RESEARCH ARTICLE

Tampa Scale for Kinesiophobia Short Form and Lower Extremity Specific Limitations

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Abstract

Background: We compared the amount of variation in Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF) Computer Adaptive Test (CAT) accounted for by The Tampa Scale for Kinesiophobia (TSK) and its short form (TSK-4) independent of other factors. Questionnaire coverage, reliability, and validity were compared for both TSK and TSK-4 using mean scaled scores, internal consistency, floor and ceiling effects, interquestionnaire correlations, and collinearity with other measures as the Pain Catastrophizing Scale short form (PCS-4), PROMIS Depression CAT, and PROMIS Pain Interference (PROMIS PI) CAT.

Methods: One hundred forty eight consecutive new or return patients were enrolled. Patients were seen in an outpatient setting in several orthopaedic clinics in a large urban area. All patients completed the TSK, PROMIS PF CAT, PROMIS PI CAT, PROMIS Depression CAT, and PCS-4.

Results: Greater fear of movement (higher TSK) was associated with worse physical function (lower PROMIS PF CAT) and the full TSK explained more variation in physical function than the short form (TSK-4). In contrast to prior studies PCS-4 was not independent of TSK. Flooring and ceiling effects were seen with TSK-4. Worse physical function was associated with older age, traumatic condition, and more symptoms of depression.

Conclusion: The short form of the Tampa Scale for Kinesiophobia can be used as a brief screening measure in patient care and research in order to identify an independent influence of kinesiophobia on lower extremity specific limitations. Additional study is needed to determine whether there is utility in screening for both TSK and PCS or if one or the other provides sufficient information about cognitive biases regarding pain to guide treatment with cognitive behavioral therapy and related techniques.

Level of evidence: II

Keywords: Fear of movement, Kinesiophobia, Lower extremity, Physical function, TSK-4

Introduction

Kinesiophobia (fear of painful movement), accounts for a moderate amount of the variation in activity limitations (1, 2). Kinesiophobia is modifiable using techniques based on cognitive behavioral therapy that help reduce unhelpful cognitive biases. The influence of kinesiophobia may be somewhat independent of related cognitive biases such as pain catastrophizing (8-11). A shorter measure of kinesiophobia would aid research to further delineate these relationships and would also be more suitable for routine measurement in patient care.

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The Tampa Scale for Kinesiophobia (TSK) is a 17-item questionnaire that quantifies fear of movement (1, 3). A study that compared several short forms of this instrument varying from 4 to 13 items concluded that the TSK-4 had inadequate internal consistency (Cronbach alpha=0.64) (4-7). We felt that this degree of internal consistency would be acceptable if the performance of the measure approximated that of the larger measure.

We addressed the primary null hypothesis that the amount of variation in activity intolerance explained by TSK and TSK-4 are comparable. In secondary analyses, we measured internal aspects of the questionnaire such as coverage and reliability, as well as relationships with other mental health measures.

Materials and Methods

Study Design

Using an approved protocol, 148 consecutive new and return patients seeking musculoskeletal specialty care in a large urban area were enrolled in this cross sectional study over a two-month period. We invited adult, English-speaking patients, seeking care for lower limb symptoms. The diagnosis was obtained from the treating surgeon [Appendix 1].

Measurements

Subjects completed questionnaires on a tablet using REDCap (Research Electronic Data Capture: a secure web-based application for building and managing online surveys and databases) (17). as follows: demographics, the TSK, the Patient-Reported Outcomes Measurement Information System Physical Function (PROMIS PF) Computer Adaptive Test (CAT), the PROMIS Pain Interference (PI) CAT, the PROMIS Depression CAT, and a 4 question version of the Pain Catastrophizing Scale (PCS-4). The survey was completed in under 10 minutes.

The original 17-item version of the TSK creates scores ranging between 17 and 68 with higher scores indicating more fear of movement (1). We used the 4 questions included in the TSK-4 to calculate that score.

PROMIS PF CAT quantifies activity tolerance, PROMIS PI CAT activity intolerance specifically related to pain, and PROMIS Depression CAT symptoms of depression (8, 12, 13).

The PCS-4 quantifies the unhelpful cognitive bias of worst-case thinking in response to nociception (14). The 4-item measure results in a total score ranging from 0 (no catastrophic thinking) to 16 (maximum catastrophic thinking) (14-16).

Statistical Analysis

We tested Pearson correlation to determine the relationship of 2 continuous and normally distributed variables (i.e. to correlate TSK with PROMIS PF CAT), Student's t-tests to compare the means of dichotomous variables (i.e. to compare PROMIS PF CAT scores between men and women), and one-way analysis of variance tests (ANOVA) for differences in continuous variables within categorical variables (i.e. to compare PROMIS PF CAT scores between married, single, and divorced patients). We compared mean total score, range, floor and ceiling effects, and internal consistency (Cronbach alpha). Factors associated with variation in PROMIS PF CAT were sought using a parsimonious linear regression including all bivariate relationships with *$P < 0.10$* [Appendix 2]. We compared the amount of variation accounted for in the models using adjusted R^2) and the amount accounted for by each specific variable using semipartial R^2. Potential multicollinearity was assessed using semipartial R^2, variance inflation factor (VIF), and tolerance.

A sample of 130 subjects was calculated a priori to provide 90% power with a seven factor model and (alpha of 0.05. We enrolled 148 subjects to account for 10-15% potential incomplete responses.

Results

Study Population

There were 72 (49%) men and the mean age was 48 ± 16 years [Table 1]. Ninety-two (62%) patients were

Table 1. Patient and clinical characteristics

Variables	**N = 148**
Age in years	48 ± 16 (18-83)
Men	72 (49)
Race/Ethnicity	
White	95 (64)
Non-White	53 (36)
Marital status	
Married/Unmarried couple	73 (49)
Single	46 (31)
Divorced/Separated/Widowed	29 (20)
Level of education	
High school or less	37 (25)
2-year college	32 (22)
4-year college	47 (32)
Post-college graduate degree	32 (22)
Work status	
Employed	80 (54)
Not working/Other	36 (24)
Retired	32 (22)
Insurance	
Private	94 (64)
Other	54 (36)
Type of diagnosis	
Traumatic	92 (62)
Non-Traumatic	56 (38)
PROMIS Physical Function	39 ± 8.2 (21-63)
PROMIS Pain Interference	60 ± 7.9 (39-84)

Table 1 Continued.	
PROMIS Depression	51 ± 10 (34-78)
PCS-4	5.8 ± 4.5 (0-16)
TSK	40 ± 8.1 (25-64)
TSK-4	9.0 ± 2.6 (4-16)

Continuous variables as mean ± standard deviation (range); Discrete variables as number (percentage); PROMIS = Patient-Reported Outcomes Measurement Information System; PCS-4 = Pain Catastrophizing Scale short form; TSK(-4) = Tampa Scale for Kinesiophobia (-short form).

under care for trauma.

TSK vs TSK-4 Variation in PROMIS PF CAT

On bivariate analysis, TSK and TSK-4 had an inverse correlation with PROMIS PF CAT (r -0.39 and -0.54, respectively) [Appendix 2]. On multivariable analysis both TSK and TSK-4 were independently associated with PROMIS PF CAT (more fear of movement with worse physical function), however TSK explained more variation in physical function than TSK-4 (semipartial R^2 0.30; Adjusted R^2 0.39 vs. semipartial R^2 0.14; Adjusted R2 0.23, respectively) [Table 2].

Factors Associated with PROMIS PF CAT

We found similar results in both models using either the long or short kinesiophobia measures. Greater activity intolerance was independently associated with older age, a traumatic condition, and greater fear of movement in both models [Table 2]. Mental health measures dropped out when included together in a multivariable model, likely due to collinearity.

Score Distributions TSK versus TSK-4

Transforming the TSK and TSK-4 total scores to a 25 to 100 scale ([lowest possible score / highest possible score]

Table 2. Multivariable linear regression of factors associated with PROMIS PF

Model	Retained variables	Regression coefficient (95% CI)	Standard error (SE)	*P value*	Semipartial R^2	Adjusted R^2
(1) PROMIS PF with TSK	Age	-0.12 (-0.20 to -0.03)	0.04	**0.006**	0.03	0.39
	Men	1.8 (-0.64 to 3.8)	1.1	0.10		
	Work status					
	Employed	Reference value				
	Retired	-0.12 (-3.6 to 3.3)	1.8	0.95		
	Not working/Other	-0.33 (-3.1 to 2.4)	1.4	0.81		
	Insurance					
	Other	Reference value				
	Private	0.27 (-2.1 to 2.7)	1.2	0.82		
	Traumatic diagnosis	-4.2 (-64 to -19)	1.1	**<0.001**	0.06	
	TSK	-0.56 (-0.70 to -0.43)	0.07	**<0.001**	0.30	
(2) PROMIS PF with TSK-4	Age	-0.09 (-0.18 to 0.01)	0.05	0.06		0.23
	Men	1.8 (-0.60 to 4.2)	1.2	0.14		
	Work status					
	Employed	Reference value				
	Retired	-0.30 (-4.2 to 3.6)	2.0	0.88		
	Not working/Other	-1.2 (-4.2 to 1.9)	1.5	0.45		
	Insurance					
	Other	Reference value				
	Private	0.38 (-2.4 to 3.1)	1.4	0.79		
	Traumatic diagnosis	-4.2 (-6.7 to -1.7)	1.3	**0.001**	0.06	
	TSK-4	-1.2 (-1.6 to -0.70)	0.24	**<0.001**	0.14	

Bold indicates statistically significant difference; Only the Semipartial R^2 of significant variables is reported; CI = Confidence Interval; PROMIS = Patient-Reported Outcomes Measurement Information System; TSK(-X) = Tampa Scale for Kinesiophobia (-short form).

* 100), we found a slightly higher mean score for the TSK (59 vs 57, *P <0.001*) [Table 3]. A few people scored the floor or ceiling (2% each) of the short measure and no one did so with the longer one. Internal consistency was high for both the long (0.88) and short (0.76) measures.

Interquestionnaire Correlations

We found moderate, inverse correlations between PROMIS PF CAT and PROMIS PI CAT (r -0.30), PROMIS Depression CAT (r -0.35), and PCS-4 (r -0.30) [Table 4]. TSK and TSK-4 were strongly correlated (r 0.86), as expected. Additionally, moderate and inverse correlations were found for PROMIS PF CAT vs TSK (r -0.54) and PROMIS PF CAT vs TSK-4 (r -0.39). PCS-4 was strongly correlated with TSK and TSK-4 (r 0.66, 0.70). Using multivariable analyses, we did not find any variance inflation factors exceeding 10 (2.3 was the highest and neither the tolerance or semipartial R^2 indicated signs of collinearity [Table 5].

Table 3. Number of items, score distributions, floor and ceiling effects, and internal consistency of the TSK and TSK-4

Questionnaire	Number of items	Item completion rate (%)	Mean score	Range	Possible range	Mean scaled score[1]	*P value*	Mean scaled range	Correlation (r)	Floor effect	Ceiling effect	*P value*	Cronbach alpha
TSK	17	100	40 ± 8.1	25-64	17-68	59 ± 12	**<0.001**	37-94	0.86[2]	0 (0)	0 (0)	-	0.88
TSK-4	4	100	9.0 ± 2.6	4-16	4-16	57 ± 16		25-100		3 (2.0)	3 (2.0)	-	0.76

Bold indicates statistically significant difference; Pearson's correlation indicated by *r;* Continuous variables as mean ± standard deviation (range); Discrete variables as number (percentage); [1] Scaled scores converted to maximum of 100; [2] P = <0.001; TSK(-4) = Tampa Scale for Kinesiophobia (-short form).

Table 4. Interquestionnaire correlations (r).[1]

Questionnaire	TSK	TSK-4	PROMIS PF	PROMIS PI	PROMIS Depression	PCS-4
TSK	-					
TSK-4	0.86	-				
PROMIS PF	-0.54	-0.39	-			
PROMIS PI	0.56	0.54	-0.52	-		
PROMIS Depression	0.47	0.44	-0.35	0.55	-	
PCS-4	0.66	0.70	-0.30	0.53	0.54	-

Pearson's correlation indicated by *r*; [1] All *P values <0.001*; TSK(-4) = Tampa Scale for Kinesiophobia (-short form); PROMIS = Patient-Reported Outcomes Measurement Information System; PF = Physical Function; PI = Pain Interference; PCS-4 = Pain Catastrophizing Scale short form.

Table 5. Multivariable linear regression with PROMIS PF and other outcome measures

Model	Retained variables	Regression coefficient (95% confidence interval)	Standard error (SE)	*P value*	VIF	Tolerance	Semipartial R^2	Adjusted R^2
(1) PROMIS PF with TSK	TSK	-0.49 (-0.67 to -0.30)	0.09	**0.001**	2.0	0.50	0.11	0.38
	PCS-4	0.44 (0.10 to 0.78)	0.17	**0.01**	2.1	0.48	0.03	
	PROMIS Depression	-0.06 (-0.19 to 0.07)	0.07	0.39	1.6	0.61	0.003	
	PROMIS PI	-0.36 (-0.53 to -0.18)	0.09	**<0.001**	1.7	0.58	0.07	
(2) PROMIS PF with TSK-4	TSK-4	-0.67 (-1.3 to -0.04)	0.32	**0.04**	2.1	0.47	0.02	0.28
	PCS-4	0.24 (-0.15 to 0.62)	0.19	0.22	2.3	0.44	0.007	
	PROMIS Depression	-0.08 (-0.22 to 0.06)	0.07	0.26	1.6	0.61	0.006	
	PROMIS PI	-0.44 (-0.63 to -0.25)	0.10	**<0.001**	1.7	0.58	0.10	

Bold indicates statistically significant difference; VIF = Variance Inflation Factor; PROMIS = Patient-Reported Outcomes Measurement Information System; PF = Physical Function; PI = Pain Interference; PCS-4 = Pain Catastrophizing Scale short form; TSK(-4) = Tampa Scale for Kinesiophobia (-short form).

Discussion

There is mounting evidence that unhelpful cognitive biases regarding pain such as kinesiophobia and catastrophic thinking account for a notable amount of variation in symptom intensity and activity intolerance for a given nociception (18-20). To better understand their relative influence it would be helpful to measure both using short questionnaires to limit survey business (2, 9, 21). In our assessment the 4 question version of the TSK performs adequately for research and clinical care.

Keep in mind the following limitations. The limited number of sites, all in one city may limit generalizability, although these tend to be relatively consistent human traits. Survey burden and priming are possible, but unlikely given the relative brevity of the questionnaires. Though low VIF scores were found, the TSK and PCS-4 measure the same construct – ineffective coping – and were strongly correlated indicating collinearity. Therefore, we left PCS-4 out of the multivariable model in Table 2. Though, to compare models using only psychological measures and the influence of TSK and TSK-4 on PROMIS PF CAT we used them in Table 5.

The longer version and shorter version of the kinesiophobia measure had comparable correlations with activity intolerance, while the longer version had a stronger correlation and accounted for more variation. This is expected with shorter questionnaires and in our opinion is acceptable for the tradeoff of diminished survey burden. The motivation for this study was prior evidence that TSK and PCS independently account for variations in symptom intensity and physical function. We found that only TSK was associated in multivariable analyses, and neither questionnaire accounted for a large amount of the variation in PROMIS PF CAT. This seems to indicate that the short form (TSK-4) is a reasonable substitute for the full TSK. Additional research is needed to confirm that there is value to using both the TSK and PCS (rather than just one of them) to help us understand the effect of less effective coping strategies in the illness of individual patients during care as well as during research.

There was partial overlap in variables (age and traumatic condition) independently associated with PROMIS PF CAT in both models along with kinesiophobia. We found PCS and TSK to be highly collinear and a model with both was unstable. Our results are consistent with previous research which showed that older age, other types of cognitive bias, and less social support were independently associated with higher TSK scores (21). Additional research found that pain intensity correlated with scores on measures of depression, physical function, and kinesiophobia; however this same study found these effects were larger in traumatic than non-traumatic patients (22).

Interquestionnaire correlations were notable between all the mental health and activity tolerance questionnaires. Additionally, we found high internal consistencies of TSK and TSK-4. High internal consistency emerges due to good instrument coverage and reliability which are markers of instrument validity. Instrument validity basically shows whether a test measures the concept in question. Our results are consistent with a previous study who looked at postoperative spine patients, which showed that TSK-4 was an effective measure of kinesiophobia (7). While previous studies showed the validity and internal consistency of the PCS and PROMIS PI CAT, TSK-4 did not show an adequate internal consistency (7-11). Though a short form is more prone to censoring (i.e. having flooring and ceiling effects), the TSK-4 showed limited flooring and ceiling effects.

The use of TSK-4 combined with other questionnaires preoperative might help identify people and populations at-risk for worse post-operative outcomes (pain intensity, length of recovery, depression). Treatment of signs of depression or anxiety and amelioration of catastrophic thinking (i.e. having less effective coping strategies) and kinesiophobia using cognitive behavioral therapy and related techniques has the potential to improve outcomes with optimal stewardship of resources. The adoption of the TSK-4 instead of the longer TSK may help reduce responder burden. Future studies should determine if measures of unhelpful cognitive biases regarding pain such as TSK or PCS are measuring a single common underlying construct that can be measured with just a few questions.

Patient consent: Informed consent was obtained from all patients. Completing questionnaires indicated informed consent.

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Appendix 1. Diagnoses

	Frequency
Knee osteoarthritis	10 (6.8)
Hip osteoarthritis	7 (4.7)
Nonspecific knee pain	7 (4.7)
Tibial plateau fracture	7 (4.7)
Knee pain	6 (4.1)
Ankle fracture	4 (2.7)
Bimalleolar ankle fracture	3 (2.0)
Meniscus tear	3 (2.0)
Osteoarthritis unspecified	3 (2.0)
Patella fracture	3 (2.0)
Pelvic fracture	3 (2.0)
Talus fracture	3 (2.0)
Unknown	3 (2.0)
Achilles tendon total rupture	2 (1.4)
Ankle pain	2 (1.4)
Anterior cruciate ligament repair	2 (1.4)
Anterior cruciate ligament rupture	2 (1.4)
Bilateral knee osteoarthritis	2 (1.4)
Femur fracture	2 (1.4)
Fibula fracture	2 (1.4)
Internal derangement knee	2 (1.4)
Medial knee pain	2 (1.4)
Medial malleolar fracture	2 (1.4)
Medial meniscus tear	2 (1.4)
Post hip replacement	2 (1.4)
Tibial fracture	2 (1.4)
Trimalleolar ankle fracture	2 (1.4)
2nd to 5th metatarsal neck fractures	1 (0.68)
Abductor muscle strain	1 (0.68)
Achilles tendinitis	1 (0.68)
Achilles tendon partial rupture	1 (0.68)
Achilles tendon post repair infection	1 (0.68)
Ankle and tibia plateau fracture	1 (0.68)
Ankle fracture and contralateral ankle sprain	1 (0.68)
Ankle sprain	1 (0.68)
Anterior cruciate ligament injury	1 (0.68)
Avascular hip necrosis	1 (0.68)
Baker's cyst	1 (0.68)
Bilateral hip and knee pain	1 (0.68)
Bilateral knee pain	1 (0.68)
Calcaneus fracture and contralateral ankle fracture	1 (0.68)
Calcaneus fracture	1 (0.68)

Appendix 1 Continued.

Compound ankle fracture	1 (0.68)
Distal tibia fracture with infected hardware	1 (0.68)
Distal tibia plateau fracture	1 (0.68)
Femoral neck fracture	1 (0.68)
Femur lengthening	1 (0.68)
Fifth metatarsal fracture	1 (0.68)
Gout in knee	1 (0.68)
Greater trochanter fracture femur	1 (0.68)
Hip bursitis	1 (0.68)
Hip dysplasia	1 (0.68)
Hip fracture	1 (0.68)
Hip replacement trauma	1 (0.68)
Knee pain after bilateral knee replacements	1 (0.68)
Knee pain after unilateral knee replacement	1 (0.68)
Labral tear hip	1 (0.68)
Lateral malleolar avulsion fracture	1 (0.68)
Lateral malleolar fracture	1 (0.68)
Lateral tibial plateau fracture	1 (0.68)
Lisfranc fracture	1 (0.68)
Lumbar radiculopathy	1 (0.68)
Malleolar avulsion fracture and tibial plateau fracture	1 (0.68)
Midfoot osteoarthritis	1 (0.68)
Neuritis unspecified	1 (0.68)
Nonspecific foot pain	1 (0.68)
Nonspecific hip and knee pain	1 (0.68)
Nonunion Pilon fracture	1 (0.68)
Nonunion ankle fracture	1 (0.68)
Nonunion distal tibial fracture	1 (0.68)
Nonunion femur fracture	1 (0.68)
Open bimalleolar fracture	1 (0.68)
Patella tendon repair	1 (0.68)
Patellofemoral osteoarthritis	1 (0.68)
Pelvic sprain	1 (0.68)
Peroneus brevis tear	1 (0.68)
Pes planus	1 (0.68)
Septic osteoarthritis	1 (0.68)
Slipped capital femoral epiphysis	1 (0.68)
Small toe fracture	1 (0.68)
Syndesmosis injury ankle	1 (0.68)
Tibial and fibula fracture	1 (0.68)
Tibial plateau and bimalleolar ankle fracture	1 (0.68)
Tibial spine evulsion fracture	1 (0.68)
Toe dislocation	1 (0.68)

Discrete variables as number (percentage).

Appendix 2. Bivariate analyses of factors associated with PROMIS PF

Variables	PROMIS PF	*P value*
Age (r)	-0.16	0.06
Sex		
Women	38 ± 7.8	0.09
Men	40 ± 8.6	
Race/Ethnicity		
White	39 ± 8.2	0.57
Non-White	39 ± 8.4	
Marital status,		
Married/Unmarried couple	40 ± 9.0	
Single	39 ± 7.6	0.60
Divorced/Separated/Widowed	38 ± 7.5	
Level of education		
High school or less	38 ± 8.1	
2-year college	38 ± 8.2	0.58
4-year college	40 ± 7.4	
Post-college graduate degree	40 ± 9.6	
Work status		
Employed	41 ± 8.2	
Not working/Other	37 ± 7.7	0.051
Retired	38 ± 8.5	
Insurance		
Private	40 ± 8.6	0.09
Other	38 ± 7.5	
Diagnosis		
Nontraumatic	42 ± 6.8	**0.002**
Traumatic	38 ± 8.7	
PROMIS Pain Interference (r)	-0.52	**<0.001**
PROMIS Depression (r)	-0.35	**<0.001**
PCS-4 (r)	-0.30	**<0.001**
TSK (r)	-0.54	**<0.001**
TSK-4 (r)	-0.39	**<0.001**

Bold indicates statistically significant difference; Pearson's correlation indicated by *r*; Continuous variables as mean ± standard deviation, unless otherwise indicated; PROMIS = Patient-Reported Outcomes Measurement Information System; PCS-4 = Pain Catastrophizing Scale short form; TSK(-4) = Tampa Scale for Kinesiophobia (-short form).