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

Article to be cited as:

Goddard, K., Roberts, C.-M., Byron-Daniel, J. Z., & Woodford, L. (2020). Psychological factors involved in adherence to sport injury rehabilitation: A systematic review. *International Review of Sport & Exercise Psychology*. <https://doi.org/10.1080/1750984X.2020.1744179>

Disclosure statement: No potential conflict of interest was reported by the authors.

Data availability statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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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

42 A range of authors have reported the societal (Brewer et al., 2003; Duda, Smart, &
43 Tappe, 1989; Murphy, Foreman, Simpson, Molloy, & Molloy, 1999), psychological and
44 emotional impact (e.g., Rees, Mitchell, Evan, & Hardy, 2010) and the substantial financial
45 costs of sport injury (e.g., Hickey, Shield, Williams, Opar, 2014; Hupperets, Verhagen,
46 Heymans, Bosmans, van Tulder, van Mechelen, 2010; Krist, van Beijsterveldt, de Wit, &
47 Backx, 2013; Marshall, Lopatina, Lacny, & Emery, 2016; Parkkari, Kujala, & Kannus,
48 2001). Due to the high cost of these incidences, non-adherence to rehabilitation amongst
49 athletes is reported to be a key issue in the eyes of practitioners and sport administrators
50 (Brewer, Jeffers, Petitpas, & Van Raalte, 1994; Hamson-Utley, Martin, & Walters, 2008;
51 Ninedek & Kolt, 2000) which further exacerbates its impact. Early research in adherence to
52 sport injury rehabilitation led scholars to label it as “atheoretical” (Levy, Polman & Clough,
53 2008, p.798) and call for the use of psychosocial theoretical frameworks to help advance
54 knowledge. Since this suggestion, psychosocial frameworks have been applied to the study
55 of rehabilitation adherence, for example: The Integrated Model for Response to Sport Injury
56 (Wiese-Bjornstal, Smith, Shaffer & Morrey, 1998) and the Adapted Planned Behaviour
57 Model (e.g., Levy et al., 2008). The Integrated Model for Response to Sport Injury (Wiese-
58 Bjornstal et al., 1998) purports to explain how athletes respond psychologically to injury and
59 is considered the most comprehensive attempt to represent psychological responses to sport
60 injury and their antecedents conceptually (Brewer, Cornelius, Van Raalte, & Tennen, 2017).
61 This model splits the factors relating to injury and injury rehabilitation adherence into
62 personal and situational (Marshall, Donovan-Hall, & Ryall, 2012). Personal factors include
63 injury characteristics (e.g., severity, type) and individual difference variables in the
64 psychological (e.g., personality, motivation, identity), demographic (e.g., age, gender), and
65 physical (e.g., health status, eating behaviour) domains. Situational factors pertain to aspects
66 of the sport (e.g., level of competition, time of the competitive season), social (e.g., family

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

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

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

91 athletes who rely on sport for their livelihood, or are hoping to do so in the future, the stakes
92 are potentially much higher and therefore the impact of injury may be substantially different
93 (Levy, Polman, Nicholls, & Marchant, 2009). Forsdyke, Smith, Jones and Gledhill (2016)
94 conducted a systematic review into studies investigating the relationship between
95 psychosocial factors and rehabilitation outcomes in competitive athletes (they focused on the
96 perceived success of rehabilitation rather than adherence to rehabilitation per se). This review
97 reported that a range of psychosocial factors were associated with rehabilitation outcomes,
98 specifically cognitive, emotional and behavioural. The authors' interpretation of
99 rehabilitation success was undefined. Additionally, research by Clement, Arvinen-Barrow
100 and Fetty (2015) documents the psychosocial response athletes go through when in
101 rehabilitation, with frustration initially being experienced, then moving to nervousness and
102 fear of re-injury. These cognitive appraisals of the injury led to participants seeking out social
103 support from a range of people (family, significant others, support staff) in order to manage
104 their emotions through the different phases of their rehabilitation. A further series of studies
105 conducted by Arvinen-Barrow and colleagues (e.g., Arvinen-Barrow, Massey, & Hemmings,
106 2014; Arvinen-Barrow et al., 2015; Arvinen-Barrow & Clement, 2017) have investigated
107 many dimensions and factors related to the complex issue of adherence to rehabilitation in
108 athletes. For example, Arvinen-Barrow, Massey and Hemmings (2014) found that despite
109 athletes accepting injuries as part of their 'job', common feelings associated with
110 rehabilitation included feelings of frustration and self-doubt throughout the process, as well
111 as rehabilitation professionals being primarily seen as being there to address physical
112 concerns, with any psychological intervention needing to be subtle and indirect. It has also
113 been reported that some athletes appear to use mental skills such as goal setting, imagery and
114 self-talk to aid the rehabilitation process, although significantly more do not (Arvinen-Barrow
115 et al., 2015). Few of the psychological skills are taught to athletes by a sport psychologist.

140 **Search Strategy**

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

158 **Inclusion and Exclusion Criteria**

159
160 Abstracts were subjected to the following inclusion/exclusion criteria: Included abstracts had
161 to contain the terms Psychological/ Psychology AND Adherence/compliance AND Injury or
162 Sport Injury AND Rehabilitation (treatment) AND Athletes/ Competitors/ Players. At this
163 stage of abstract review, a certain amount of latitude was given in order not to reject

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

166 **Data Extraction, Quality Assessment and Synthesis**

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

181 **Results**

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

187 - most were therefore descriptive, with one using a cohort design. As could be expected from
188 the nature of these studies, no study reported the use of a control or comparison group. Only
189 two studies endeavoured to use mixed measures to triangulate data on either the independent
190 or dependent variables (Albinson & Petrie, 2003 and Chan et al., 2011). Across the 17
191 studies there was a mix of prospective, retrospective and cross-section designs. None of the
192 articles reported on blinding, excluding Murphy et al., (1999). The majority of studies bar one
193 (Albinson, 2003) did not report on withdrawals. All studies excluding one (Fields et al.
194 1995) were rated moderate on the use of psychological theory in the quality assessment
195 rating. All studies bar two (Mahoney & Hanrahan 2011 and Daly et al. 1995) were rated
196 weak on the 'participants/population' aspect of the quality assessment.

197 ****Table 1 about here****

198 **Participants**

199 No studies scored strongly on the level of detail provided on participants, thus
200 limiting or restricting the identification of selection bias and confounding factors. Largely,
201 the type of injuries were reported in sufficient detail. These were predominantly sprains,
202 strains and ligament injuries. The type of sports was not always reported (eight studies) and
203 for five studies the number and range of types of sports included within each study were
204 large, especially in comparison to the sample size. Only one study (Chan, Hagger, & Spray,
205 2011) included a power rating for the study within the statistical analysis. There was limited
206 evidence across the studies that authors had tried to identify potential confounding variables
207 within their sample. Overall, the studies appeared to feature convenience samples, even
208 though the nature of the sample was rarely reported, one study reported the aim of having a
209 purposive sample but due to poor response they adopted a convenience sample (Fields,

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

212 **Psychological Factors/Theories/Models**

213 There was no distinct consistency between the studies with regard to the theory or
214 model used, apart from the overarching use of a psychosocial perspective. There were some
215 recurring themes across the studies, however these were in part generated by the same groups
216 of authors publishing different papers on the same subject (Chan et al., 2011; Chan &
217 Hagger, 2012; Chan, Lonsdale, Ho, & Chan, 2009). Another recurring theme was that of
218 attributions and locus of control; whilst the two are conceptually different (attributions
219 backward looking and locus of control forward looking), four causal dimensions (Locus of
220 Control Causation, Stability, Personal Control, External Control) were explored (Brewer, et
221 al., 2000); others considered the three factor conception of Locus of Control (Internal,
222 Powerful Others and Chance) (Murphy, et al., 1999). Two studies (Albinson & Petrie, 2003;
223 Horvath, et al., 2007) were based on the Integrated Model of Psychological Responses to
224 Sport Injury (Wiese-Bjornstal et al., 1998) which covers a range of psychological
225 dimensions; however, the two studies did not measure the same dimensions and the
226 dimensions that were consistent were not measured in the same way. Another recurring
227 theme was cognitive appraisal and emotional response/control, which was implicit in Wiese-
228 Bjornstal and colleagues' model (Wiese-Bjornstal et al., 1998) and implicit within Protection
229 Motivation Theory (Rogers, 1975) utilised by Brewer et al., (2003). One study focused on
230 cognitive appraisal as the primary model (Daly, Brewer, Van Raalte, Petitpas, & Sklar,
231 1995). Self-efficacy was also a focus of a number of studies, either as the main focus (Milne,
232 Hall, & Forwell, 2005) or implicit within the main theory/model used, for example Duda et
233 al., (1989) in their use of Personal Investment Theory (Maehr & Braskamp, 1986) and Levy

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

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

250 **Outcomes**

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

258 (2011) both used a hypothetical injury scenario and had no adherence measure; in another
259 study by the same main author (Chan et al., 2009) participants were asked to recall
260 retrospectively their adherence based on an adapted adherence questionnaire that had not
261 been psychometrically validated. There was some consistency in the measurement of
262 adherence across the studies with regard to clinic adherence: eight studies used the Sports
263 Injury Rehabilitation Adherence Scale questionnaire (SIRAS: Brewer, et al., 2000).
264 Practitioners rate injured athletes on three items (five point Likert scale): (1) Intensity (min
265 effort/max effort), (2) frequency of following instruction and advice (never/always), (3)
266 receptivity to changes in previous weeks' programme (unreceptive/very receptive), and the
267 items were summed. Generally, a frequently used measure of adherence in clinic reported by
268 third parties was attendance ratio, which was defined as the number of attended sessions
269 divided by the number of scheduled sessions and represented as a percentage.

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

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

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

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

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

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

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

316 **Intention.** As part of planned behaviour (Theory of Planned Behaviour and the
317 Adapted Planned Behaviour Model), intention was found to relate to clinic attendance ($r=$
318 $.41$) and clinic adherence and home adherence (Levy et al., 2008). It was also found that it
319 fully mediated the effects of perceived severity, learning goal orientation and attitude, with
320 regard to clinic based adherence. Horvath et al. (2007) reported that, unusually, intention
321 remained stable through the three phases of rehabilitation. According to Chan and Hagger
322 (2012), an unexpected finding in their study was that control motivation (as part of Self
323 Determination Theory; Ryan & Deci, 2000) was positively related to intention, but reported
324 no other findings related to intention. Chan and colleagues (2011) found that autonomy
325 treatment motivated was related to intention.

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

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

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

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

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

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

362 **Discussion**

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

374 **Research Design Issues**

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

389 **Adherence**

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

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

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

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

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

431 **Changing Behaviour**

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

443 **Pattern and Themes of Psychological factors**

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

465 **Limitations of this review**

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

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

476 **Implications for Practitioners**

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

489 **Future Recommendations**

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

497 **Conclusion**

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

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