Fear of movement/(re)injury in Chinese patients with chronic pain: Factorial validity of the Chinese version of the Tampa Scale for Kinesiophobia

Running title: Chinese Tampa Scale for Kinesiophobia


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Abstract:

**Objective:** To assess the factor structure of the Chinese version of Tampa Scale for Kinesiophobia (TSK).

**Design/Patients:** Chinese patients with chronic pain attending either orthopedics specialist services \( (n=216) \) or multidisciplinary specialist pain services \( (n=109) \) participated in this study.

**Method:** Subjects completed the Chinese version of TSK, The Chronic Pain Grade Questionnaire, Hospital Anxiety and Depression Scale, and questions assessing socio-demographic characteristics. Confirmatory factor analyses (CFA) were used to compare hierarchical and correlated models of five different factor solutions previously reported in patients with chronic pain in the West.

**Results:** CFAs demonstrated inequality of the TSK factor structure in that the TSK11 for the Orthopedics sample was best represented by a two-factor correlated model \( (S-B\chi^2=49.593; CFI=0.93; NFI=0.911; RMSEA=0.025) \) comprising two first-order factors, Somatic Focus (TSK11-SF) and Activity Avoidance (TSK-AA). The Pain Clinic sample showed a one-factor structure as best representing the TSK4’s underlying dimensions \( (CFI=0.971; NFI=0.912; RMSEA=0.048) \).

No evidence was seen for a single overarching concept of kinesiophobia.

**Conclusion:** The TSK appears to have utility in Chinese chronic pain populations. Elucidation of the TSK’s psychometrics properties in other Chinese/Asian pain populations with different diagnoses and presentations of pain problems is warranted.

**Key words:** Tampa Scale for Kinesiophobia, Chinese, chronic pain, confirmatory factor analysis.
Introduction

Pain-related fear can both maintain and exacerbate pain and associated disability (1, 2). Patients with chronic low back pain (CLBP) with higher levels of pain-related fear report more pain (3, 4), greater disability (5-7) and reduced physical functioning (8, 9). Similar findings are also documented for patients with acute low back pain (ALBP) (10, 11). Conversely, a number of intervention studies show that lowering pain-related fear is associated with reduced work absence (12) and compensation costs (13), improved functional abilities (14, 15) and increased physical activity levels (16).

The 17-item Tampa Scale for Kinesiophobia (TSK) (17, 18) was designed to assess fear of movement/(re)injury. Different factor structures for the TSK have been reported. In a sample of CLBP, Vlaeyen et al. (8) identified 4 factors for the Dutch version of the 17-item TSK (TSK17) using principal component analysis (PCA). Clark et al. (19) later reported a two-factor model for a 13-item version on in-patients with chronic pain. This two-factor structure was replicated using confirmatory factor analysis (CFA) by Geisser et al. (20) in patients with CLBP. In a sample of ALBP, Swinkels-Meewisse et al. (11) failed to replicate Vlaeyen et al.’s (8) four-factor structure and Clark et al.’s (19) two-factor model, and instead identified a different two-factor solution for the TSK17. This new two-factor structure, which omitted the four reverse-scored items was later confirmed by CFA. Goubert et al. (21) suggested Clark et al.’s (19) two-factor structure was invariant across 188 patients with CLBP and 89 patients with fibromyalgia (FM). The Swedish version of TSK demonstrated good internal consistency and construct validity in a sample of patients with CLBP (22).

Subsequently, Woby et al. (23) documented that, in a sample of ALBP, not only did the four reverse-scored items have low item-total correlations, item analyses further showed items 9 and 14 deviated from a normally distributed pattern. Given these findings, the authors excluded these six items and examined the psychometric properties of the remaining 11 items (TSK11).
The TSK11 possessed good internal consistency, test-retest reliability, responsiveness, concurrent validity, and predictive validity. Roelofs et al. (24) re-examined Woby et al.’s (23) TSK11 in patients with chronic musculoskeletal pain drawn from Netherlands, Sweden, and Canada. CFAs offered support for a two-factor structure for the TSK11. Based on a sample of patients with sciatica due to disc herniation, a recent study identified 3 factors in the Norwegian version of the 13-item TSK using PCA and concluded that the scale possessed good internal consistency and construct validity (25).

Hence, the TSK’s psychometric properties have been determined in different patient groups, such as CLBP (8, 20, 21, 23), ALBP (26), other pain conditions (19, 24, 27) and FM (21, 28). The differences in factor structure seen across studies are probably mainly due to sample heterogeneity and different statistical methods employed. Thus far, the TSK has only been examined in Western countries. Chronic pain is common among Chinese adults in Hong Kong’s general population, with a prevalence of 34.6% (29). Specialist services for chronic pain in Hong Kong are currently limited to four multidisciplinary pain clinics in public hospitals. Most patients with chronic pain are managed by orthopedics specialists. This study aimed to evaluate the factorial validity of a Chinese version of the TSK in a sample of Chinese patients with chronic pain. In particular we examined if the TSK could be extended to patients with chronic pain attending orthopedics specialist services and pain clinic multidisciplinary services in Hong Kong.

Materials and Methods

Subjects

Following ethics approval, subjects were recruited from two Orthopedics specialist out-patient clinics (SOPC) and an outpatient Pain Clinic in Hong Kong. Patients were invited to participate in the present study during visits for clinical consultations with doctors. Patients were eligible for study participation if they met the following criteria: (1) 18 or above years of age, (2)
native Cantonese speakers, (3) having no communication problems or physical conditions that would prevent the completion of the interview, (4) no confusion or cognitive impairment diagnosis from medical record, and (5) willingness to participate in the study. All eligible patients gave informed consent and were interviewed while they were waiting for medical consultation.
Measures

**Tampa Scale for Kinesiophobia (TSK)**

Rated on a 4-point Likert scale (1=strongly disagree; 4=strongly agree), the TSK was designed to assess fear of movement/(re)injury. Of the original 17 items, four (items 4, 8, 12, and 16) are negatively phrased and thus reverse scored. Total score ranges from 17 to 68. The Chinese version of TSK was translated by the first author. The initial Chinese version was back-translated by a bilingual local psychologist. To evaluate the semantic equivalence of the Chinese items with the English version, the items were reviewed by an orthopaedics physician, a clinical psychologist, and a postgraduate student, all of whom were bilingual in Chinese and English. Discrepancies were discussed and resolved by joint agreement between translator and reviewers and the translation amended as necessary. Comprehensibility and appropriateness of the language in the Chinese cultural context were emphasized in the translation and cross-cultural adaptation procedure. The penultimate Chinese TSK version was piloted on 20 local Chinese patients attending a public hospital orthopaedics SOPC in Hong Kong. Subsequently, patients were asked to explain their responses on each item to the researchers. The finalized translation of the Chinese version of TSK was prepared based on the results of this pilot.

**Chronic Pain Grade (CPG)**

The presence of chronic pain was first identified by affirmative answers to two questions: (i) “Are you currently troubled by physical pain or discomfort, either all the time, or on and off?”; (ii) Have you had this pain or discomfort for more than 3 months?”(30). Subjects answering yes to both questions were then asked about site of their pain. Chronic pain severity was assessed using the Chronic Pain Grade (CPG) questionnaire (31), a seven-item instrument that measures severity in three dimensions: persistence, intensity and disability. Rating on an 11-point scale (0=no pain at all; 10=pain as bad as could be), three pain intensity items assess the present,
average, and worst pain of the respondents. Three items measured pain interference with daily activities, social activities, and working ability on an 11-point rating scale (0=no interference/change, 10=unable to carry on activities/extreme change). The original questionnaire inquires about current pain and pain over the previous 6 months and classifies chronic pain into five hierarchical grades: Grade Zero (pain free), Grade I (low disability-low intensity), Grade II (low disability-high intensity), Grade III (high disability-moderately limiting) and Grade IV (high disability-severely limiting). Considering the definition of chronic pain by IASP (30) as pain which has persisted for at least 3 months, we changed the time frame of CPG items from 6 months to 3 months. The CPG is valid and reliable when used as a self-completion postal questionnaire in the UK general population ($\alpha>0.9$) (32) and is responsive to change over time (33). It is also suitably brief. Respondents were classified as having chronic pain if they reported having any pain symptom that has persisted for at least three months.

**Hospital Anxiety and Depression Scale (HADS)**

Respondents’ mental health was evaluated with the Hospital Anxiety and Depression Scale (34) (HADS), which was utilized because the scale, designed for assessing emotional well-being in those with physical illness measures affective and behavioral symptoms of depression rather than cognitive and physical symptoms which may be attributable to underlying medical illness and not psychological causes. The 14 item HADS comprises two subscales measuring anxiety (HADS-A, seven items) and depression (HADS-D, seven items). Individuals indicate their feelings over the past week on three-point Likert scales. Each HADS subscale is scored between 0 and 21, with higher scores indicating greater levels of anxiety and depressive symptoms. Both anxiety (Cronbach’s $\alpha=0.93$) and depression (Cronbach’s $\alpha=0.90$) subscales have good internal consistency (35). Psychometrics for Chinese populations suggest cut-offs of 15/16, 8/9, and 5/6 for the full, depression, and anxiety scales respectively (36, 37). Both the
anxiety and depression subscales for Chinese versions have good test-retest reliability (35), and good internal consistency (36).

**Socio-demographic and pain-related characteristics**

The socio-demographic section included questions on sex, age, education, marital status, and employment status. In addition to the CPG, four pain-related variables were assessed including whether the patients were pursuing litigation because of pain (no/yes), whether the patients were pursuing medico-legal compensation because of pain (no/yes), whether pain was the reason for the first clinic visit (no/yes, pain was the main reason/yes, pain was one of the symptoms, but not the main reason), pain duration, and number of days of pain associated sick leave.

**Statistical Analysis**

Using SPSS (Statistical Package for the Social Sciences) version 15.0 (38), descriptive statistics summarized socio-demographic and pain characteristics of the sample, then t-tests and \( \chi^2 \) tests were used to examine whether pain characteristics and fear of movement/(re)injury differentiated between types of pain service received.

To examine univariate and multivariate normality assumptions in the present Chinese sample data, univariate skew and kurtosis as well as Mardia’s coefficient for skewness and kurtosis were computed (39). CFA using EQS for Windows 6.1 structural equation modeling program (40) was used to examine the factor structure of the TSK. There are five different factor solutions previously reported in the literature (8,11,19,24,28). Which of these solutions would be best for these two Chinese samples was unknown. Therefore all five different factor solutions were each independently assessed for fit to each of the two samples, and also both hierarchical and correlated models were compared (excepting for the one-factor model where these are not
applicable). This generated four models for each of the four different previous multi-factor solutions examined on each of the two samples, and two models for the one-factor solution.

A number of fit indices were employed to assess data-model fit. Since the $\chi^2$ statistic has known limitations in relation to sample size and evaluation of model approximations, the comparative fit index (CFI) (41), normed-fit index (NFI) (42), root mean square error of approximation (RMSEA) (43) and 90% confidence interval of RMSEA (CI) were used as primary indices given their widespread use, good interpretive guidelines, and sensitivity to number of estimated parameters (43). CFI and NFI value of $\geq 0.90$, and RMSEA value of $\leq 0.08$ were indicative of good fit (41, 43).

After confirming the factor structure in CFA, the internal consistency of the Chinese version of TSK for the subscales and the entire scale was determined based on Cronbach’s $\alpha$. The correlation of the TSK factors with the pain intensity and pain interference measures of the CPG, and the HADS scores were evaluated to determine the concurrent validity. We hypothesized that TSK scores would significantly and positively correlate with all these criterion measures.

**Results**

**Sample characteristics**

Overall 216 patients from the Orthopaedics outpatient clinics and 109 patients from the Pain Clinic participated in the study (Table 1). Pain Clinic participants were older (mean=54.69, SD=16.11; $t=5.69$, $p<0.001$) and more (62.2%) reported low monthly household income ($<$HK$15,000; \chi^2=15.28$, $p<0.01$) compared to the Orthopaedics participants. More Orthopaedic clinic participants (38.1%) were never married ($\chi^2=22.02$, $p<0.001$), achieved tertiary education (21.4%; $\chi^2=49.21$, $p<0.001$) and were in full-time employment or housewives (59.7% and 14.4% respectively).
Pain characteristics: While more Pain Clinic participants (23.2%) reported pursuing pain-related litigation than did their Orthopedics counterparts (13%) ($\chi^2=5.19, p<0.05$), proportions pursuing pain-related medical-legal compensation (Orthopedics: 10.3%; Pain Clinic: 17.3%) did not differ significantly (Table 2). Compared to just 30.3% of Pain Clinic participants most Orthopedics participants (84.3%) indicated pain was the main reason for their first clinic visit ($\chi^2=34.1, p<0.001$). Pain Clinic participants reported duration of chronic pain averaging 7.3 years/2680 days (SD=8.0 years/2918 days), 50% longer than the average duration reported by Orthopaedics participants (mean=5 years/1835 days; SD=6.6 years/2398 days) ($t=3.32, p<0.01$). Most Orthopaedics participants (52.8%) had suffered from chronic pain for ≤2 years, while 20.8% of the Pain Clinic participants reported having had chronic pain for more than 10 years.

Pain Clinic participants (present pain: mean=5.32, SD=2.74; average pain: mean=5.99, SD=2.04; worst pain: mean=8.42, SD=1.98) reported greater pain intensity than their Orthopaedics counterparts (present pain: mean=4.35, SD=2.50; average pain: mean=5.20, SD=1.87; worst pain: mean=7.61, SD=2.10) (all $p<0.01$). However, the two samples did not differ on pain interference measures (all $p>0.05$); mean days of pain associated disability days (Orthopaedics 27.65 days (SD=79.65), Pain Clinic 28.01 days (SD=39.13)); or average days of pain-associated leave of absence (Orthopaedics: mean=19.01, SD=62.08; Pain Clinic: mean=20.67, SD=36.68). The CPG classified 55% of Orthopaedics participants as Grade II or below, (high pain intensity but low related disability), while 33.3% and 24.2% of Pain Clinic participants were classified as Grade III and IV respectively. Significantly more Pain Clinic than Orthopaedics participants achieved a higher CPG classification ($\chi^2=11.55, p<0.01$).

Pain Clinic participants scored significantly higher HADS-D (mean=7.57, SD=5.41), HADS-A (mean=7.95, SD=5.45), and HADS total scores (mean=15.36, SD=9.97) than did
Orthopaedics participants (HAD S-D: mean=4.30, SD=3.86; HADS-A: mean=6.35, SD=4.68; HADS total score: mean=10.74, SD=7.91) (all $p<0.01$) (Table 2).

**Underlying factor comparisons**

We compared the underlying factor structure against the models reported in the literature to determine the best fit for our Chinese sample. First, Vlaeyen et al.’s (8) four-factor solution for the TSK17 specified that 12 of 17 TSK items could be explained by four first-order factors, labeled Harm, Fear of (Re)injury, Importance of Exercise, and Avoidance of Activity (Models 1, 2, 10, and 11). Second, Clark et al.’s (19) two-factor solution for the TSK17 was examined. The 4 reverse-scored items (item, 4, 8, 12, and 16) were excluded and the remaining 13 items were hypothesized to load on one of two first-order factors (Activity Avoidance (8 items) or Pathological Somatic Focus (5 items)) (Models 3, 4, 12, and 13). Third, we tested Swinkels-Meeuwisse et al.’s (11) two-factor solution. This presumed that the 17 TSK items were loaded on two first-order factors, Activity Avoidance (9 items) and Harm (8 items) (Models 5, 6, 14, and 15). Fourth, Roelofs et al.’s (24) two-factor solution for the TSK11 specified that after excluding the four reverse-scored items and two additional items (item 9 and 14), the remaining 11 items were presumed to be explained by two latent first-order factors, namely Somatic Focus (SF) (5 items) and Activity Avoidance (AA) (6 items) (Models 7, 8, 16, and 17). Finally, we tested Burwinkle et al.’s (28) one-factor four-item solution suggesting that the 17 TSK items are reducible to 4 (items 3, 6, 7, and 11), which were hypothesized to load on one single factor (Models 9 and 18). Except Burwinkle et al.’s (28) one-factor solution, the other 4 factor solutions were tested on both hierarchical and correlated structures, hence, a total of 4+4+1=9 models were fitted for each sample (9+9=18). In a hierarchical structure, a higher, second-order factor, kinesiophobia, is assumed to account for the first-order factors. For a correlated structure, first-order factors were allowed to correlate but no higher order was hypothesized.
Factorial validity of the Chinese version of TSK

Univariate skew estimates for the 17 TSK items ranged from -0.817 to 0.525 for the Orthopaedics clinic sample and from -1.247 to 0.363 for the Pain Clinic sample. Univariate kurtosis estimates ranged between -0.818 and 1.995 for the Orthopaedics clinic sample and between 0.582 and 3.226 for the Pain Clinic sample and Mardia’s estimate was 39.017 and 52.863 respectively. These results indicated the data were not normally distributed. Hence, we report the Satorra-Bentler (S-B) $\chi^2$ statistic because it incorporates a scaling correction for non-normal sampling distributions (44).

Table 3 presents the results of CFAs applied on the two samples independently for the 9 competing models.

i. Orthopedics sample: Excepting Model 8, fit indices for all other models (Models 1-7, and 9), failed to meet the minimum acceptable fit criterion (CFI $\leq$ 0.825; NFI $\leq$ 0.787). The fit indexes for Roelofs et al.’s (24) two-factor correlated model for TSK11 (Model 8) supported factorial validity, (S-B $\chi^2$=49.593 ($df$=43); CFI=0.930; NFI=0.911; RMSEA=0.025, (90% CI: 0.000, 0.051)). Consequently, the two-factor correlated model represented the best fit underlying structure for the TSK11 in the Orthopedics sample. Table 4 reports the standardized factor loadings of the two-factor correlated model for TSK11 on the respective latent factors, Somatic Focus (TSK11-SF) and Activity Avoidance (TSK11-AA).

ii. Pain Clinic sample: Models 10-17 demonstrated poor fit. All fit indices failed the minimum acceptable fit criterion (CFI $\leq$ 0.820; NFI $\leq$ 0.774), suggesting poor data-model fit for the TSK measure of fear of movement/(re)injury. However, Model 18, Burwinkle et al.’s (28) one-factor, 4-item model fitted the Pain Clinic sample well, (CFI=0.971; NFI=0.912; RMSEA=0.048 (90% CI: 0.000, 0.209)), though S-B $\chi^2$=22.048, $df$=9 was not significant ($p$>0.05). Consequently, the underlying factorial structure of the TSK was best represented by the one-factor solution for
the four-item version of TSK. The standardized factor loadings of the TSK4 one-factor model for the Pain Clinic sample are presented in Table 5.

Reliability and concurrent validity

Cronbach’s alphas for the TSK11 and its subscales, TSK11-SF and TSK11-AA, were 0.67, 0.56, and 0.60 respectively for the Orthopedics sample, while the internal consistency of the TSK4 for the Pain Clinic sample was 0.61. Among Orthopedics participants, the correlation between the TSK11-AA and TSK11-SF, was modest ($r=0.37$, $p<0.01$) (Table 6). However, moderately high correlations existed between the TSK11 total score and TSK11-AA ($r=0.85$, $p<0.01$)/TSK11-SF ($r=0.81$, $p<0.01$) scores. Though TSK11 scores were significantly correlated with average pain, ($r$ ranging from 0.23 to 0.30; $p<0.05$), they were not significantly correlated with worst pain (all $p>0.05$). Modest ($r\leq0.31$) correlations with TSK11 scores were observed for measures of pain interference in daily activities and social activities ($p<0.05$). Excepting the HADS-D - TSK11-AA correlation, all remaining TSK11 - HADS-A/HADS-Total scores were significantly correlated (all $p<0.05$). In the Pain Clinic sample, the TSK4 significantly correlated with pain intensity measures ($rs$ ranging between 0.20-0.27, all $p<0.01$), pain interference measures (all $r=0.25$, all $p<0.01$), and HADS scores ($rs$ ranging between 0.28-0.35, all $p<0.01$) (Table 7).

Comparison of TSK scores between pain and orthopedics samples

Despite having different factor structures, scores of TSK11 and TSK4 were computed for both samples to compare fear of movement/(re)injury (Table 2). No significant difference was found between the two samples on the mean scores for TSK11-Total, TSK11-SF and TSK11-AA ($p>0.05$). The mean TSK4 score was 11.36 (SD=1.50) and 11.06 (SD=1.41) for the Orthopaedics and Pain Clinic sample respectively ($p>0.05$).
Discussion

This study compared possible TSK factor structures in two samples of Chinese patients with chronic pain drawn from orthopedic and pain clinic settings. CFAs replicated the factor structures reported by Roelefs et al. (24) in the orthopedics sample and Burwinkle et al. (28) in the pain clinic sample. Specifically, the TSK, when used with Chinese patients with chronic pain receiving specialist orthopedics service, was most adequately represented by the two-factor correlated model for the TSK11, which comprises two first-order factors (24). When used with Chinese chronic pain patients who are attending specialist pain services, the TSK was best represented by the 4-item single factor model (28).

The better fit of the TSK11 correlated model in the Orthopedics sample and the TSK4 in the Pain Clinic sample offers tentative evidence for the cross-cultural validity of the TSK. On the one hand, the underlying latent constructs of the TSK11 are similar for the present Chinese and the Dutch, Swedish, and Canadian chronic musculoskeletal samples as reported by Roelofs et al. (24). On the other hand, the superiority of the one-factor model for the TSK4 over other models in the present Pain Clinic sample indicates that the underlying latent construct of the TSK4 is similar to that underlying an American FM sample (28). From a cross-cultural perspective, although we cannot directly evaluate cross-cultural factorial invariance, these findings tentatively suggest that there would be no differences between Chinese and Western patients with chronic pain in terms of the elements comprising kinesiophobia, as indexed by the TSK11 and TSK4. Differences in the TSK11 and TSK4 mean scores would therefore likely indicate true group differences or effects of an intervention on the underlying construct, rather than a change in the factor structure and loadings of the scale. The replication of the TSK11 structure reported by Roelofs et al. (24) in the present Chinese Orthopedics sample might be partly explained by patient similarity that both studies employed patients with various chronic musculoskeletal pain
conditions. However, the results for the Pain Clinic sample were less clear. Our Pain Clinic sample did not include patients with FM, and reported a shorter pain duration (mean=7.3 years) but higher pain intensity (mean worst pain=8.42) than that of Burwinkle et al.’s (28) American FM sample (mean pain duration=10.3 years; mean worst pain=4.23). Future studies that attempt to directly evaluate cross-cultural factorial invariance of TSK would be valuable.

The TSK11 and TSK4 factor structures in these Chinese samples support the shortened version of the TSK over the full, 17-item version (Models 1, 2, 10, and 11) being a more appropriate instrument for assessing fear of movement/(re)injury among patients with chronic pain. Prior studies generally support the exclusion of the four inversely scored items because removing these items increased the internal consistency of the scale (11, 26). In studies assessing the TSK factor structure, CFAs showed these four items consistently loaded poorly on first-order factors under different factor solutions (8, 19-21, 23, 24). Our findings reaffirm this, showing that excluding the four reverse-scored items significantly enhanced the TSK’s psychometric properties. Further, the Orthopedics sample data showed that the psychometric properties of the TSK are improved by removing two additional items, item 9 (“I am afraid that I might injure myself accidently”) and item 14 (“It’s really not safe for a person with a condition like mine to be physically active”) as previously suggested (23). Unlike other AA items, the two deleted items do not clearly address avoidance of movement and/or fear in relation to pain. This could explain their weak relationship with other items comprising the AA subscale and the poor CFA fit statistics when the items were included. The four TSK4 items were originally loaded on the SF factor of Clark et al.’s (19) model and on the Harm factor of Goubert et al.’s (21) model. However, as pointed out by Burwinkle et al. (28), the content of these 4 items (item 3, 6, 7, and 11) addressed a general sense of vulnerability or a tendency to catastrophize a painful problem, rather than a specific fear of movement. The uncertain TSK content validity may therefore
contribute to the inconsistencies in reported scale factor structures. A closer examination of content validity is warranted.

The TSK factor structure differences between the two samples probably reflect sample heterogeneity in terms of socio-demographic and pain characteristics. Not only were they older and of lower socio-economic status than the Orthopedics sample (62.2% fell into the lowest income group and only 28% had full time employment), but the Pain Clinic sample also had more pain for longer duration and more pain-related disability. Pain location also differed; more Pain Clinic participants reported facial pain whereas more Orthopedics participants reported shoulder, arm, and muscle pain. Although Pain Clinic participants did not differ statistically in their TSK11 and TSK4 scores from their Orthopedics counterparts they did report higher HADS anxiety and total scores that met the psychiatric case criterion for Chinese people (35). These differences suggest different factors may be at play in determining fear of movement/(re)injury for the two groups of patients with chronic pain. Moreover, type and availability of pain services and treatment contexts may also impact patients’ pain-related fear. Within a multidisciplinary setting, patients with chronic pain attending pain clinic services are managed by specialist pain physicians, clinical psychologists, occupational therapists, and physiotherapists with special training in pain management. Patients with chronic pain attending orthopedics SOPCs may if needed, also be referred by orthopedics specialists to other clinical psychology, physiotherapy and occupational therapy services, but these tend not to specialize in chronic pain and due to limited resources, pain patients must compete with patients from other departments for these services. Both clinics apparently serve different populations and our samples reflect this.

The weak correlation between TSK11-AA and TSK11-SF ($r=0.37$) in the Orthopedics sample is consistent with previous studies (20, 24, 26). This has been the basis of previous recommendation for using subscale rather than total TSK scores. Yet, no studies have tested whether a second, higher-order latent factor might possibly underlie the presumed first-order
factors. The better fit of correlated over hierarchical models on all factor solutions (except Models 9 and 18) tested is inconsistent with a higher, general factor of kinesiophobia. In particular, while the TSK11’s two first-order factors were correlated, they were not explained by a higher-order factor of general kinesiophobia, and are not readily subsumed under the kinesiophobia/fear of movement/(re)injury construct. Compared to the somatic focus factors, previous studies generally demonstrated a stronger association between the activity avoidance factor and disability (4, 9, 14, 16, 45, 46). These data offer further support for the better utility of the two-factor scale than the one-factor scale. The use of subscale scores, instead of total score, would provide a more accurate account on how the two dimensions associate with other parameters and pain adjustment outcomes. One generalized concept of kinesiophobia may be unwarranted, inaccurate and conceptually misleading as a result.

Importantly, results of post-hoc $t$-test analyses showed that mean scores of the TSK11-SF (Orthopedics: mean=13.73; Pain Clinic: mean=13.49) and TSK11-AA (Orthopedics: mean=16.42; Pain Clinic: mean=15.96) among the present Chinese sample were significantly higher than those reported in Roelofs et al. (24) whose three Western samples obtained means of 11.3 and 14.3 for the TSK11-SF and TSK11-AA respectively (all $p < 0.001$) (24). These differences on TSK scores may reflect cross-cultural differences on emotion response to pain between Western and Chinese populations. Chinese culture encourages adoption of sick role when family caretaking becomes mandatory. This might contribute both to greater immobility, with more sensory activity on limited movement, and/or inflated pain ratings from sick role nocebo influences. These await further elucidation in future cross-cultural research.

The TSK11, TSK11-AA and TSK4 demonstrated marginally-acceptable Cronbach $\alpha$ ~0.60, reflecting poor scalability of items and weak internal consistency. The standardized factor loadings of item 11 on both the TSK11 (0.16) and TSK4 (0.13) were low, partly explaining the TSK11-SF’s marginal internal consistency ($\alpha$=0.60). Removal of this item should improve item
scalability. Correlations of the TSK11 subscales and the TSK4 with other measures were all in the expected direction, but generally weak, suggesting higher pain-related fear is only weakly associated with higher pain intensity and interference, and greater psychological distress. The low correlations between TSK4 and other measures ($r$s ranging from 0.20 to 0.35) were generally higher than those with the TSK11, some of which were very low ($r$s ranging from 0.08 to 0.31). Nonetheless, the present study generated $r$s for the TSK11 and TSK4 comparable with other studies (24, 26). The low correlations of TSK scores with pain intensity, interference, and psychological distress might be due to the possibility that fear of pain may be sometimes adaptive and sometimes maladaptive. Moreover, pain-related fear is likely to be labile and associated with pain desynchrony, whereby the different components of pain (sensory, emotional, cognitive, motivational and communicative) become disintegrated resulting in, for example, a declining sensory component but increasing emotional components, or greater catastrophizing resulting in pain sensitivity thresholds being repeatedly re-set downwards. Some persons will adaptively live with their pain and not have high emotional components, whereas others may continue to react negatively to low levels of sensory activity. This individual variability will result in the low correlations seen. Longitudinal and experimental research to determine how different clinical and psychological variables influence the differential effects of pain-related fear on adjustment outcomes is therefore warranted.

This study is limited in being conducted in Cantonese-speaking Chinese only and the multidisciplinary specialist pain services sample is somewhat small, which might have compromised the findings on the CFAs for that particular group. The recommended minimum sample size for structural equation modeling ranges widely from 100 (47) or 5 times the number of variables examined (48) to 200 (49) or 20 times of the number of variables (50). Generally speaking, a minimum of 10 subjects per variable, plus 50 extra is considered acceptable and 20
desirable (51). The pain clinic sample CFA should be considered with caution. Replication in other Chinese and Asian populations using a bigger pain services sample is desirable.

In conclusion, the present study demonstrated inequality in the TSK factor structure between patients with chronic pain recruited from Orthopedics SOPC and a specialist Pain Clinic. A two-factor correlated structure, as reported by Roelofs et al. (24), best represented the underlying dimensions of the TSK11 in a sample of Chinese patients with chronic pain using Orthopedics pain services whereas a one-factor structure, as reported by Burwinkle et al. (28), best represents the underlying dimension of the TSK4 in a sample of patients with chronic pain attending pain clinic services. No evidence was found for one over-arching construct of kinesiophobia.

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