabilitation programs. *Journal of Athletic Training, 43,* 258-264.
580 http://dx.doi.org/10.4085/1062-6050-43.3.258

581 Hickey, J., Shield, A. J., Williams, M. D., Opar, D. A. (2014). The financial cost of hamstring
582 strain injuries in the Australian Football League. *British Journal of Sports Medicine,*
583 *48*, 729–730. http://dx.doi.org/10.1136/bjsports-2013-09288

584 Horvath, S., Birrer, D., Meyer, A., Moesch, K., & Seiler, R. (2007). Physiotherapy following
585 a sport injury: Stability of psychological variables during rehabilitation. *International*
586 *Journal of Sport and Exercise Psychology, 5,* 370-386.

587 Hupperets, M., Verhagen, E., Heymans, M., Bosmans, J. E., van Tulder, M. W., & van
588 Mechelen W. (2010). Potential savings of a program to prevent ankle sprain
589 recurrence: economic evaluation of a randomized controlled trial. *American Journal*
590 *of Sports Medicine, 38,* 2194-2200. https://doi.org/10.1177/0363546510373470

591 Kübler-Ross, E. (1969). *On death and dying*. New York, NY: Macmillan.

592 Krist, M. R., van Beijsterveldt, A. M. C., de Wit, G. A., & Backx, F. J. G. (2013). Preventive
593 exercises reduced injury-related costs among adult male amateur soccer players: A
594 cluster-randomised trial. Journal of Physiotherapy, 59, 15-23.
595 https://doi.org/10.1016/S1836-9553(13)70142-5

Levy, A., Polman, C., & Clough, P. (2008). Adherence to sport injury rehabilitation programs: an integrated psycho-social approach. *Scandinavian Journal of Medical Science Sports, 18*, 798-809.

Levy, A., Polman, R., Nicholls, A., & Marchant, D. (2009). Sport injury rehabilitation adherence: Perspectives of recreational athletes. *International Journal of Sport and Exercise Psychology, 7*, 212-229.

Maehr, M. L., & Braskamp, L. A. (1986). The motivation factor: A theory of personal investment. Lexington, MA: Lexington Books.

Mahoney, J., & Hanrahan, S. (2011). A brief educational intervention using Acceptance and Commitment Therapy: Four injured athletes' experiences. *Journal of Clinical Sport Psychology*, 5, 252-273.

Marshall, A., Donovan-Hall, M., & Ryall, S. (2012). An exploration of athletes' views on their adherence to physiotherapy rehabilitation after sport injury. *Journal of Sport Rehabilitation, 21*, 18-25.

Marshall, D., Lopatina, E., Lacny, S., & Emery, C. A. (2016). Economic impact of a neuromuscular training prevention strategy to reduce injuries in youth soccer. *British Journal of Sports Medicine, 50*, 1388-1393. http://dx.doi.org/10.1136/bjsports-2015-095666

Milne, M., Hall, C., & Forwell, L. (2005). Self-efficacy, imagery use, and adherence to rehabilitation by injured athletes. *Sport Rehabilitation, 14*, 150-167.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. (2009). Preferred reporting items for systematic reviews and meta-analysis (PRISMA). *PLoS Med, 6.*

Murphy, G., Foreman, P., Simpson, C., Molloy, G., & Molloy, E. (1999). The development of a locus of control measure predictive of injured athletes' adherence to treatment. *Journal of Science and Medicine in Sport, 2*, 145-152.

Ninedek, A., & Kolt, G. (2000). Sport physiotherapists' perceptions of psychological strategies in sport injury rehabilitation. *Journal of Sport Rehabilitation, 9*, 191-206.

Parkkari, J., Kujala, U. M., & Kannus, P. (2001). Is it possible to prevent sports injuries? Review of controlled clinical trials and recommendation for future work. *Sports Medicine, 31*, 985-995.

Rees, T., Mitchell, I., Evans, L. & Hardy, L. (2010). Stressors, social support and psychological responses to sport injury in high- and low-performance standard participants. *Psychology of Sport & Exercise, 11*, 505-512.

Rogers, R.W. (1975). A protection motivation theory of fear appeals, and attitude change 1. *The Journal of Psychology, 91*, 93-114.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68-78.

Scherzer, C., Brewer, B., Cornelius, A., Van Raalte, J., Petitpas, A., Sklar, J.,…Ditmar, .D. (2001). Psychological skills and adherence to rehabilitation after reconstruction of the anterior cruciate ligament. *Journal of Sport Rehabilitation, 10*, 165-172.

Schiffer, D. E., & Ajzen, I. (1985). Intention, perceived control and weight loss: An application of the theory of planned behaviour. *Journal of Personality and Social Psychology, 49*, 843–851.

639 Thomas, B. H., Ciliska, D., Dobbins, M., & Micucci, S. (2004). A process for systematically
640 reviewing the literature: Providing the research evidence for public health nursing
641 interventions. *Worldviews on Evidence-Based Nursing, 1*, 176-184.
642 http://dx.doi.org/10.1111/j.1524-475X.2004.04006.x

643 Walker, N., Thatcher, J., & Lavallee, D. (2007). Psychological responses to injury in
644 competitive sport: A critical review. *The Journal of the Royal Society for the*
645 *Promotion of Health, 127*, 174-180.

646 Wiese-Bjornstal, D. M., Smith, A. M., Shaffer, S. M., & Morrey, M. A. (1998). An integrated
647 model of response to sport injury: Psychological and sociological dynamics. *Journal*
648 *of Applied Sport Psychology, 10,* 46-69.

649