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Norming of the Tampa Scale for Kinesiophobia across pain diagnoses and various countries

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ABSTRACT

The present study aimed to develop norms for the Tampa Scale for Kinesiophobia (TSK), a frequently used measure of fear of movement/(re)injury. Norms were assessed for the TSK total score as well as for scores on the previously proposed TSK activity avoidance and TSK somatic focus scales. Data from Dutch, Canadian, and Swedish pain samples were used (N = 3082). Norms were established using multiple regression to obtain more valid and reliable norms than can be obtained by subgroup analyses based on age or gender. In the Dutch samples (N = 2236), pain diagnosis was predictive of all TSK scales. More specifically, chronic low back pain displayed the highest scores on the TSK scores followed by upper extremity disorder, fibromyalgia, and osteoarthritis. Gender was predictive of TSK somatic focus scores and age of TSK activity avoidance scores, with male patients having somewhat higher scores than female patients and older patients having higher scores compared with younger patients. In the Canadian (N = 510) and Swedish (N = 336) samples, gender was predictive of all TSK scales, with male patients having somewhat higher scores than female patients. These norm data may assist the clinician and researcher in the process of decision making and treatment evaluation.

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1. Introduction

A plethora of research has shown that pain-related fear is associated with the maintenance of (chronic) pain [2,16,34]. More specifically, pain-related fear is associated with impaired physical performance [1,8,32] and increased self-reported disability [2,33], and may predict future occupational disability [9,11,14,36]. A number of self-report measures of pain-related fear are available, such as the Pain Anxiety Symptoms Scale [18] and the Fear-Avoidance Beliefs Questionnaire [35], all tapping different forms or aspects of pain-related fear. The Tampa Scale for Kinesiophobia (TSK) [19] is a widely used instrument to assess fear of movement/(re)injury and has been applied to various pain conditions such as chronic low back pain [8,12,23], fibromyalgia [23], osteoarthritis [13], traumatic neck pain [6,20], sports injury [15], sickle cell disease [22], and burn pain [37].

Most factor-analytic studies of the TSK have favored a 2-factor solution [5,10,12,23,38]. Recently, Roelofs et al. [24] found that a 2-factor model of the TSK comprising TSK activity avoidance (TSK-AA; beliefs that activity may result in [re]injury or increased pain) and TSK somatic focus (TSK-SF; beliefs in underlying and serious medical problems) could be applied to (ie, was invariant across) Dutch, Swedish, and Canadian samples and various pain conditions. Although these findings illustrate the transdiagnostic nature of the 2 TSK scales, there is a need for norm scores in both clinical and research settings, so that the raw score of a single pain patient can be compared with the scores in the reference population. Norm scores can assist in providing quantitative labels for the degree to which a raw TSK score is to be considered as average, elevated, or extreme and might be useful for diagnostic purposes, clinical decision making, or the evaluation of treatment effects.

A traditional approach to deriving norm scores is to compare an individual's raw score to a reference group that matches on background variables such as age and gender. Test norms are thus

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generally obtained by splitting the reference group into subgroups based on these background variables [21]. However, it is unknown what background variables are relevant for deriving norm scores, and splitting a sample into subgroups leads to a loss of information and consequently unstable and unreliable norms. Multiple regression as a technique for norming questionnaire data overcomes these 2 limitations of traditional norming as this approach allows for an examination of which background variables are predictive of the scores in the full sample. This way, reliable and valid norm scores can be obtained [30]. This study sought to develop norm scores of the TSK (total score) and 2 TSK subscales (ie, TSK-AA and TSK-SF) in Dutch, Canadian, and Swedish samples. Based on previous research that has shown that TSK scores correlate with gender [28,32,33] and studies showing that TSK scores seem to depend on pain diagnosis [3,4,13,23,26,27], these variables were included as norming variables. In a more exploratory way, age, country, and language of TSK (only for Canada) were also included as norming variables.

2. Methods

2.1. Participants and procedure

In line with Roelofs et al. [24], data from Dutch patients with upper extremity disorders (N = 1109) [26], chronic low back pain (N = 482, 225 from the original study and another 257 referred patients) [23], fibromyalgia (N = 391) [23], and osteoarthritis (N = 254) [13] were included as well as data from Canadian patients with musculoskeletal pain who completed the English version of the TSK (N = 335) [27] or the French version of the TSK (N = 175, unpublished data), and data from Swedish patients with musculoskeletal pain (N = 336) [3,4]. Thus, a total number of 3082 patients with various chronic musculoskeletal pain conditions were included. Table 1 presents an overview of age and gender characteristics of all pain samples included in this study. A more detailed description of the samples can be found in the original articles.

2.2. TSK

The TSK [19,32] was used to assess fear of movement and (re)-injury. The TSK has 17 items, with items 4, 8, 12, and 16 being reversely scored items. Each item is scored on a 4-point Likert-type scale. Scoring possibilities range from strongly disagree (score = 1) to strongly agree (score = 4). Total TSK scores range between 17 and 68. Previous research has supported a 2-factor model of the TSK comprising 11 items [24,38]. More specifically, the TSK-AA (sample item: "I'm afraid that I might injure myself if I exercise") scale comprises 6 items with scores ranging between 6 and 24, and the TSK-SF (sample item: "My body is telling me I have something dangerously wrong") consists of 5 items with scores ranging from 5 to 20. The remaining 6 items of the total TSK were not included in the TSK-AA or the TSK-SF scales. Table 2 presents descriptive information of the TSK scales for all samples.

2.3. Statistical analyses

The Statistical Package for the Social Sciences (version 15.0, SPSS Inc., Chicago, Illinois, USA) was used to carry out the regression analyses to determine a parsimonious model for obtaining TSK norms (see van Breukelen et al. [30] for a detailed description). Based on earlier work [24,38], 11 of 17 TSK items were selected for norming the subscales, whereas all 17 items were used for norming the total score. More specifically, norm scores were developed for the TSK-AA scale (6 items, range 6 to 24), the TSK-SF scale (5 items, range 5 to 20), and TSK total scale (TSK-Total; 17 items, range 17 to 68). For norming the TSK scales, scores on the TSK were the dependent variables in the regression analyses, and gender, age, pain diagnosis, country, and language (only for Canada) were the predictor variables. Dummy coding was used for the categorical predictors gender (0 = male, 1 = female) and pain diagnosis. For pain diagnosis, low back pain served as the reference category. Due to collinearity of country with diagnosis in our sample (ie, the Dutch sample did not include musculoskeletal pain, whereas the Canadian and Swedish samples consisted of this diagnosis group only), norms were determined for the Dutch sample separately. Country was therefore only examined for Canada and Sweden (0 = Canada, 1 = Sweden). By using dummy coding, a regression weight is included in the model to represent the mean scale difference between the reference category and each other category, adjusted for all other predictors in the model. Linear and quadratic terms were included for the quantitative predictor

Table 1
Descriptive information about the various samples.

Country and sample	Mean age	SD	% Female
Dutch			
Low back pain (N = 482)	51.9	14.1	61
Fibromyalgia (N = 391)	47.4	10.1	94
Osteoarthritis (N = 254)	51.7	5.0	59
Upper extremity disorders (N = 1109)	40.7	8.7	67
Canadian			
Musculoskeletal pain (N = 335) (English sample)	41.8	8.6	44
Musculoskeletal pain (N = 175) (French sample)	41.4	11.3	53
Swedish			
Musculoskeletal pain (N = 336)	46.2	9.4	53

Table 2
Descriptive statistics and internal consistency ratings of the TSK-11 and its subscales in various pain populations.

Pain population	Mean	SD
Upper extremity disorders (N = 1109)		
TSK-Total	37.8	7.6
TSK-AA	14.3	3.6
TSK-SF	11.3	3.2
Chronic low back pain (N = 482)		
TSK-Total	43.2	8.4
TSK-AA	16.1	4.3
TSK-SF	12.1	3.6
Fibromyalgia (N = 391)		
TSK-Total	36.6	8.4
TSK-AA	14.0	3.8
TSK-SF	10.4	3.3
Osteoarthritis (N = 254)		
TSK-Total	24.5	6.0
TSK-AA	13.9	3.7
TSK-SF	10.6	3.2
Musculoskeletal pain English version (N = 335)		
TSK-Total	42.0	8.2
TSK-AA	15.5	3.5
TSK-SF	13.0	3.5
Musculoskeletal pain French version (N = 175)		
TSK-Total	44.2	8.7
TSK-AA	16.2	3.9
TSK-SF	13.9	3.5
Musculoskeletal pain Swedish version (N = 336)		
TSK-Total	39.4	6.8
TSK-AA	12.5	3.7
TSK-SF	11.5	3.9

TSK-AA = Tampa Scale for Kinesiophobia activity avoidance; TSK-SF = Tampa Scale for Kinesiophobia somatic focus.

age to examine linear and curvilinear effects of age [30]. The age variable was centered (by subtracting the mean age from each individual value) before computing the quadratic term to prevent near-collinearity with the quadratic age term.

The regression models were reduced in a stepwise fashion by eliminating the least significant predictor ($P > .05$). For the final models, residuals were plotted and analyzed to check the assumptions of normality and homogeneity of residual variance across the entire range of predicted scale scores and the absence of outliers. With the final model, a raw scale score of an individual can be converted into a standardized z-score by computing the predicted score Y (by means of filling in the regression analysis), computing the residual error (subtracting predicted Y from observed Y), and finally, dividing the residual error by the SD(e), which is the square root of the MS(residual). If the residuals are normally distributed with the same variance, then z is normally distributed and the standard normal distribution can be used to interpret z-values [30].

3. Results

3.1. Predictors of the TSK scores

To examine whether separate norms for the Canadian and Swedish samples were needed, interactions between country (0 = Canada, 1 = Sweden) and age, and between country and gender were tested. These were not significant ($P > .05$), and so norms for Canada and Sweden could be calculated from the joint data by using a regression model with a main effect of country in addition to age, gender, and language effects. Within the Dutch and Canadian/Swedish samples, the interaction between age and gender was not significant, and within the Canadian sample, the interactions between language and age and between language and gender were not significant. Thus, norm scores for the TSK scales did not have to be calculated for subgroups based on age, gender, or language separately, but could be obtained from the total sample (Dutch, or Canadian/Swedish) with a regression model with main effects of age, gender, country, language. This gives more reliable norms due to larger sample size than in subgroup analyses.

Regression analysis revealed that, except for TSK-AA in the Dutch samples, gender emerged as a significant predictor of all TSK scales in the Dutch samples as well as the Canadian/Swedish samples, with male patients having higher scores than female patients. Age emerged as a significant predictor for TSK-AA and TSK-Total only in the Dutch samples, with older patients having higher TSK scores. Further, pain diagnosis was a significant predictor of TSK-AA, TSK-SF, and TSK-Total. Patients with chronic low back pain had the highest TSK scores, followed by upper extremity disorders, fibromyalgia, and osteoarthritis. Country was a significant predictor of TSK scores, with higher TSK scores on all scales in Canada compared with Sweden. Language was not a predictor of TSK scores in the Canadian sample.

3.2. Model checks

Before continuing with computing z-scores, some model checks are necessary. More specifically, the use of (standardized) residuals requires a normal distribution with homogeneous variances. In all models, normality was checked by means of skewness and kurtosis (ie, values should be in the range of −1 to +1) as well as visual inspection of histograms and by means of the Kolmogorov–Smirnov test. Residuals were normally distributed for TSK-AA, TSK-SF, and TSK-Total. Further, actual percentiles (5, 10, 25, 50, 75, 90, 95) of the standardized residuals were compared with the corresponding percentiles of the standard normal distribution, and revealed no deviation larger than .10. The homogeneity of variances was tested by grouping patients into quartiles of the predicted scale score and applying Levene's test to the residuals. The homogeneity assumption was not violated ($P > .05$), and the residual standard deviation within each quartile did not deviate more than 10% from the overall residual standard deviation of the scale. Thus, the overall residual standard deviations were used to compute z-scores.

3.3. Computing z-scores

The final models for the 3 TSK scales can be used to convert raw scores of an individual into a standardized residual or z-score. For the Dutch sample, results of the final models are presented in Table 3. As can be seen in Table 3, the linear and quadratic age terms were replaced with dummy indicators to simplify computation of the predicted score for a person and thereby to increase user-friendliness of our regression models at the price of a small loss of precision, by categorizing age into 5 groups (18 to 30 years, 31 to 40 years, 41 to 50 years, 51 to 60 years, and >60 years), with the 18 to 30 years group as the reference group. These 5 age groups comprised respectively 9.4%, 9.6%, 24.5%, 32.1%, and 24.4% of the total sample size. The reference categories for age and pain diagnosis were chosen such as to simplify the regression output because TSK scores were lowest in the reference age group and highest in the reference diagnosis (low back pain). To illustrate how Table 3 can be applied, consider a Dutch male patient with fibromyalgia with a TSK-SF score of 14. Table 3 gives a predicted score of 12.50 (constant) − .70 (gender = 0) − 1.40 (fibromyalgia = 1) − 1.53 (osteoarthritis = 0) − .77 (upper extremity disorders = 0) = 11.10. The residual standard deviation is $\sqrt{10.68} = 3.27$. Thus, the z-score is equal to $(14 - 11.10)/3.27 = .89$, which means that this man's score is considered in the normal range (see below). In a similar vein,

Table 3
Final regression model for TSK-SF, TSK-AA, and TSK-Total in Dutch samples (N = 2236).

Predictor	B	SE of B	P (2-tailed)
TSK-SF (R^2 = .04, MS residual = 10.68)			
Constant	12.50	.17	<.001
Gender	−.70	.15	<.001
Fibromyalgia	−1.40	.23	<.001
Osteoarthritis	−1.53	.25	<.001
Upper extremity disorders	−.77	.18	<.001
TSK-AA (R^2 = .05, MS residual = 14.23)			
Constant	15.36	.33	<.001
Fibromyalgia	−1.88	.26	<.001
Osteoarthritis	−2.06	.31	<.001
Upper extremity disorders	−1.38	.23	<.001
Age (31–40)	.04	.31	.89
Age (41–50)	.55	.31	.08
Age (51–60)	.70	.32	.03
Age (61 or more)	1.62	.42	<.001
TSK-Total (R^2 = .10; MS residual = 62.01)			
Constant	42.26	.72	<.001
Gender	−1.02	.36	.004
Fibromyalgia	−5.68	.57	<.001
Osteoarthritis	−6.28	.65	<.001
Upper extremity disorders	−4.30	.48	<.001
Age (31–40)	.13	.66	.85
Age (41–50)	.88	.65	.17
Age (51–60)	1.15	.65	.10
Age (61 or more)	3.54	.69	<.001

Low back pain is the reference group. Gender is coded as dummy (0 = male; 1 = female). Age 18 to 30 years is the reference category for age effects. TSK-SF range: 5 to 20; TSK-AA range: 6 to 24; TSK-Total scores range: 17 to 68.
MS = Mean square; SE = standard error; TSK-AA = Tampa Scale for Kinesiophobia activity avoidance; TSK-SF = Tampa Scale for Kinesiophobia somatic focus; TSK-Total = Tampa Scale for Kinesiophobia total scores.

results of the final regression models for the Canadian/Swedish samples are presented in Table 4.

3.4. Interpreting z-scores

On the basis of the obtained z-score, the following interpretation can be given. Scores that lie in the interval between −1 and +1 are considered normal scores. Scores above 1 are considered elevated scores, whereas scores above 2 are indicative of high scores. Scores below −1 are reduced scores, whereas scores below −2 are low scores. To ensure user-friendly norm procedures, tables with norm scores are presented in Appendices 1–3. Because the residuals from which the z-scores were computed had a normal distribution and the actual percentiles agreed very well with percentiles according to the normal distribution, the z-scores of −2, −1, 0, 1, 2 correspond to the 2nd, 16th, 50th, 84th, and 98th percentiles, respectively.

4. Discussion

The present study sought to develop norms for the TSK total score as well as the previously reported TSK-AA and TSK-SF scales [12,21,23]. Multiple regression analysis was used to investigate which background variables were important to take into account for deriving norm data as well as to obtain reliable and stable norms. Due to statistical constraints (collinearity of diagnosis with country if all 3 countries were included in the analysis), norms were determined for Dutch and for Canadian/Swedish samples separately. Appendices 1–3 present norm data (as computed with the regression models in Tables 3 and 4) in a user-friendly form. These Appendices can be used to compare the raw TSK score of a single patient with scores in the reference population by determining the z-interval in which the raw TSK score lies, and subsequently, how extreme a raw TSK score is.

In deriving norm data, relevant background variables that influence the norm data were identified. It was hypothesized that pain diagnosis and gender would emerge as significant norming variables. Pain diagnosis significantly predicted TSK scores in the Dutch samples, with patients with low back pain (reference group) having higher scores on all TSK scales compared with patients with fibromyalgia, osteoarthritis, and upper extremity disorders. Thus, patients with low back pain seem to endorse beliefs that the occurrence of pain indicates underlying serious bodily damage (TSK-SF) and anxious beliefs that activity may result in (re)injury or increased pain (TSK-AA) to a greater extent than patients with another pain diagnosis. Except for TSK-AA in the Dutch samples, gender was found to be predictive of all TSK scales in all samples. Male patients were found to have somewhat higher scores compared with female patients, which is in line with previous studies [28,32,33] showing that male patients endorse higher levels of fear-avoidance beliefs than female patients. In accounting for this gender difference, it should be noted that the effect of gender was significant but quite modest. Nevertheless, the finding that male patients have somewhat higher scores than female patients contradicts research showing that female patients generally display higher levels of somatic and anxiety symptoms compared with male patients. Future research should examine possible explanations. Notwithstanding, the findings add to the idea that, also in the light of gender, assessing different stimulus and response dimensions of anxiety, and pain-related fear in particular, is important [17,31]. Age was found to influence TSK-AA and TSK-Total scores in the Dutch samples only, with older pain patients having higher scores. Studies that have examined the relation between age and TSK have produced mixed results [7,28]. It may be that (re)injury risks are higher for older adults and that associated fears that are tapped specifically with the TSK are fueled when catastrophic thinking occurs (see also Leeuw et al. [16]). There is, however, some evidence to suggest that high pain catastrophizing is associated with younger age [25,29], which would be associated with lower levels of fear in older pain patients. Clearly, more research is needed to unravel the relation between age and fear of movement/(re)injury.

Some differences between the results for the Dutch versus Canadian/Swedish samples need discussion. In the Dutch sample, gender did not predict TSK-AA, and age did not predict TSK-SF, whereas both predicted TSK-Total scales. In the Canadian/Swedish sample, age was not predictive and gender was predictive for each scale. These differences between countries/samples cannot be attributed to confounding by diagnosis, which was adjusted for in the Dutch sample and constant in the other sample. Interaction of diagnosis with age or gender could be an explanation because diagnosis was collinear with country. However, an additional test of such interaction in the Dutch sample (in which diagnosis varied) did not show such interaction. Alternatively, these findings may be explained by differences in the inclusion criteria for the various studies, differences in the organization of the health care system between countries, differences in the severity and comorbidity of symptoms that patients present in the various pain clinics, and the translational nature of the TSK questionnaire. Our data support the notion that it is important to examine whether it is necessary to provide norm data separately for subgroups based on background variables. A priori providing norms on the basis of subgroups (1) requires knowledge of which personal characteristics are relevant for subgrouping (validity), and (2) may lead to a loss of precision in estimating regression weights and residual variance. With multiple regression, we can first determine which subgroups have to be formed and then estimate effects and variance as reliably as possible by preventing splitting of the sample into unnecessarily small groups. In the present study, splitting by country was needed because of collinearity with diagnosis, but splitting by age or gender within countries was not, because no age–gender interaction was found.

How can these norms be applied? Because the interpretation of raw TSK scores will differ for the various pain diagnoses, z-scores computed from the residuals of the present regression of the TSK scales can provide a more objective picture of the clinical relevance of levels of pain-related fear in different groups of pain patients. More specifically, the norms for the TSK scales (see Appendices) can be used to assess fear of movement/(re)injury in individuals

Table 4
Final regression model for TSK-SF, TSK-AA, and TSK-Total in the Canadian (N = 510) and Swedish (N = 336) samples.

Predictor	B	SE of B	*P* (2-tailed)
TSK-SF (R^2 = .03, MS residual = 12.67)			
Constant	13.74	.20	<.001
Country	−.72	.24	.004
Gender	−.96	.25	<.001
TSK-AA (R^2 = .24, MS residual = 14.33)			
Constant	16.23	.21	<.001
Country	−4.22	.27	<.001
Gender	−.95	.26	<.001
TSK-Total (R^2 = .12; MS residual = 75.85)			
Constant	43.84	.49	<.001
Country	−6.21	.62	<.001
Gender	−2.19	.60	<.001

Gender is coded as dummy (0 = male; 1 = female) and country is coded as dummy (0 = Canada; 1 = Sweden). TSK-SF range: 5 to 20; TSK-AA range: 6 to 24; TSK-Total TSK scores range: 17 to 68.
MS = Mean square; SE = standard error; TSK-AA = Tampa Scale for Kinesiophobia activity avoidance; TSK-SF = Tampa Scale for Kinesiophobia somatic focus; TSK-Total = Tampa Scale for Kinesiophobia total scores.

and compare a patient's score to those of other patients with the same background characteristics. Individuals with low or very low z-scores on the TSK scales might experience few signs of pain-related fear relative to patients with the same diagnosis, age, and gender. However, it may also be the case that those with extremely low scores on the TSK may in some way deny these symptoms, so in clinical practice we advise interpretation of very low scores in the light of scores on other measures available.

In sum, the results of the current study provide reliable norms for various pain populations. Three limitations need to be addressed. First, for some models, the explained variance is rather low and indicates that the background variables are perhaps of minor importance. Other background variables such as education or pain duration, which have shown to be related to a measure of pain cognition [30], might also have been relevant, but this information was not available. Second, generalization of the norms beyond the diagnoses and countries included in the current study is not warranted. Finally, the use of stepwise regression to reduce the model entails some risk that replication in a new sample would lead to a slightly different model. This is the price paid for model reduction for the sake of user-friendliness of norming. The alternative would be to use the full model with all predictors and interactions for norming at the expense of simplicity. But given this stepwise model reduction, cross-validation of the current model in a different sample would be useful. On the positive side, this study used a large sample of pain patients with various diagnoses for norming the TSK scales. The data add to previous studies that have supported the reliability and validity of the TSK scales by providing norms that may assist the clinician and researcher in the process of decision making and treatment evaluation.

Conflict of interest statement

The authors report that they have no conflict of interest regarding this publication.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.pain.2011.01.028.

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