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Review article

Psychological Assessment Tools Utilized in Sports Injury Treatment Outcomes Research: A Review

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Abstract
The use of self-report psychological assessment tools in outcomes research has become increasingly frequent, though many sports medicine providers and researchers are unfamiliar with these instruments. We conducted a systematic search of the sports medicine literature in PubMed, Scopus, SPORTDiscus, and Google Scholar of studies published on or before November 1st, 2019. Included psychological self-assessment tools were limited to those in a written self-assessment format and were used in musculoskeletal sports injury or concussion treatment outcome studies. Both pre- or post-treatment psychological assessments were included. Thirty-four assessment scales of psychological factors were utilized across 152 sports injury treatment outcomes studies. Six assessment tools were utilized in 5 or more studies and the remaining 28 were utilized in 4 or fewer studies. Many of the utilized scales have adequate assessment and reporting of internal consistency reliability, supporting further reliability and validation studies for use in sports injury treatment outcomes research.

Key words: Psychological factors, sports injuries, assessment tools, systematic review.

Introduction

Many psychological factors influence an injured athlete's perception of symptom severity (Domenech et al., 2014), ability to rehabilitate from injury (Levy et al., 2008), and ability to return to sport (Ardern et al., 2012). Psychological factors such a high optimism (Brewer et al., 2006; Thomee et al., 2006), self-motivation (Brewer et al., 2003), athletic self-identity (Brewer and Cornelius, 2010), and perceived social support (Brewer et al., 2003; Brewer et al., 2000) positively impact injury rehabilitation and return to sport. Alternatively, psychological factors such as high levels of kinesiophobia (Domenech et al., 2013; Kvist et al., 2005), pain catastrophizing (Domenech et al., 2014), and depressive symptoms (Galambos et al., 2005) can negatively impact sports injury treatment outcomes.

With the growing body of evidence linking psychological measures to sport injury treatment outcomes, there is a need for sports medicine clinicians and researchers to familiarize themselves with psychological assessments used in the context of sports medicine injury treatment. Though the concepts are often intuitive, sports medicine providers may be unfamiliar with assessment tools used to measure psychological factors. This lack of familiarity makes it difficult to critically assess new literature in this area or to employ the assessment tools in practice. Self-report measures are advantageous in that they are simple to administer and are the most common method used to assess psychological factors in sports medicine literature. However, it is first essential to confirm that the tool has adequate internal consistency (a measure of internal reliability) prior to performing further validation studies (John and Soto, 2007) or utilizing the tool in a clinical context.

The primary aim of this review is to identify all self-report psychological assessment tools and specific psychological traits investigated in sports-related musculoskeletal injury or concussion treatment outcomes studies reported in the English literature. A secondary aim is to identify the proportion of these assessment tools with adequate internal consistency, which can be utilized as a starting point for evaluation since it is a single, consistently reported reliability metric.

Methods

A systematic search was performed with reporting of results per PRISMA guidelines (Figure 1)(Moher et al., 2009). A search of relevant studies published from 1950 (earliest indexed article that met our search terms) to November 1st, 2019 was initially performed on PubMed. Initial PubMed MESH terms used were ([psychological outcomes] OR [psychological measures]) AND ([sports medicine] OR [sports injury] OR [ACL] OR [knee] OR [ankle] OR [shoulder] OR [back] OR [hip] OR [elbow] OR [concussion]) which yielded 2759 human studies reported in English. Searches were then performed in Google Scholar, Scopus, and SPORTDiscus as well as review of citations used in relevant studies to identify an additional 119 studies (n = 878 total). The searches were performed independently by two authors with review of all discrepant selections by a third author. Studies were reviewed for predetermined inclusion criteria, including report of a sports injury treatment outcomes study, use of a self-report psychological assessment tool before and/or after injury treatment, and a requirement of publication in English in a peer-reviewed journal (Table 1). The database searches yielded a total of 2878 studies. A total of 2612 studies were excluded due to clear failure to meet 1 or more inclusion criteria based on the content of the study title or abstract alone. The entire manuscripts of the remaining 266 studies were reviewed, resulting in exclusion of a further 114 studies. This yielded a total of 152 sports-related injury out a pre-treatment or post-treatment, self-report psychological assessment tool. For this review, a self-report assessment

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tool was defined as one available in paper or electronic format that is completed by the patient with or without supervision of clinical staff. None of the included psychological assessment tools required completion by an individual other than the patient. Scoring could occur via manual scoring (scoring by hand) or with the use of automated scoring tools.

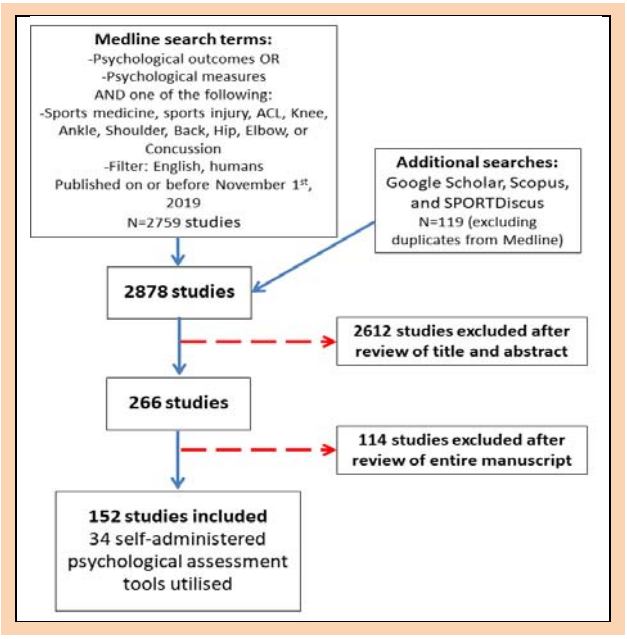

Figure 1. **PRISMA flowchart of systematic search strategy.** An initial Medline search as well as searches of GoogleScholar, Scopus, and SportDiscus yielded 2338 studies for potential inclusion. After review of studies for inclusion criteria, 152 sports injury treatment outcome studies were identified with either a pre- or post-treatment psychological assessment. Among these studies, 35 unique self-report psychological assessment tools were utilized.

A total of 34 unique self-report psychological tools were identified that were employed either pre-intervention or post-intervention in a musculoskeletal sports injury or concussion treatment study. After identifying all self-report psychological assessment tools, citations for the original publication describing the assessment tool, and, as available, the initial validation studies, were compiled.

The validity of a scale is limited by its reliability (John and Soto, 2007); thus, it is essential to determine that a scale is reliable before determining validity. A key measure of reliability for self-report measures is internal consistency; often reported as Cronbach's alpha, this is a measure of the correlation between different items within the same assessment tool. A higher value implies that individual items in a scale or subscale are measuring the same psychological trait. The recommended minimum value for Cronbach's alpha is 0.70 (Bland and Altman, 1997; DeVellis, 2016; Nunnally and Bernstein, 1994), and the number of assessment tools with internal consistency (both in whole and all subscales) above 0.70 and 0.80 were determined.

Results were organized by 1) psychological traits that generally have a "positive" influence on treatment outcomes into categories based on the factors or traits being assessed including personality traits (n = 2 tools); self-motivation (n = 3); coping strategies (n = 2); perceived social support (n = 2); athletic self-identity (n = 1); and optimism and self-efficacy (n = 5), 2) traits that have "negative" influence on outcomes including fear-avoidance of pain or movement (n = 5 tools); psychological distress (n = 5); and depressed mood (n = 8), as well as 3) general measures of mental-health related quality of life (n = 2). Finally, the most commonly utilized self-report psychological assessment tools, defined as those that were utilized in more than 5 sports medicine injury outcomes studies, were identified and summarized.

Table 1. Inclusion criteria.

Studies investigating treatment outcomes in a sport-related injury population. • Sports-related musculoskeletal injuries or concussions included • The study must report the outcomes of a surgical or non-surgical treatment of a sport-related injury • No minimum length of follow-up
At least one of the pre- or post-treatment factors being studied is based upon a psychological assessment tool • The psychological assessment was performed pre-treatment or post-treatment • The psychological assessment tool is self-administered in either paper or electronic format
The research is reported in an English, peer-reviewed manuscript • Retrospective studies, prospective studies, and case series were included • Minimum 5 patients required for inclusion • Abstracts and posters excluded.

Results

A total of 34 distinct self-report psychological assessment tools used across 152 studies were identified within the sports medicine literature pertaining to treatment of concussions or injuries of the shoulder, elbow, knee, hip, ankle, or foot. The median number of items per scale was 20 (range: 4 to 567, lengths of each individual assessment tool are listed in Table 2). Assessments of psychological traits that generally have a "positive" influence on treatment outcomes (n =15 tools) included personality traits (n =2 tools); self-motivation (n = 3); coping strategies (n = 2); perceived social support (n = 2); athletic self-identity (n = 1); and optimism and self-efficacy (n = 5). Assessments of psychological traits that have a "negative" influence on outcomes (n = 17 tools) including fear-avoidance of pain or movement (n = 4 tools). Finally, two self-report psychological assessment tools for general mental-health related quality of life were identified.

Internal consistency was reported for the whole scale and all subscales of 31 of 34 (91%) assessment tools.

The three assessment tools without demonstrated internal consistency of all or part of the assessment tool are the Psychovitality Scale (no data reported) (Gobbi and Francisco, 2006), the Emotional Responses of Athletes to Injury Questionnaire (ERAIQ) (no data reported)(Smith et al., 1990), and the ACL deficiency Quality of Life scale (ACL-QoL) (no data reported for subscales; total scale internal consistency reported as $\alpha = 0.93$)(Mohtadi, 1998).

Of the 34 assessment tools, 28 (82%) met the cutoff of $\alpha \geq 0.70$ for adequate internal consistency of both the whole scale and each subscale (12 tools (35%) had an α between 0.70-0.79 and 16 tools (47%) had an $\alpha \geq 0.80$). Three assessment tools with adequate reporting of internal consistency failed to meet a minimum internal consistency of $\alpha = 0.70$ for the total scale or one or more subscales; these included the Sports Injury Rehabilitation Beliefs Survey (SIRBS) severity subscale ($\alpha = 0.52$) (Taylor and May, 1996), the Illness Perception Questionnaire- Revised (IPQ-R) (subscales $\alpha = 0.67$-0.89) (Moss-Morris et al., 2002), and the Swedish universities Scales of Personality (SSP) social desirability subscale ($\alpha = 0.59$) (Gustavsson et al., 2000).

Six psychological assessment tools have been utilized in 5 or more sports injury treatment outcome studies: the Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995), Tampa Scale for Kinesiophobia (TSK) (Huang et al., 2019; Kori et al., 1990) and TSK-11 (Woby et al., 2005)), Sports Injury Rehabilitation Beliefs Survey (SIRBS) (Taylor and May, 1996), Beck Depression Inventory Fast Screen (BDI-FS) (Steer et al., 1999), Emotional Responses of Athletes to Injury Questionnaire (ERAIQ) (Smith et al., 1990), Short Form 36 Questionnaire Mental Health Component (SF-36 MCS) (Ware Jr and Sherbourne, 1992).

Personality traits

The link between personality measures and sports injury treatment outcomes is not commonly investigated (Table 2). Two scales of personality trait, The Minnesota Multiphasic Personality Inventory (MMPI) (Hathaway and McKinley, 1940) (since revised to MMPI-2 and MMPI-2-RF)(Hathaway et al., 1989) and the Swedish Universities Scale of Personality (SSP) (Gustavsson et al., 2000) have been utilized in a sports medicine context (Swirtun and Renström, 2008; Wise et al., 1979), with internal consistency of subscales ranging from 0.59-0.92 and length ranging from 91-567 items.

Self-motivation

Self-motivation is the ability to initiate activity without the influence of others (Dishman and Ickes, 1981). Three scales, the ACL Return to Sport after Injury Scale (ACL-RSI)(Webster et al., 2008), the Self-Motivation Inventory (SMI)(Dishman and Ickes, 1981), and the Psychovitality Scale (Gobbi and Francisco, 2006) have been applied in a sports injury context(Ardern et al., 2014; Brewer et al., 2000; Gobbi and Francisco, 2006; Langford et al., 2009). (Table 2) with internal consistency ranging from 0.91-0.92 (though no internal consistency data reported for the Psychovitality Scale) and length ranging from 6-40 items.

Coping

Coping refers to the strategies and mechanisms patients use in adjusting to the psychological, physical, and emotional stress related to their injury and rehabilitation (Carver, 1997). The Brief Coping Orientation to the Problem Experience inventory (Brief COPE) (Carver, 1997) and Acceptance and Action Questionnaire (AAQ) (Carver, 1997) have been applied in a sports injury context(Ardern et al., 2014; Baranoff et al., 2015; Brewer et al., 2000; Gobbi and Francisco, 2006; Langford et al., 2009; Rosenberger et al., 2009). Length ranges from 9-28 items with internal consistency ranging from 0.70-0.84.

Social support

Social support refers to the network of assistance from others and from the patient's environment (Sarason et al., 1987) (Table 2). The Social Support Questionnaire (SSQ) 27-item (Sarason et al., 1987), and 7-item versions (Furukawa et al., 1999)) and Social Support Inventory (SSI) (Brown et al., 1988) have been utilized in a sports injury context (Brewer and Cornelius, 2010; Brewer et al., 2003; Brewer et al., 2000; Cohen and Wills, 1985; Covassin et al., 2014). Length ranges from 7-39 items with internal consistency ranging from 0.79-0.94.

Athletic Identity

Athletic identity is the degree to which an individual identifies with the athlete role and looks to others for acknowledgement of that role (Brewer et al., 1993). The Athletic Identity Measurement Scale (AIMS) is a 7-item assessment of the degree to which being an athlete is central to a self-identity (Table 2) (Brewer and Cornelius, 2001) with an internal consistency of 0.81 and has been utilized for ACL injury research (Brewer and Cornelius, 2010).

Optimism and Self-Efficacy

Self-efficacy is the extent to which people believe they are capable of performing specific behaviors in order to attain certain goals (Bandura and Ramachaudran, 1994). Self-efficacy in the context of task completion for rehabilitation, and optimism regarding treatment outcomes are important variables in the orthopedic sports medicine literature (Ardern et al., 2014; Chmielewski et al., 2011; Rosenberger et al., 2009; van Wilgen et al., 2010) with multiple measures utilized to study these two factors (Table 2). The Sports Injury Rehabilitation Beliefs Survey (SIRBS) (Taylor and May, 1996), the Knee Self-Efficacy Scale (K-SES) (Ardern et al., 2014; Thomee et al., 2006) and the Modified Self-Efficacy for Rehabilitation Outcome Scale (SER) (Waldrop et al., 2001) were identified assessment tools for self-efficacy. The Life Orientation Test Revised (LOT-R) (Scheier et al., 1994) and the Illness Perception Questionnaire Revised (IPQ-R) (Moss-Morris et al., 2002) were identified tools for intrinsic optimism. Length ranges from 10-84 items with internal consistency ranging from 0.52-0.94

Fear-avoidance response to pain

The fear-avoidance response to pain is observed among patients who experience recurrent pain with particular movements or activities and then develop an exaggerated negative psychological response to pain or to the anticipation of pain (Waddell et al., 1993) which leads to kinesiophobia, an active avoidance of movement out of fear of recurrent pain or injury (Flanigan et al., 2015). Measures related to the fear-avoidance response are common in the orthopedic sports medicine literature (Table 3) (George et al., 2008; Kvist et al., 2005; Ross, 2010). The Tampa Scale for Kinesiophobia 17 item (Huang et al., 2019; Kori et al., 1990) and 11 item versions (Woby et al., 2005), Fear Avoidance

Beliefs Questionnaire (FABQ) (Waddell et al., 1993), The Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995), Fear of Pain Questionnaire (FPQ (McNeil and Rainwater, 1998) and revised FPQ-III (McNeil and Rainwater, 1998). Length ranges from 1140 items and with internal consistency ranging from 0.76-0.92.

Psychological distress

Psychological distress negatively affects post-surgical outcomes (Table 3). Distress is a broad term that has been used to describe unpleasant modes of thinking, mood disturbances, and depressive and anxiety symptoms (Ridner, 2004). Identifying psychological distress in disturbances,

Table 2. Psychological assessment tools of factors with neutral or positive association with sports injury treatment outcomes.

Category	Scale Name and Acronym	Factor assessed	Length	Reliability: internal consistency (Cronbach Alpha)	Other useful information
Personality traits	Minnesota Multiphasic Personality Inventory (MMPI) (Hathaway and McKinley, 1940) Revised to MMPI-2 (Hathaway et al., 1989)	Personality profile across 10 clinical scales	567 items (MMPI-2)	0.75-0.92	Administration takes 30 minutes or longer. MMPI-2 has replaced the MMPI for routine clinical or research use. Specialised software needed for scoring; not available without trained provider
Personality traits	Swedish Universities Scales of Personality SSP (Gustavsson et al., 2000)	Survey of personality traits including optimism & pessimism (embitterment)	91 items	0.59 for social desirability, 0.74-0.84 all other subscales	Divided into 13 scales including somatic trait anxiety, impulsiveness, adventure seeking, revised version of Karolinska Scales of Personality, embitterment score; was correlated with outcomes in ACLRs (Swirtun and Renström, 2008)
Self-motivation	ACL Return to Sport after Injury Scale (ACL-RSI) (Webster et al., 2008)	Perceived ability and motivation to return to sport	12 items	0.92	Created around psychological response to sport resumption: emotions, confidence in performance, and risk appraisal(Langford et al., 2009)
Self-motivation	Self-motivation Inventory (SMI) (Dishman and Ickes, 1981)	Self-motivation to complete a task	40 items	0.91	Self-motivation was a large predictor of physical therapy adherence (Brewer et al., 2000) Originally validated in patients who were prescribed therapeutic exercise (Dishman and Ickes, 1981).
Self-motivation	Psychovitality (Gobbi and Francisco, 2006)	Motivation and perceived likelihood to return to sport after injury	6 items	No reported internal reliability	Used in two studies study only (Gobbi and Francisco, 2006; Zaffagnini et al., 2008)
Coping	Acceptance and Action Questionnaire (AAQ) (Hayes et al., 2004)	Experiential acceptance	9 items	0.70	Relatively insensitive to change with intervention The AAQ includes items such as "I am able to take action on a problem even if I am uncertain what is the right thing to do," and "my thoughts and feelings get in the way of my success". AAQ average scores of 42 and 38 represent the upper quartile of experiential avoidance in clinical and non-clinical samples, respectively (Hayes et al., 2004).
Coping	Brief Coping Orientations to the Problem Experience (Brief COPE) inventory (Carver, 1997)	Coping methods	Full version: 60 items Shortened version: 28	0.72-0.84	Measures across 2 domains: problem-focused coping and emotion-coping. Sample items include "I get upset and let my emotions out." Test-retest stability has been demonstrated at 1 and 2-year follow-up(Cooper et al., 2008).
Athletic identity	Athletic Identity Measurement Scale (AIMS) (Brewer and Cornelius, 2001)	Athletic self-identity (a source of social support among athletes)	10 items	0.81	Predictive of post-injury psychological distress(Brewer and Cornelius, 2001)
Optimism	Life Orientation Test-Revised (LOT-R) (Scheier et al., 1994)	Individual differences in generalised optimism versus pessimism	10 items	0.78	Used extensively in behavioral, affective and health research. The LOT-R has demonstrated convergent and discriminant validity in comparison to measures of mastery, anxiety, self-esteem, and personality. Scheier and colleagues have reported LOT-R norms of 14.33 (SD = 4.28) in college students and 15.16 (4.05) in cardiac bypass patients (Scheier et al., 1994).
Optimism	Illness Perception Questionnaire- Revised (IPQ-R) (Moss-Morris et al., 2002)	Measure cognitive and emotional Representations illness	84 items	0.67-0.89 for individual subscales	8 dimensions: identity, timeline, consequences, personal control, treatment control, illness coherence, cyclical timeline, emotional representation. Test-retest stability at follow-up ranging from 3 weeks to 6 months (Moss-Morris et al., 2002).

Table 2. Continued ….

Category	Scale Name and Acronym	Factor assessed	Length	Reliability: internal consistency (Cronbach Alpha)	Other useful information
Self Efficacy	Sports Injury Rehabilitation Beliefs Survey (SIRBS) (Taylor and May, 1996)	Assesses health beliefs as well as level of sports participation, importance of sport to the athlete	19 items	0.52 (severity subscale) – 0.91 (self efficacy subscale)	Subscales in susceptibility, severity, self-efficacy, and treatment efficacy. Respondents rate the degree to which they agree with statements such as "Being fully recovered from injury is extremely important to me", and "In order to prevent a recurrence of this injury, my rehabilitation program is essential"
Self Efficacy	Modified Self-Efficacy for Rehabilitation Outcome Scale (SER) (Waldrop et al., 2001)	Perceived ability to perform tasks during injury rehabilitation	12 items	0.94	Respondents rate the degree to which they are certain about their ability to perform rehabilitation-related tasks (e.g., "I believe I can do my therapy regardless of the amount of pain I am experiencing"). Demonstrated convergent validity with Functional Independence Measure (FIM), the Life Orientation Test (LOT), and the Perceived Health Competence Scale (PHCS)(Waldrop et al., 2001)
Self Efficacy	Knee Self-Efficacy Scale (K-SES) (Thomee et al., 2006)	Perceived ability to perform knee-related tasks	22 items	0.78-0.94 for subscales	Four scale subsections. Measures both present self-efficacy and perceived future self-efficacy. Respondents report the degree to which they are certain about items/statements such as "Jumping sideways from one leg to another", and "How certain are you that your knee will not break"

disturbances, and depressive and anxiety symptoms (Ridner, 2004). Identifying psychological distress in patients allows clinicians to treat underlying stressors, allowing patients to proceed with physical rehabilitation unencumbered by maladaptive psychological factors. In the orthopedic sports medicine literature, many different measures are encountered (Brewer et al., 2003; Covassin et al., 2014; Galambos et al., 2005; Langford et al., 2009; Morrey et al., 1999; Rosenberger et al., 2009). The Emotional Response of Athletes to Injury Questionnaire (ERAIQ) (Langford et al., 2009) the Surgery Stress Scale (SSS) (Rosenberger et al., 2009), The Perceived Stress Scale (PSS) (Roberti et al., 2006), The State-Trait Anxiety Inventory (STAI) (Spielberger, 2010) and the Brief Symptom Inventory (BSI) (Derogatis and Melisaratos, 1983) were identified as tools for psychological distress. Measures ranged from 4 items to 55 items with internal consistency ranging from 0.76-0.95.

Depressed mood

Depressed mood is generally associated with worse outcomes after treatment of sports injuries (Cho et al., 2015; Hiscock et al., 2015; Nota et al., 2015) (Baranoff et al., 2015; Cho et al., 2015; Galambos et al., 2005; Hiscock et al., 2015; Potter et al., 2015; Tripp et al., 2011; van Wilgen et al., 2010; Çelebi et al., 2015). A variety of depression scales exist in the sports medicine literature, with the Beck Depression Inventory Fast Screen (BDI-FS) (Vargas et al., 2015) being the most popular (Table 3). The Center for Epidemiological Studies Depression Scale (CES-D) (Nota et al., 2015), the Hospital and Anxiety Depression Scale (HADS) (Zigmond and Snaith, 1983), The 9-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001), the Shortened Profile of Mood States (S-POMS) (Shacham, 1983), Distress Risk Assessment Method (DRAM) (Main et al., 1992) the Depression Anxiety and Stress Scale (DASS) (Lovibond and Lovibond, 1995) and the Brunel Mood Scale (BRUMS) (Terry and Lane, 2003) were identified as tools for depressed mood. Scales ranged in length from 8 to 42 items with internal consistency ranging from 0.76 to 0.90.

Health-related quality of life

The Medical Outcomes Study Short- Form 36 (SF-36) is a generic measure commonly used to assess health-related quality of life (Table 4). It is used to compare general health and functioning, estimate burden of disease, screen patients, and identify health benefits of interventions. Physical component scores are most responsive to treatments targeting physical symptoms, and mental components scores are most responsive to treatments that target emotional health (Ware and Gandek, 1998). Mental components scores have been utilized in the study of recurrent concussion (Guskiewicz et al., 2007). The chronic ACL deficiency Quality of Life scale (ACL-QoL) is a 31-item measure of perceived quality of life that encompasses physical and psychological characteristics related to functional ability and satisfaction (Mohtadi, 1998). Internal consistency for quality of live scores ranged from 0.90-0.93.

Discussion

Psychological factors play an important role in sports injury treatment outcomes. In this review, we have identified 152 sports injury treatment outcome studies that utilized 34 distinct self-report psychological assessment tools, though only 6 assessment tools were used in 5 or more publications. Demonstration of adequate internal consistency is necessary in order to effectively determine the validity of the scale in the context of sports injury research (John and Soto, 2007), and the majority of assessment tools utilized in sports injury outcomes research have demonstrated adequate internal consistency. Survey burden and clinical ap-

plicability are also important considerations in sports injury research. As an example, comprehensive personality testing with tools utilized previously in sports injury out comes studies (the MMPI and SSP) are lengthy, and few specific personality traits have been associated with clinical outcomes (Swirtun and Renström, 2008).

Table 3. Psychological assessment tools of factors with a negative association with sports injury treatment outcomes.

Category	Scale Name and Acronym	Factor assessed	Length	Reliability: internal consistency (Cronbach Alpha)	Other useful information
Fear-avoidance response to pain	Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995)	Emotional response to pain	13 items	0.87	Items relate to rumination, magnification, and helplessness, associated with reported pain intensity and sensitivity (George and Hirsh, 2009) The PCS has demonstrated good construct and discriminant validity as a measure of catastrophizing, and displayed high test-retest reliability (Sullivan et al., 1995).
Fear-avoidance response to pain	Tampa Scale for Kinesiophobia (TSK) (Huang et al., 2019; Kori et al., 1990) and TSK-11 (Woby et al., 2005))	Fear of activity and re-injury	17 item and 11 item versions	0.76 (TSK) 0.79 (TSK-11)	Kvist et al. (2005) adapted for use in ACL patients Can change throughout time, often high in early treatment and seems to persist in patient having trouble with rehabilitation
Fear-avoidance response to pain	Fear Avoidance Beliefs Questionnaire (FABQ) (Waddell et al., 1993)	Tests association between fear avoidance and work/ activity disability	16 items	0.77-0.88	Used across broad spectrum of orthopedic settings. The FABQ is unique in that it also assesses the effects of pain in the workplace
Fear-avoidance response to pain	Fear of Pain Questionnaire (FPQ-III) (McNeil and Rainwater, 1998)	Measures fear of pain	30 items	0.92 total scale, 0.87-0.88 subscales	Correlated with pain sensitivity in persons with shoulder pain (George et al., 2008). Validated in healthy controls, along with inpatient and outpatient pain patients receiving treatment for acute or chronic pain.
Psychological Distress	Emotional Responses of Athletes to Injury Questionnaire (ERAIQ) (Smith et al., 1990)	Emotional impact of injury and perceived social support	12 items	Not performed	Initially developed from clinical interviews and is a psychosocial assessment for injured athletes (Smith et al., 1990). The ERAIQ consists of a list of emotions that respondents rank from 0 to 12, with higher scores reflecting greater emotional disturbance. Used extensively in sports med and with ACL reconstruction. Convergent validity with Short Profile of Mood (LaMott, 1994).
Psychological Distress	Surgery Stress Scale (SSS) (Rosenberger et al., 2009)	Perceived stress about knee surgery process	4 items	0.76	Stress was predictive of postoperative pain 1 year postop(Rosenberger et al., 2009)
Psychological Distress	Perceived Stress Scale-10 (PSS) (Cohen et al., 1994)	Measures degree to which situations are appraised as stressful	10 items	0.89 total, 0.85-0.82 subscales	The PSS-10 yields a total score along with sub-scores for perceived helplessness and perceived self-efficacy. Items are rated on a 5-point Likert scale.
Psychological Distress	State Trait Anxiety Inventory (STAI) (Spielberger, 2010)	Measures chronic level of anxiety, both state and trait anxiety (scored separately)	40 items	0.89 (STAI-T subscale)	Widely used in medical, surgical and psychiatric patients. STAI- Trait (STAI-T) subscale consists of 20 statements that require respondents to rate how they generally feel on a 4-point Likert scale (Bieling et al., 1998). good demonstrated test-retest reliability (Barnes et al., 2002).
Psychological Distress	Brief Symptom Inventory (BSI) (Derogatis and Melisaratos, 1983)	Psychological distress	53 items	0.95	Made up of Global Severity Index and Positive Symptom Distress subscales. Has demonstrated very good test-retest reliability (Derogatis and Melisaratos, 1983).
Depressed Mood	Beck Depression Inventory Fast Screen (BDI-FS) (Steer et al., 1999)	Assess presence and degree of depressive symptoms	7 items	0.86	The BDI and subsequent versions have been validated in a variety of medical populations. Has been utilized post-concussion in athletes (Vargas et al., 2015). Assesses symptoms of depression consistent with the American Psychiatric Association's Diagnostic and Statistical Manual for Mental Disorders Fourth Edition (DSM-IV) criteria for Major Depressive Disorder

Table 3. Continued ….

Category	Scale Name and Acronym	Factor assessed	Length	Reliability: internal consistency (Cronbach Alpha)	Other useful information
Depressed Mood	Center for Epidemiological Studies in Depression Scale (CES-D) (Radloff, 1977)	Depressive symptoms within the last week	20 items	0.90	Widely used in general and clinical populations, associated with pain preoperatively(Rosenberger et al., 2009) CES-D does not include an item addressing suicidal ideation or intent
Depressed Mood	Hospital Anxiety and Depression Scale HADS (Zigmond and Snaith, 1983)	Detects mood disorders	14 items	0.83 for anxiety, 0.82 for Depression (Bjelland et al., 2002)	Developed for use among patients with concomitant physical health problems. Includes only cognitive and emotional symptoms of depression and anxiety, thereby avoiding mislabeling the physical symptoms of depression, such as fatigue and hypersomnia. Used in non-psychiatric populations. Extensively studied and validated (Bjelland et al., 2002)
Depressed Mood	Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001)	Measures how often athletes exhibit 9 signs of depression as diagnosed by the DSM-IV	9 items	0.89	Brief measure also based on DSM-IV criteria for Major Depressive Disorder
Depressed Mood	Shortened Profile of Mood States (S-POMS) (Shacham, 1983)	Used to assess temporary mood states across 6 spectrums of emotion	37 items	0.87 Total mood disturbance, 0.76-0.93 subscales (Curran et al., 1995)	Designed to assess transient, distinct mood states in healthy and medical patient populations
Depressed Mood	Distress and Risk Assessment Method (DRAM) (Main et al., 1992)	Measures depressive symptoms among 4 domains: pervasive affect, physiological equivalents, other disturbances, and psychomotor activities	20 items	0.82 (depression scale), (Gabrys and Peters, 1985) 0.78 (somatic perceptions) (Deyo et al., 1989)	Originally validated in patients with low back pain and designed as a simple screen for clinicians to determine the degree of patient distress.
Depressed Mood	Depression Anxiety Stress Scale (DASS) (Lovibond and Lovibond, 1995)	Assessment of depressed mood, anxiety, and stress	42 items	0.84-0.97 for subscales (Parkitny and McAuley, 2010)	Contains separate subscales for depression, anxiety, and stress.
Depressed Mood	Brunel Mood Scale (BRUMS) (Terry and Lane, 2003)	Measures mood across 6 subscales: anger, confusion, depression, fatigue, tension, and vigor	24 items	0.76-0.83 for subscales (Rohlfs et al., 2005)	Among elite athletes, higher BRUMS depression scores were associated with a greater number of athletic injuries and more training and competition time lost post-injury (Galambos et al., 2005).

Self-motivation, optimism, and self-efficacy measures are associated with return to sport, rehabilitation adherence, and overall injury outcomes. In particular, these measures are useful because they help illuminate the psychologic factors that accompany orthopedic injuries, such as perceived ability and confidence in rehabilitation. For the most part, these three categories of self-report psychological assessment tools have high levels of internal consistency as well as established correlations with various orthopedic outcomes such as pain, function, and return to sports. Self-efficacy and optimism were explored by Scherzer et al. (2001) when testing the utility of goal setting and positive outlook to improve rehabilitation adherence. Each of these attributes have scales that are viable for use clinically, with different scale options consisting of around 10-20 items which would limit the time burden. For these reasons, tools that assess these attributes would be generally informative for providers during rehabilitation without adding too much time burden. However, as compared to other measures, there is less data supporting the effect of these attributes on sports treatment injury outcomes, which limits these scales somewhat.

Perceived social support is a factor that has been assessed with self-report assessment tools with adequate internal reliability. Perceived social support may vary among injured athletes, both between different types of injury (Covassin et al., 2014) and among athletes with similar injuries (Brewer et al., 2003). Measurements of social support may be a useful tool for determining potential issues with rehabilitation, particularly in high risk patients. Also, athletic identity may be used as a measuring tool for outcomes and return to sport. Social support for different types of injuries is variable, and therefore should be accounted for when treating injured patients. As elucidated by

Table 4. Measures of mental health-related quality of life.

Scale Name and Acronym	Factor assessed	Length	Reliability: internal consistency (Cronbach Alpha)	Other useful information
Short Form 36 Questionnaire Mental Health Component (SF-36 MCS) (Ware Jr and Sherbourne, 1992)	Mental Health (MH) component: psychological distress	36 items	0.90	Extensively utilized throughout the general medical literature Available free of charge at http://www.rand.org/health/surveys_tools/mos/36-item-short-form.html
ACL deficiency Quality of Life scale (ACL-QoL) (Mohtadi, 1998)	Subscores for 5 domains: symptoms/physical complaints, work-related concerns, sport/recreational concerns, lifestyle issues, and social/emotional concerns	31 items	0.93 total score, subscale consistency not reported	Includes visual analogue scales, which respondents use to respond to questions. Reliability analysis from Lafave et al. (2017) for the ACL-QoL in a test-retest sample shows a moderate reliability, with a measured intraclass correlation coefficient (2,k) of 0.60.

Covassin et al. (2014) concussed athletes report less satisfaction with social support than athletes with orthopedic injuries. Measures of perceived social support may be a useful tool for determining potential issues with rehabilitation as it has been associated with rehabilitation adherence (Brewer et al., 2003). Measures of perceived social support may be used longitudinally to determine the effect of changing social support on rehabilitation outcomes. Despite its utility for determining high risk patients, perceived social support as an assessment tool is limited due to the relative paucity of readily available interventions for providers to recommend or pursue. If measures of perceived social support are paired with opportunities for improving social support, then this could be a potential area of effective intervention.

Self-report assessment tools for coping have been utilized in the sports injury outcomes literature, have adequate internal consistency and also have been associated with post-injury and post-surgical outcomes. The AAQ in particular can serve to predict depression at 6 months post-surgery when tested early in rehabilitation after ACL reconstruction (Baranoff et al., 2015); identification of maladaptive coping strategies early in the rehabilitation process may allow for timely intervention with a sports psychologist with tools such as cognitive behavioral therapy. This can be an effective initial screening tool, as it allows for providers to determine patients coping abilities either pre-operatively or early on in rehabilitation and intervene as necessary. However, these are limited in utility after intervention due to high time burden for the Brief COPE and the AAQ's insensitivity to change.

The interplay between kinesiophobia, pain catastrophizing, and coping strategies plays an important role in recovery and return to sport for a variety of sports medicine injuries and highlights the need for reliable, valid self-report assessment tools to study what may be a complex relationship between variables that predict injury outcomes and/or return to sport. Perhaps best studied in sports medicine in the context of ACL reconstruction, fear of re-injury (kinesiophobia) is a major determinant of return to sport (Flanigan et al., 2013; Tjong et al., 2014). Patients with chronic ankle instability who are functional "non-copers" tend to also have greater kinesiophobia and fear-avoidance beliefs (Houston et al., 2014; 2015). Athletes with shoulder instability who undergo a soft tissue stabilization procedure cite kinesiophobia as a major determinant in return to sport decisions (Tjong et al., 2015); kinesiophobia plays a similar role in return to sport decisions after arthroscopic hip surgery for femoroacetabular impingement (FAI) (Tjong et al., 2016). Finally, kinesiophobia, pain catastrophizing and maladaptive coping all correlate with baseline symptoms and disability in anterior knee pain patients (Domenech et al., 2013), with reduced catastrophizing throughout treatment predicting improvement in symptoms after treatment (Domenech et al., 2014). Kinesiophobia, along with pain catastrophizing and maladaptive coping, have been shown to be associated with return to sport and disability in a variety of different sports medicine conditions. This suggests that these attributes would be particularly valuable to providers as a measuring tool for both determining high risk patients, with kinesiophobia measurements being a potential means of measuring psychological progress with rehabilitation. These measures also have a relatively low time burden, with most questionnaires being 10-20 items long.

There is currently no widely accepted screening algorithm from a psychological perspective to identify injured athletes at risk for an unsatisfactory outcome. Assessment of relevant psychological variables using tools with adequate demonstrated reliability may allow sports medicine researchers to perform further validation studies in a sports injury context and allow providers to risk-stratify patients in clinical practice. Knowledge of a patient's psychological risk for an unsatisfactory surgical outcome may facilitate individualized discussion of operative versus non-operative treatment of a sports injury. Psychological screening could help identify patients that might benefit from interventional efforts such as motivational interviewing (Knight et al., 2006) or cognitive behavioral therapy (Hofmann et al., 2012) to improve treatment outcomes.

This review has several limitations. Though internal consistency is an important measure of reliability, other measures of reliability and validity are important to consider when evaluating an assessment tool for use in a

clinical or research context; due to length restrictions and the large number of assessment tools identified, a comprehensive description of the psychometric properties of each assessment tool could not be provided in the current review. Though we were able to identify the most commonly utilized self-report psychological assessment tools in sports injury outcomes research, we were unable to determine which specific tools are the most predictive of outcomes in a sports-related injury setting. This limits the ability to make recommendations of which psychometric tools to use specifically, although general recommendations based on category and time burden could be explored.

Conclusion

Thirty-four self-report psychological assessment tools have been utilized in sports injury treatment outcome studies and are summarized in the current review. Many of the utilized scales have acceptable internal consistency, supporting further reliability and validation studies in sports injury treatment outcomes research.

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Key points

- Thirty-four assessment scales of psychological factors were utilized across 152 sports injury treatment outcomes studies.
- The use of psychological assessment tools in sports injury outcomes research has become increasingly common.
- Many caregivers remain unfamiliar with these tools.

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