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Original Research

Psychological factors during rehabilitation of patients with Achilles or patellar tendinopathy: a cross-sectional study

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ABSTRACT

Objective: to examine psychological factors during rehabilitation of patients with Achilles or patellar tendinopathy as well as the association between psychological factors and tendinopathy severity, sport participation, and satisfaction with activity level and tendon function.
Design: cross-sectional study. Setting: online survey platform.
Participants: 119 patients (mean age: 44 years (SD 14)) diagnosed with Achilles or patellar tendinopathy.
Main outcome measures: A range of patient-reported psychological and outcome measures were recorded. Multivariate regression analyses were performed to establish the association between each psychological factor and outcome measures, adjusted for relevant confounders.
Results: Psychological readiness and confidence to return to sports (I-PRRS) and pain catastrophizing (PCS) were significantly associated with tendinopathy severity (modified VISA), sport participation(OSTRC-O), and satisfaction. Kinesiophobia (TSK) and the importance to patients of returning to pre-injury activity level were significantly associated with sports participation and satisfaction.
Conclusion: The current study provides evidence of impairments in psychological factors during rehabilitation of patients with Achilles and patellar tendinopathy. Most investigated psychological factors were associated with tendinopathy severity, function, participation, and satisfaction. Physical therapists should recognize patients with lack of psychological readiness to return to sports and also patients with kinesiophobia or catastrophizing thoughts when experiencing pain.

1. Introduction

Tendinopathies are difficult-to-treat musculoskeletal overuse injuries in athletes, but they can also develop in non-athletes (Cook & Purdam, 2009; de Jonge et al., 2011; Paavola et al., 2000; Zwerver, 2008). Multiple treatment options range from conservative to surgical methods (Caudell, 2017; Magnussen et al., 2009; Malliaras et al., 2013; van Ark et al., 2011; van der Worp et al., 2014; Zwiers et al., 2016). Although tendinopathy symptoms in some individuals recover with simple interventions, in others they appear resistant to treatment (Gaida & Cook, 2011; Larsson et al., 2012).

Rehabilitation generally aims at restoring most or all of the patient's physical, psychological and social impairments in normal functional life. The importance of psychological aspects in rehabilitation and return to sports (RTS) after sports injuries is being increasingly recognized (Crossman, 1997; Forsdyke et al., 2016; Podlog & Eklund, 2007; Podlog et al., 2014). Knowledge about the role of psychological factors during rehabilitation is obtained from

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the fields of elective orthopedic surgery, anterior cruciate ligament (ACL) rehabilitation, and spine and lower back injuries (Ardern et al., 2013a, 2014; Doury-Panchout et al., 2015; Everhart et al., 2015; Flanigan et al., 2015; Pincus & McCracken, 2013; Podlog et al., 2014; Tichonova et al., 2016). Associations have been found between psychosocial factors, motivation, rehabilitation compliance, and patient-reported outcomes (Sonesson et al., 2017; Vuistiner et al., 2015). Psychosocial distress, fear/avoidance behavior, poorly perceived self-efficacy, and pessimistic personality traits contribute to suboptimal rehabilitation outcome (Ardern et al., 2013a, 2014; Doury-Panchout et al., 2015; Everhart et al., 2015; Flanigan et al., 2015; Pincus & McCracken, 2013; Podlog et al., 2014; Tichonova et al., 2016). It is shown that physical and psychological readiness to RTS do not always occur simultaneously (Ardern et al., 2013a, 2014; Podlog et al., 2014). Some athletes return to training while not psychologically ready, possibly resulting in poor functional outcome (Crossman, 1997; Podlog et al., 2014).

So far only few studies into psychological factors in lower limb tendinopathies have been conducted. A recent systematic review by Mallows et al. (2017) (Mallows et al., 2017) found that the majority of studies investigated tendinopathy of the upper limb and only two of the lower limb. It is argued that the potential relationship of psychological variables, will likely be dependent on the specific tendon's anatomical and biomechanical properties (Lewis, 2010; Mallows et al., 2017). One cross-sectional study showed limited evidence that anxiety and depression levels in patellar tendinopathy (PT) patients are not elevated compared to healthy controls (van Wilgen et al., 2013), and a case series found an association between kinesiophobia and jump performance in patients with Achilles tendinopathy (AT) (Silbernagel et al., 2011). More recently, a case-control study reported small-to-moderate negative correlations between anxiety, depression and tendon function and small positive correlations between pain self-efficacy and tendon function in patients with PT (Plinsinga et al., 2018a). No significant differences in measures of depression or anxiety between AT patients and pain-free controls were found (Plinsinga et al., 2018a). In a cross-sectional study in patients with gluteal tendinopathy was found that pain catastrophizing and depression scores were associated with severity of complaints (Plinsinga et al., 2018b). In addition, lower pain self-efficacy was found in patients with severe complaints compared to patients with moderate or mild complaints (Plinsinga et al., 2018b). A qualitative study on experiences and perceptions of people with persistent AT reported loss of self, frustration with the treatment process, fear of future prognosis, and desire to run (Mc Auliffe et al., 2017). In conclusion, some evidence suggests that psychological factors play a role in tendinopathy recovery, but studies are scarce and show conflicting results.

Therefore, the aim of this study was to assess self-reported psychological factors in patients during rehabilitation from an AT or PT. A further aim was to explore the association between self-reported psychological factors and tendinopathy severity, sport participation and performance, and satisfaction with activity level and tendon function.

2. Methods

2.1. Study design and participants

In this cross-sectional study, eligible patients were adults (≥18 years) who visited the Sport & Exercise Medicine Department of University Medical Center Groningen between March 2017 and April 2019, with a history of persistent tendon pain and loss of function related to mechanical loading for at least three months, regardless of phase of rehabilitation and diagnosed with AT or PT by an experienced sports medicine physician. The diagnosis was mainly based on history and clinical examination (Maffulli et al., 2020; Rio et al., 2020). If indicated, imaging (radiographs, ultrasonography, ultrasound tissue characterization, or MRI) were performed to exclude other diagnoses (Maffulli et al., 2020). Patients with chronic joint diseases, signs or symptoms of other coexisting joint pathology, or inability to understand written Dutch were excluded.

2.2. Procedure

Included patients received a study information email in June 2019 containing a link to online questionnaires and a code. Informed consent was recorded by ticking a box before the first questionnaire. The local Medical Ethics Committee evaluated the procedures employed in this study and waived further need for approval (METc 2019−351).

2.3. Measurement instruments

Participants were asked for biographical information, anthropometrics, lifestyle factors, personal medical history, injury (etiology, extent, symptoms), and management factors during rehabilitation. The questionnaires used, assessing current psychological factors and outcome measures, are described below (Table 1).

2.3.1. Questionnaires assessing psychological factors

The *Injury Psychological Readiness to Return to Sport (I-PRRS) scale* was used to assess psychological readiness and confidence of injured athletes to return to sports participation (Glazer, 2009). The Dutch language I-PRRS has shown to be valid and reliable (Slagers et al., 2019a, 2019b).

The *Tampa Scale for Kinesiophobia (TSK)* measures fear of reinjury due to movement and physical activity (Kori, 1990). The Dutch version is considered valid (Vlaeyen et al., 1995a) and was adapted for this study to be used for tendon injuries, in accordance with the previous method to adapt the TSK to be used for ACL injuries (Kvist et al., 2005, 2013; Slagers et al., 2017, 2019a).

Internal Health Locus of Control (IHLC) is the extent to which individuals attribute their health to their own actions. IHLC is measured using the internal part of the multidimensional HLC-C scale (Wallston et al., 1976). For this study, the IHLC-C scale was translated into Dutch following international guidelines (Beaton et al., 2000) and the word “condition” was replaced by “tendon problems”.

Catastrophizing thoughts or feelings in relation to painful experiences were measured using the *Pain Catastrophizing Scale (PCS)* (Sullivan et al., 1995). Patients had to indicate the degree to which they experienced each of the 13 thoughts or feelings when in pain. The Dutch version of the PCS used in this study is considered valid and reliable (Crombez et al., 1999; Lame et al., 2008; Severeijns et al., 2005; Sullivan et al., 1995).

A 6-item questionnaire described by Sonneson et al. (Sonesson et al., 2017) on expectations and motivation to return to pre-injury activity level and satisfaction with activity level and tendon function was adapted and translated for purposes of this study (supplement Table A). The satisfaction part (2 questions) was used as outcome measure.

2.3.2. Questionnaires assessing function and participation

The *modified Victorian Institute of Sport Assessment (VISA) scale* was used to assess tendinopathy severity by asking about pain, function, and activity (Visentini et al., 1998). The original version of the VISA scale contains eight questions. Two VISA scales are

Table 1
Patient-reported outcome measures.

PROMs	Construct	Items	Score range	Interpretation
Psychological factors				
I-PRRS	Psychological readiness and confidence of injured athletes to return to sports participation	6 items, 100-point scale	0–60	60: high confidence 40: moderate confidence 20: low confidence
TSK	Kinesiophobia, fear of re-injury due to movement and physical activity	17 items, 4-point scale	17–68	Higher scores = higher kinesiophobia levels
IHLC	Internal health locus of control	6 items, 6-point scale	6–36	Higher scores = low level of internal HLC
PCS	Catastrophic thoughts or feelings in relation to painful experiences	13 items, 5-point scale	0–52	Higher scores = higher level of pain catastrophizing
Expectations and motivation questionnaire	Expectations, motivations to return to pre-injury activity level	Expectations: 2 items Motivation: 2 items	10–100 per item	Higher scores = higher expectation/motivation level
Outcome				
Modified VISA-A/VISA-P	Tendinopathy severity, function	6 items, 11-point scale	0–60	0: severe complaints 60: no complaints
OSTRC-O	Consequences of overuse injuries in sports participation and performance	4 items, scored on 4- or 5-point scale (numerical value 0–25)	0–100	0: no participation or performance problems.
Satisfaction questionnaire	Satisfaction with activity level and tendon function	2 items	10–100	Higher scores = higher level of satisfaction
Reasons for not RTS	Rank the reasons for failed RTS	1	Order of rank	NA

Abbreviations: I-PRRS, Injury-Psychological Readiness to Return to Sport scale; TSK, Tampa Scale of Kinesiophobia; IHLC, Internal Health Locus of Control scale; PCS, Pain Catastrophizing Scale; VISA-A/VISA-P, Victorian Institute of Sport Assessment scale (VISA-A Achilles tendinopathy, VISA-P patellar tendinopathy); OSTRC-O, Oslo Sports Trauma Research Centre - Overuse injury questionnaire; RTS, Return to Sport.

available; VISA-A for AT and the VISA-P for PT – both translated into Dutch and considered reliable and valid (Sierevelt et al., 2018; Zwerver et al., 2009). Since questions 7 and 8 refer to sport activities (accounting for 40% of points) and recreational athletes with lower activity levels would score low on this domain regardless of tendinopathy severity, only the modified VISA score, leaving out both questions was computed and used for this study. This modified score has been previously described in literature and is considered useful in mixed populations of athletes and non-athletes (Sierevelt et al., 2018).

The *Oslo Sports Trauma Research Centre overuse injury questionnaire (OSTRC-O)* was used to measure the consequences of overuse injuries in sports participation and performance (Clarsen et al., 2013). The OSTRC-O is translated into several languages for international comparison and considered reliable and valid (Ekman et al., 2015; Hirschmuller et al., 2017; Jorgensen et al., 2016; Nagano et al., 2019); the Dutch version was modified for tendon injury by replacing “knee” with “tendon” (Pluim et al., 2016).

Patients reporting reduced participation in sports activities compared to before the tendinopathy were asked to rank the following reasons in the questionnaire on failed RTS from most to least important: “poor tendon function”, “no trust in the tendon”, “fear of re-injury”, “team/training has changed”, “family commitments”, “work commitments”, “fear of having to repeat rehabilitation”, “fear of not reaching the same level”, “fear of not meeting expectations of team, coaches or family”, “fear of loss of income” and “other reasons”. This questionnaire was used in previous ACL injury research (Ardern et al., 2014). The scale has been translated to Dutch and modified for tendon injury.

2.4. Statistical analysis

IBM SPSS Statistics for Windows software (v 23.0, Armonk, NY: IBM Corp.) was used for statistical data analyses. Data were assessed for normal distribution and descriptive statistics were used to describe the study population and questionnaire outcomes. Independent-sample T-tests were performed to investigate differences between AT and PT in demographic data and scores on the psychological questionnaires. Multivariate regression analyses were performed according to the enter method to establish the association between each psychological factor separately and the different outcome measures, adjusted for relevant confounders (body mass index (BMI), gender, age, symptom duration, VAS pain, and diagnosis (AT/PT)). The PCS was not adjusted for VAS pain in the context of collinearity. Statistical significance was defined as $p < 0.05$.

3. Results

Out of 154 eligible patients, eight were excluded because of chronic joint diseases ($n = 2$), signs or symptoms of other coexisting joint pathology ($n = 5$), and inability to understand written Dutch ($n = 1$). Of the 146 tendinopathy patients approached, 119 (85 with AT, 34 with PT) returned the questionnaires (response rate 81.5%). Participants’ mean age was 44 (SD 14) years (Table 2). Participants with PT were significantly younger, with a lower BMI than those with AT ($p < 0.01$). Just over one third had bilateral tendon problems. Mean symptom duration of all participants was 39.9 (SD 42.8) months. All non-responders were contacted by telephone. The reasons they indicated for not responding were lack of time or motivation to complete questionnaires, but were unrelated to the injury. Non-responders were comparable to responders in terms of gender, age and diagnosis distribution.

3.1. Psychological and outcome questionnaire scores

An overview of the various questionnaire scores on psychological factors and outcome measures is shown in Table 3. Scores on the psychological questionnaires were: I-PRRS 39.2 (SD 12.3), TSK 35.3 (SD 6.0), IHLC 21.1 (SD 6.2) and PCS 13.6 (SD 10.0). There only was a significant difference in mean PCS scores of 4.8 points between AT and PT patients ($p = 0.02$), but after correcting for age as confounder no significant differences were found ($p = 0.34$). Ninety percent of participants wanted to return to pre-injury level and most believed this was possible (mean 68.7). Most participants rated returning to their pre-injury activity level as very important

Table 2
Demographic characteristics of all participants and of patients with Achilles and patellar tendinopathy separately

	All $n = 119$	AT $n = 85$ (71%)	PT $n = 34$ (29%)	*P-value*
Gender				
Male, n (%)	76 (63.9)	50 (59)	26 (76)	0.06
Female, n (%)	43 (36.1)	35 (41)	8 (24))	
Age, years (SD)	44.0 (14)	49.0 (12.9)	32.3 (11.2)	< 0.01
Height, cm (SD)	179.6 (9.3)	178.0 (9.4)	183.6 (7.8)	< 0.01
Body mass index, kg/m^2 (SD)	26.3 (4.1)	27.2 (4.2)	24.5 (3.1)	< 0.01
Symptom duration, months (SD)	39.9 (42.8)	41.1 (46.7)	37.0 (32.1)	0.65
Tendon pain, mean (SD)[a]	4.6 (2.3)	4.6 (2.4)	4.8 (1.8)	0.74

Abbreviations: AT, Achilles tendinopathy; PT, patellar tendinopathy.
[a] Visual Analogue Scale 0–10.

Table 3
Descriptive statistics (mean (SD)) of scores on the psychological and outcome questionnaires.

	All $n = 119$	AT $n = 85$	PT $n = 34$	*p*-value
Psychological factors				
I-PRRS (0–60)	39.2 (12.3)	39.5 (13.0)	38.7 (12.3)	0.79
TSK (17–68)	35.3 (6.0)	35.2 (5.7)	35.5 (6.6)	0.81
IHLC (6–36)	21.1 (6.2)	21.5 (6.6)	20.1 (5.2)	0.28
PCS (0–52)	13.6 (10.0)	12.2 (9.3)	17.0 (10.8)	0.02[a]
Expectation[b]				
1 Is your goal to return to your pre-injury activity level? yes/no (%)	90/10	86/14	100/0	0.09
2 Do you think it is possible to return to your pre-injury activity level?	68.7 (27.3)	68.0 (27.3)	70.3 (27.5)	0.68
Motivation[b]				
1 How important is it for you to return to your pre-injury activity level?	86.7 (16,1)	85.8 (17.2)	88.8 (13.2)	0.30
2 How much effort are you willing to make to return to your pre-injury activity level?	89.3 (13.4)	88.9 (13.5)	90.3 (13.4)	0.61
Outcome measures				
Modified VISA- A/P (0–60)	38.5 (14.4)	40.0 (14.4)	35.7 (12.6)	0.18
OSTRC-O (0–100)	49.7 (34.4)	49.0 (33.9)	51.6 (36.1)	0.71
Satisfaction[b]				
1 Satisfaction with current activity level	49.4 (28.0)	49.8 (26.4)	48.5 (31.8)	0.83
2 Satisfaction with current tendon function	42.2 (29.2)	42.8 (28.0)	40.6 (32.2)	0.71

Abbreviations, All, all participants; AT, Achilles tendinopathy; PT, patellar tendinopathy; SD, standard deviation; I-PRRS, Injury-Psychological Readiness to Return to Sport scale; TSK, Tampa Scale of Kinesiophobia; IHLC, Internal Health Locus of Control scale; PCS, Pain Catastrophizing Scale; VISA-A/P, Victorian Institute of Sport Assessment scale for Achilles tendinopathy and Patellar tendinopathy; OSTRC-O, Oslo Sports Trauma Research Centre overuse injury questionnaire.
[a] When corrected for age as confounder: p = 0.34.
[b] Response model: see supplement table A.

and were accordingly eager to make an effort (mean 89.3). Mean modified VISA and OSTRC-O scores were 38.4 (SD 14.4) and 49.7 (SD 34.4), respectively. There were no significant differences in modified VISA and OSTRC scores between AT and PT patients.

3.2. Association between each psychological factor and outcome measures

After correcting for confounders, significant associations between I-PRRS, PCS, and modified VISA score were found (Table 4). The modified VISA score was higher in participants with higher I-PRRS levels and lower in participants with higher PCS levels. Significant associations were found between IPRRS, TSK, PCS, the importance to patients of returning to pre-injury activity level, and OSTRC-O. OSTRC-O was lower in participants with higher I-PRRS scores, and higher in participants with higher TSK and PCS scores. Significant associations were found after correcting for confounders between IPRRS, TSK, PCS, the importance to patients of returning to pre-injury activity level, and all satisfaction questions.

3.3. Reasons for reduced participation in activities

Forty-nine (41%) patients reported to participate fully in athletic training, yet half of them reported persisting tendon problems. Of the 70 patients who did not participate fully in athletic training, 25 (36%) reported reduced participation due to tendon problems and 45 (64%) were unable to participate at all. The three most important reasons for not returning to pre-injury activity level were “poor tendon function” (83%), “no trust in the tendon” (74%) and “fear of re-injury” (67%). Another important factor was “fear of having to repeat rehabilitation” (supplement Table B). Mean symptom duration at the time of data collection in patients who did not RTS was 39.8 months (SD 41.9) vs 39.8 months (SD 44.9) in patients who did RTS (with or without current tendon problems). Mean symptom duration of patients without current tendon problems who did RTS was 23.2 months (SD 17.4).

4. Discussion

The aim of this study was to assess self-reported psychological factors during rehabilitation of patients with AT or PT as well as the association between these psychological factors and tendinopathy severity, sport participation and performance, and satisfaction with activity level and tendon function. Significant associations were found between psychological readiness to RTS and pain catastrophizing with tendinopathy severity, participation, and satisfaction levels: higher level of psychological readiness to RTS, lower pain catastrophizing levels were associated with lower levels of tendinopathy severity, and higher levels of participation, performance and satisfaction. Furthermore, lower kinesiophobia levels were associated with higher participation, performance, and satisfaction levels. Although PT patients differ from AT patients on

Table 4
Associations between psychological factors and outcome measures.

	Modified VISA			
	Regression coefficient	95% CI	*p*-value	R^2
I-PRRS	**0.29[d]**	**0.10 ; 0.48**	**<0.01**	**0.42**
TSK	-0.28[d]	-0.68 ; 0.13	0.18	0.38
IHLC	-0.07[d]	-0.44 ; 0.30	0.71	0.40
PCS	**-0.56[e]**	**-0.85 ; -0.28**	**<0.01**	**0.19**
Possibility[a]	0.08[d]	-0.07 ; 0.23	0.27	0.37
Importance[b]	0.08[d]	-0.01 ; 0.17	0.08	0.38
Effort[c]	0.17[d]	-0.02 ; 0.35	0.08	0.39
	OSTRC-O			
	Regression coefficient	95% CI	*p*-value	R^2
I-PRRS	**-0.97[d]**	**-1.47 ; -0.48**	**<0.01**	**0.30**
TSK	**1.44[d]**	**0.40 ; 2.49**	**<0.01**	**0.25**
IHLC	0.50[d]	-0.50 ; 1.50	0.33	0.23
PCS	**1.13[e]**	**0.61 ; 2.01**	**<0.01**	**0.13**
Possibility[a]	0.08[d]	-0.32 ; 0.48	0.7	0.19
Importance[b]	**-0.33[d]**	**-0.56 ; -0.10**	**0.01**	**0.25**
Effort[c]	-0.34[d]	-0.84 ; 0.16	0.18	0.20
	Satisfaction with current level of activity			
	Regression coefficient	95% CI	*p*-value	R^2
I-PRRS	**0.99[d]**	**0.57 ; 1.41**	**<0.01**	**0.28**
TSK	**-1.42[d]**	**-2.32 ; -0.52**	**<0.01**	**0.21**
IHLC	-0.21[d]	-1.08 ; 0.65	0.63	0.13
PCS	**-0.64[e]**	**-1.24 ; 0.04**	**0.04**	**0.07**
Possibility[a]	0.02[d]	-0.33 ; 0.37	0.91	0.12
Importance[b]	**0.34[d]**	**0.14 ; 0.54**	**<0.01**	**0.21**
Effort[c]	0.34[d]	-0.09 ; 0.78	0.12	0.14
	Satisfaction with current tendon function			
	Regression coefficient	95% CI	*p*-value	R^2
I-PRRS	**1.17[d]**	**0.78 ; 1.56**	**<0.01**	**0.41**
TSK	**-1.50[d]**	**-2.36 ; -0.63**	**<0.01**	**0.30**
IHLC	-0.30[d]	-1.13 ; 0.54	0.48	0.24
PCS	**-1.01[e]**	**-1.61 ; -0.40**	**<0.01**	**0.12**
Possibility[a]	0.14[d]	-0,20 ; 0.48	0.42	0.21
Importance[b]	**0.52[d]**	**0.36 ; 0.70**	**<0.01**	**0.41**
Effort[c]	0.42[d]	-0,00 ; 0.84	0.05	0.24

[a] Expectations: Possibility of returning to pre-injury activity level.
[b] Motivation 1: Importance for returning to pre-injury activity level.
[c] Motivation 2: Willing to make effort to return to pre-injury activity level.
[d] Corrected for tendinopathy type (AT/PT), BMI, gender, age, symptom duration and Pain-VAS.
[e] Corrected for tendinopathy type (AT/PT), BMI, gender, age and symptom duration.

demographic characteristics (e.g. younger, lower BMI), this study demonstrated no differences between AT and PT patients with respect to psychological factors during rehabilitation.

To the best of our knowledge, no previous studies have been conducted in tendinopathy patients for psychological readiness and confidence to RTS participation, therefore only comparisons with other injuries can be made. However, differences in injury mechanism, treatment strategies, the chronic nature of an overuse injury like tendinopathy, and symptoms variability over time hamper comparison with an acute injury like ACL rupture. Keeping this in mind, the moderate level of psychological readiness and confidence to RTS in this study (mean I-PRRS 39.2) is comparable to scores of patients with other sports injuries. A cross-sectional study with 150 patients 3–16 months after ACL reconstruction reported a mean I-PRRS score of 44 (Slagers et al., 2019b). Our participants with higher levels of self-reported psychological readiness and confidence to RTS participation had less tendinopathy severity and better function, participation, and satisfaction. These findings are in line with previous cross-sectional and longitudinal studies of patients after ACL reconstruction, where the psychological readiness to RTS was the best predictor of returning to preinjury level of sports (Ardern et al., 2013b, 2014; Langford et al., 2009). However, due to the

limitation of the study design in the current study, the direction of the association can be determined, but not the causality. Therefore less severe tendinopathy could also lead to higher self-reported psychological readiness to RTS, better participation and satisfaction.

The kinesiophobia level can be considered moderate in tendinopathy patients (mean TSK 35.3), and comparable to those in chronic low back pain and fibromyalgia populations (Crombez et al., 1999; Goubert et al., 2000; Vlaeyen et al., 1995a, 1995b), and other sports injuries like ACL (Ardern et al., 2014; Huang et al., 2019; Kvist et al., 2013; Slagers et al., 2019a). After correcting for confounders the current study did show significant associations with sport participation and satisfaction with activity level and tendon function. These findings are in line with those of a case series study demonstrating a statistically significant negative correlation between kinesiophobia levels and scores on a test battery of jump tests in AT patients at 5 years' follow-up (Silbernagel et al., 2011).

Internal locus of control in tendinopathy patients is comparable to other patient groups with different pain conditions (Bonafe et al., 2018; Konkoly Thege et al., 2014), yet as no association with tendinopathy severity and function, participation, or satisfaction levels were found, internal locus of control appears to play a minor role during rehabilitation in tendinopathy patients. A possible explanation is that the IHLC scale assesses the extent to which patients attribute their health and tendinopathy symptoms to their own control, yet does not assess the ensuing behavior (Murphy et al., 1999).

At first glance, pain catastrophizing seems to be a less dominant psychological factor during rehabilitation in tendinopathy patients, who reported a mean PCS score lower than chronic low back pain patients and fibromyalgia patients or even pain-free students (Lame et al., 2008; Sullivan et al., 1995; Van Damme et al., 2002). Tendinopathy patients' prolonged habituation to low-grade recurrent pain may explain this. Despite mild pain, most patients continue their daily activities, work, and sports (De Vries et al., 2017). They adapt their everyday activities and sports to their level of complaints, but do not catastrophize pain. However, the association with symptom severity and function, participation, and satisfaction has been demonstrated. It seems therefore important that, when present, patients' catastrophizing thoughts or feelings be recognized.

Despite prolonged symptoms duration, most patients expected it would be possible to return to pre-injury activity levels and were accordingly motivated to make an effort. In contrast to previous studies in ACL patients, where returning to pre-injury (sport) activity level was associated with higher motivation (Sonesson et al., 2017), this study found no significant associations with the effort patients willing to make for returning to pre-injury activity level, only for the importance of it. In tendinopathy or overuse injuries in general, patients' extreme motivation may also be an obstacle during the recovery process if it is associated with insufficient background knowledge of tendinopathy recovery processes. Qualitative research reveals that many patients are frustrated with the management process and continue their sports activities despite pain (Mc Auliffe et al., 2017). Obsessive passionate athletes are more likely to report injuries and may develop tendinopathy recurrences (de Jonge et al., 2020). On the other hand, patients with high levels of kinesiophobia or pain catastrophizing might perform fewer exercises, at less intensity than prescribed. These findings highlight the importance of counseling for obsessive passionate attitudes toward sports activities, but also for the presence of kinesiophobia or pain catastrophizing. Counseling for these psychological factors, management of expectations, and pain education during the rehabilitation process of tendinopathies, and aligning exercise prescriptions using a pain-monitoring model that might allow for improved compliance during rehabilitation (Silbernagel et al., 2007), might improve treatment outcome and accelerate symptom-free return to sports performance. Further research on this topic is highly recommended.

There is a limited amount of literature on psychological interventions during rehabilitation in sports injuries. Most studies' interventions have focused on relaxation and guided or visual imagery (Coronado et al., 2018; Rodriguez et al., 2019). Current use of these interventions is not extensive and there is limited and conflicting evidence on their effectiveness during the rehabilitation of patients with sports injuries. Given the expanding evidence on the influence of psychological factors during rehabilitation, future research on this subject is warranted.

4.1. Strengths and limitations

To the best of our knowledge, this is the first study specifically investigating the role of psychological factors in a large group of AT and PT patients and their association with severity, function, participation, and satisfaction. Selection bias may be a limitation in this study, as included patients were from our tertiary referral and clinical expertise center treating mainly recalcitrant tendinopathy cases and included a sample of recreational athletes of all types of levels, ranging from those only walking to participating in organized sport. This may have consequences for the generalizability of results. The analysis of the combined group, AT and PT, can be seen as a limitation, however, with regard to the psychological factors, this study showed no difference between AT and PT. Moreover, validity of some of the used questionnaires has not been studied yet in the lower limb tendinopathy population.

In this cross-sectional study causality could not be determined. Longitudinal cohort studies are required to investigate the predictive value of baseline psychological factors on long-term clinical outcome and this should be the subject of further studies. Other psychological factors (e.g. anxiety, depression) could also play a role in tendinopathy patients and should be further explored.

5. Conclusion

The current study provides evidence of impairments in psychological factors during rehabilitation of patients with Achilles and patellar tendinopathy. Most psychological factors showed an association with tendinopathy severity, function, participation, and satisfaction. Physical therapists should be aware of and recognize patients with lack of psychological readiness and confidence to return to sports and also patients with kinesiophobia or catastrophizing thoughts when experiencing pain.

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Statement of institutional ethics committee

The Medical Ethics Review Board of University Medical Center Groningen evaluated the procedures employed in this study and waived further need for approval (METc 2019–351).

Declaration of competing interest

The authors report no potential conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ptsp.2021.04.010.

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