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Cross-cultural adaptation and psychometric properties of the Thai version of the Neurophysiology of Pain Questionnaire in individuals with chronic low back pain

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KEYWORDS
Pain neurophysiology; Chronic low back pain; Cross-cultural adaptation; Reliability; Validity.

ABSTRACT
Pain neurophysiology knowledge is hypothesized to influence pain beliefs and physical performance in individuals with chronic low back pain (LBP). Valid and reliable measures of such knowledge are important to evaluate the pain treatment on this domain as well as to understand its role in both physical and psychological functions of individuals with chronic pain. This study aimed to culturally adapt the revised Neurophysiology of Pain Questionnaire into Thai (T-rNPQ), using the Functional Assessment of Chronic Illness Therapy translation methodology, and to evaluate its reliability and validity. Two hundred sixty-three individuals with chronic LBP completed the T-rNPQ and seven health and function domains of Thai versions of the Patient-Reported Outcomes Measurement Information System-29. Forty-five lecturers in musculoskeletal physical therapy completed the T-rNPQ. A subset of 95 individuals with chronic LBP completed the T-rNPQ again after an interval of seven to 15 days. Internal consistency for the total score and two subscales that emerged in the current analyses showed marked variability (Cronbach's alphas = 0.82, 0.82, and 0.63). Test-retest reliability was poor to good (ICC's$_{(2,1)}$ = 0.71, 0.40, and 0.65). Known-groups and discriminant construct validity of the T-rNPQ total score and subscale scores were satisfactory. The findings indicate that the T-rNPQ measures two knowledge domains, i.e., 'Neurophysiology Knowledge' and 'Pain means Harm'. The psychometric property assessment of the T-rNPQ indicated that using the scale in Thai individuals with chronic LBP should be undertaken with discretion.

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Introduction

Chronic low back pain (LBP) is one of the most common chronic musculoskeletal pain problems worldwide[1]. Only one-third of individuals who have an episode of LBP have been found to fully recover within a year of the episode[2]. Chronic LBP is known to be associated with low productivity, absenteeism, psychological stress (in both the person with LBP and their families), and significant costs to individuals and society[3,4].

The experience and impact of chronic pain is known to be influenced by a number of personal factors[5], including maladaptive beliefs about pain[6]. These beliefs include the idea that "hurt is a signal of harm" (i.e., if it hurts, something must be seriously injured), that "pain is a signal to stop what you are doing" (i.e., if an activity results in pain, you should stop before you injure yourself), and that "rest is the best medicine" (i.e., pain is a signal for you to rest to recuperate your body)[7]. Treatments that target maladaptive beliefs about pain and reducing fear-avoidance behaviors have been shown to be effective for the management of catastrophizing, fear of movement, improve self-efficacy, and persistent pain states[8].

Clinical practice guidelines for LBP have recommended education, exercise, and psychological therapies as the first-line treatment[9]. Pain neurophysiology education (PNE) is an educational therapy usually provided by physical therapists. It is also a treatment that specifically targets knowledge about pain for change, with the hypothesis that as people understand more about the neurophysiology and meaning of pain, they are less likely to catastrophizing about and be disabled by that pain[10]. Consistent with these ideas, PNE has been shown to increase knowledge about pain neurophysiology in individuals with chronic pain[11], and also to result in moderate-effect reductions in kinesiophobia and pain catastrophizing, with no identified harms or negative side-effects in individuals with chronic musculoskeletal pain[12,13]. A recent systematic review confirms the efficacy of multimodal approaches to chronic pain treatment, including PNE, for increasing compliance with exercise therapy and positive outcomes at long-term follow-up in individuals with chronic LBP[14].

In order to determine the extent to which PNE influences pain knowledge, as well as the extent to which such change mediates the beneficial effects of PNE and other treatments that target pain beliefs, it is necessary to be able to assess pain knowledge. The Neurophysiology of Pain Questionnaire (NPQ) was designed to do just that. The original NPQ contained 19 items[15] and assesses an individual's level of knowledge about the neurophysiology of pain. The NPQ was later been revised to contain 12 items (rNPQ) and considered as a unidimensional scale[16]. To date, the rNPQ has been translated and cross-culturally validated into French[17], Brazilian Portuguese[18], and German[19]. Although, the rNPQ is generally thought to be unidimensional, its dimensionality of the scale has been shown to vary, i.e., 2-4 dimensions[17,19]. Internal consistency has been found to be satisfactory in the original English version (Pearson Separation Index = 0.82)[16]. However, the internal consistency of the rNPQ was found to be unacceptable in the French version[17] and the German version [19] (Cronbach's alphas = 0.30 and 0.52, respectively).

The availability of valid and reliable translations of the rNPQ is necessary to be able to determine the extent to which pain knowledge plays a similar role to outcome across individuals who speak different languages and live in different countries. This study aimed to cross-culturally adapt and translate the rNPQ into Thai version (T-rNPQ) as well as to evaluate its psychometric properties (i.e., dimensionality, internal consistency, test-retest reliability, ceiling and floor effects, known-groups validity, and discriminant validity).

Materials and methods

Study design

The study was conducted in two phases. In the first phase, a cross-cultural adaptation of the rNPQ into Thai using the Functional Assessment of Chronic Illness Therapy (FACIT) translation methodology was conducted. In the second phase, the psychometric properties of the translated rNPQ were evaluated. The study was approved by the University Human Ethics Committee (COA No. 240/2020). All participants provided signed informed consent.

Phase 1: Cross-cultural translation and adaptation

The FACIT translation methodology was used to develop the culturally appropriate translation of the rNPQ[20], which was chosen as it also included the original developer in the quality review instead of an optional process found in other methods. This would help improve a consistency in the content and face validity between English and Thai versions of a questionnaire. There are 11 steps in the FACIT translation methodology, including forward translation, reconciliation, back-translation, back-translation review/quality control, independent reviews, pre-finalization review, finalization process, harmonization and quality assurance, formatting and proofreading, cognitive testing and linguistic validation, and evaluation of the participants' comments and finalization of translation. Detailed descriptions of the FACIT translation methodology are published elsewhere[20].

Phase 2: Evaluation of the reliability and validity of the TrNPQ

Participants

Two groups of participants provided data to evaluate the psychometric properties of the T-rNPQ. The first group was recruited from large public hospitals and government offices in the Bangkok metropolitan area from August 2020 through April 2021. Inclusion criteria included those aged 18 years or older, being able to read and speak Thai, and having chronic LBP (defined as "a back pain problem that has persisted at least three months and has resulted in pain on at least half the days in the past six months")[21]. The low back region was defined as the space between the lower posterior margin of the rib cage and the horizontal gluteal fold[21]. Exclusion criteria included having serious medical conditions or complications that might interfere with the participant's ability to respond to the study questionnaires (such as vision or reading impairments during data collection). The second group was Thai-speaking lecturers with at least five years of experience in a field of musculoskeletal physical therapy from 10 universities in Thailand.

Procedures

The researcher provided participants in both groups with an online questionnaire link, which was distributed to participants via email. Participants firstly completed written informed consent followed by a questionnaire asking about demographics and the T-rNPQ items. The participants with chronic LBP then completed the Thai version of Patient-Reported Outcomes Measurement Information System-29 (T-PROMIS-29): Physical Activity, Anxiety, Depression, Fatigue, Sleep Disturbance, Ability to Participate in Social Roles and Activities, and Pain interference[22]. We believed that the T-rNPQ (pain neurophysiology knowledge) assessed different characteristics from the T-PROMIS-29 (health-related quality of life), which would allow us to evaluate the discriminant validity of the T-rNPQ. All seven domains of the T-PROMIS-29 were assessed with scales ranging from 1 to 4 items. Respondents were asked to indicate the frequency that they experienced what was described with each item in the past seven days using 5-point Likert scales. Except for items assessing physical function, that were rated based on the present time. Pain intensity was assessed with a single item asking respondents to rate the magnitude of their pain in the past week on a 0 ("No pain") to 10 ("Worst imaginable pain") numerical scale. The T-PROMIS-29 scale scores were transformed into T-scores (mean 50 and SD 10) according to the PROMIS adult profile instrument guideline (http://www.healthmeasures.net). The direction of PROMIS scales is with respect to the scales name; higher scores indicate more of the domain assessed. The Thai version of the PROMIS-29 has been shown to provide valid and reliable measures of the domains it assesses, with good to excellent internal consistency (i.e., Cronbach's alpha coefficients ranging from 0.84 to 0.94) and moderate to good test re-test reliability, ICC's $_{(2,1)}$ coefficient ranging from 0.57 to 0.74[22].

The T-rNPQ contains 12 questions that are answered with "True," "False," or "Undecided." The overall T-rNPQ score is the sum of correct responses, and so can range from 0 to 12. A higher score indicates a greater understanding of the biological mechanisms that underpin chronic pain.

To assess the test-retest reliability of the T-rNPQ, participants with chronic LBP were asked to complete the T-rNPQ again at least seven days after the initial completion.

Statistical analysis

All analyses were performed using SPSS version 22.0 for Windows. A Shapiro-Wilk test verified the normal distribution for all parameters. Quantitative variables that were normally distributed were expressed as mean ± standard deviation (SD), and quantitative variables that were not normally distributed were expressed as median (percentile 25, percentile 75). The level of significance was set at 0.05.

Dimensionality

The dimensionality of the T-rNPQ questionnaire was tested by conducting an exploratory principal component analysis (PCA), using the scree test to determine the number of underlying components assessed by the measure (eigenvalues of > 1). Varimax rotation was applied, and the items with a factor loading of 0.30 or greater for a given factor were used to indicate that an item loaded on the factor(s) that emerged[23].

Internal consistency

Internal consistency for the T-rNPQ was calculated using Cronbach's alpha. Cronbach's alpha values that were 0.70 or greater were used to determine that the scale's internal consistency was acceptable[24].

Reliability

For test-retest reliability, we computed the intraclass correlation coefficient ($ICC_{(2,1)}$ for individuals with chronic LBP[25]. ICC values less than 0.50 indicate poor reliability, values between 0.50 and 0.75 indicate moderate reliability, values between 0.75 and 0.90 indicate good reliability, and values greater than 0.90 indicate excellent reliability[26]. The $SEM_{test\text{-}retest}$, which is a measure of the standard error of measurement, was calculated as $\sqrt{(\sigma^2_{\text{time}} + \sigma^2_{\text{residual}})}$[27]. The minimal detectable change at 95 percent confidence ($MDC_{95\%}$), which indicates the minimal change score to be confident at the 95% level that the change is not due to measurement error, was calculated by $MDC_{95\%}$ = square root of 2 multiplied by $SEM_{test\text{-}retest}$ and 1.96[25,27].

Ceiling and floor effects

Ceiling and floor effects were evaluated by calculating the percentages of the responses of the highest and the lowest possible scores achieved by respondents. Rates greater than 15% for the highest and the lowest scores indicated ceiling and floor effects, respectively[28].

Known-groups validity

The known-groups validity, by comparing the T-rNPQ scores from the 263 individuals with chronic LBP and 45 lecturers in a field of musculoskeletal physical therapy. If the T-rNPQ scale was valid, we hypothesized that the scores obtained from lecturers in a field of musculoskeletal physical therapy would be significantly higher than those obtained from individuals with chronic LBP. As the T-rNPQ scores of both groups were not normally distributed, a Mann–Whitney test was used for this analysis.

Discriminant validity

The discriminant validity, by computing Spearman's rank correlation coefficients between the T-rNPQ and seven health and function domains of the T-PROMIS-29 scales. We hypothesized that if the T-rNPQ scale (or scales, if the planned factor analysis indicated that the measures assess more than one domain of knowledge) was valid, weak associations between the T-rNPQ and the T-PROMIS-29 measures of these domains would be found.

Results

Cross-cultural translation and adaptation

The cross-cultural translation and adaptation of the rNPQ into a Thai version was deemed to be understandable and culturally appropriate, except for one item; that is, the item stating that "Nerves adapt by increasing their resting level of excitement." The sentence contained the word "resting" and was difficult to understand in the Thai language. After discussions within the translation committee and with the developer of the rNPQ, it was decided to delete this word, and the item was modified to be "Nerves adapt by increasing their sensitization to stimuli."

Participants

Eight hundred and fifty individuals with chronic LBP were screened for eligibility and 587 of these did not meet the study inclusion and exclusion criteria which left 263 participants (Table 1). The majority of individuals with chronic LBP were middle-aged women and worked full time, reporting an average pain intensity of 5. Seventy lecturers were invited to participate, and 45 agreed to do so. The majority of lecturers were middle-aged women and had experience in a field of musculoskeletal physical therapy for an average of 10 years, ranging from 5 to 27 years.

Table 1 Demographic and characteristics of participants

Characteristic	N (%)	Mean (SD)
Individuals with chronic LBP (n=263)		
Age (in years)		40.7 (11.7)
Sex		
Women	161 (61)	
Men	102 (39)	
Weight (self-reported), kg		67.1 (16.2)
Height (self-reported), cm		162.9 (8.5)
Employment status		
Working full time	247 (94)	
Unemployment	16 (6)	
Pain intensity (1-10)		5.0 (2.1)
Educational level		
Primary school	10 (4)	
Secondary school	9 (3)	
High school	41 (15)	
University	203 (78)	
T-rNPQ (0-12)		3.7 (2.1)
T-PROMIS (T-scores)		
Physical Function		43.7 (8.0)
Anxiety		57.2 (8.7)
Depression		50.3 (9.5)
Fatigue		53.4 (7.8)
Sleep Disturbance		51.3 (6.8)
Ability to Participate in Social Roles and Activities		51.6 (8.1)
Pain Interference		57.1 (6.2)
Lecturers in musculoskeletal physical therapy (n=45)		
Age (in years)		42.4 (6.6)
Sex		
Women	36 (80)	
Men	9 (20)	
Work duration (in years)		14.1 (9.2)
Experience in a field of musculoskeletal physical therapy		10 (6.8)
T-rNPQ (0-12)		6.9 (1.9)

Note: LBP, Low back pain.

Dimensionality

An exploratory factor analysis using data from the 263 participants with LBP pain followed by varimax rotation was used to test the dimensionality of the T-rNPQ. The result of Bartlett's test of sphericity indicated that the correlation matrix was not random, x^2 (66, *N*=263) = 806.7, *p*-value < 0.001, the Kaiser-Meyer-Olkin statistic was 0.84, indicating that there were a sufficient number of correlated items in the matrix to conduct the EFA. All individual measures of sampling adequacy values were greater than 0.30. A scree test suggested two meaningful factors with eigenvalues of more than 1 (46% of the total variance); factor 1 (eigenvalue 4.04), and factor 2 (eigenvalue 1.46). We, therefore, concluded that the T-rNPQ items assess two distinct underlying components (Spearman's rho between the two components = 0.07, *p*-value = 0.24). The former represents responses of the neurological system (which we labeled "Neurophysiology Knowledge") to pain and the latter represents injury and pain perception (which we labeled "Pain means Harm"). The component loadings for the T-rNPQ are presented in Table 2. As could be seen, only one item (item 11) had an item-total correlation less than 0.40.

Table 2 Factor loading for twelve T-rNPQ items

Item number	Item	Factor loading	
		Neurophysiology Knowledge	Pain means Harm
3	Special nerves in your spinal cord convey 'danger' messages to your brain	**0.86**	0.09
12	When you are injured, special receptors convey the danger message to your spinal cord	**0.78**	0.02
9	Descending neurons are always inhibitory	**0.74**	0.06
6	Nerves adapt by increasing their resting level of excitement.	**0.68**	0.16
5	The brain decides when you will experience pain.	**0.57**	0.24
10	When you injure yourself, the environment that you are in will not affect the amount of pain you experience, as long as the injury is exactly the same.	**0.55**	0.33
1	When part of your body is injured, special pain receptors convey the pain message to your brain.	**0.52**	0.19
11	It is possible to have pain and not know about it.	**0.38**	0.20
4	Pain occurs whenever you are injured.	0.11	**0.76**
2	Worse injuries always result in worse pain	0.16	**0.72**
8	Pain only occurs when you are injured or at risk of being injured.	0.14	**0.63**
7	Chronic pain means that an injury hasn't healed properly.	0.12	**0.54**

Internal consistency

Given the results of the factor analysis suggesting that the T-rNPQ assesses two distinct pain neurophysiology knowledge domains, we examined the internal consistency of the T-rNPQ total score as well as the two subscale scores. The total score IC was acceptable (Cronbach's alpha = 0.82) for the total score, for the Neurophysiology Knowledge score (Cronbach's alpha = 0.82), but unacceptable for the Pain means Harm scale (Cronbach's alpha = 0.63) in the group of individuals with chronic LBP.

Neither the ceiling nor floor effect of the T-rNPQ total score or the Neurophysiology Knowledge subscale was observed. However, floor effect was found for the Pain means Harm scale in the group of individuals with chronic LBP (53%).

Test-retest reliability

With at least 7-day apart (range = 7 to 15 days; average = 10 days), 95 individuals with chronic LBP returned completed T-rNPQs. The $ICC_{(2,1)}$ value indicated poor to moderate test-retest reliability for the chronic LBP group (Table 3).

Table 3 Mean (standard deviation) and test-retest reliability coefficients of the T-rNPQ scores at the first and second session

	1st session	2nd session	$ICC_{(2,1)}$ (95%CI)	$SEM_{test-retest}$	$MDC_{95\%}$
Individuals with chronic LBP (n=95)					
T-rNPQ total score	3.5 (2.2)	3.7 (1.9)	0.71 (0.57-0.81)	1.10	3.04
Neurophysiology Knowledge	3.2 (1.8)	3.0 (1.6)	0.40 (0.10-0.60)	1.31	3.62
Pain means Harm	0.7 (1.0)	0.5 (0.9)	0.65 (0.47-0.76)	0.56	1.55

Note: ICC, Intraclass correlation coefficient; MDC, Minimal detectable change; SEM, Standard error of measurement; LBP, Low back pain.

Known-groups validity

For the T-rNPQ, a Mann-Whitney test revealed a significantly higher T-rNPQ total score in the group of lecturers (Mdn = 7, 6.0 – 8.0) than the group of individuals with chronic LBP (Mdn = 4, 2.0 – 5.0) (*p*-value < 0.001). The items that had more than 50% of lecturers answered incorrectly were items 1, 2, 4, 7, and 11. The items that had more than 50% of individuals with chronic LBP answered incorrectly were items 1-3 and 9-12.

For "Neurophysiology Knowledge" factor, a Mann-Whitney test revealed a significantly higher Neurophysiology Knowledge subscale score in the group of lecturers (Mdn = 5, 4.0 – 6.0) than the group of individuals with chronic LBP (Mdn = 3, 1.0 – 4.0) (*p*-value < 0.001)

For "Pain means Harm" factor, a Mann-Whitney test revealed a significantly higher Pain means Harm subscale score in the group of lecturers (Mdn = 2, 1.0 – 3.0) than the group of individuals with chronic LBP (Mdn = 1, 0.0 – 2.0) (*p*-value < 0.001).

Discriminant validity

Non-significant and little correlations were found between the total score and its subscale scores of the T-rNPQ and the T-PROMIS-29 scores (Table 4).

Table 4 Spearman correlation coefficients between the T-rNPQ and the validity criteria measure (n=263)

Measures	T-rNPQ total score	Neurophysiology Knowledge	Pain means Harm
T-PROMIS-29			
• Physical Function	-0.06	-0.09	-0.05
• Anxiety	0.10	0.05	-0.01
• Depression	0.05	0.03	-0.01
• Fatigue	0.03	0.05	0.06
• Sleep disturbance	0.07	0.02	0.07
• Ability to Participate in Social Roles and Activities	-0.02	-0.11	-0.01
• Pain Interference	0.01	0.13	0.02

Discussion

In this study, the English version of the rNPQ was successfully translated into a Thai version, in which most parts were deemed to have cultural equivalence except one item. The change required for the single item was semantic (i.e., changing "Nerves adapt by increasing their resting level of excitement" to "Nerves adapt by increasing their sensitization to stimuli"). The results indicated that the T-rNPQ assessed two underlying constructs and showed marked variability internal consistency and test-retest reliability. It had acceptable known-groups and discriminant validity for use in Thai individuals with chronic LBP.

The exploratory factor analysis of the T-rNPQ generated two factors: one for the Neurophysiology Knowledge and the other for the Pain means Harm. This result is in contrast to the original English version of the rNPQ that was proposed the 12 items version of the NPQ after a Rasch analysis, claiming that this 12 items version had superior psychometric properties, and considering it is a unidimensional scale. The present result was in line with previous studies of the adapted scale in other languages, although the number of and the items in the factors differed between studies[17,19]. The separate scoring on both subscales provides important information justifying a change to the subscale structure of the test. However, we assume that the two subscales found in this study ('Neurophysiology Knowledge' and 'Pain means Harm') have much more significance in identifying patients with problematic pain neurophysiology knowledge and beliefs, which will probably strongly influence their future behavior. Future validation studies are needed to confirm our findings using a confirmatory factor analysis, which is a more sophisticated method. As all previous studies did not report the psychometric properties of the rNPQ for each factor, thus this study used the total score to compare with the previous studies.

An acceptable internal consistency for the T-rNPQ total score for the individuals chronic LBP is similar to that reported for the original English version with Pearson Separation Index (a Rasch analysis equivalent of Cronbach's alpha that can be interpreted similarly) (Pearson Separation Index = 0.82)[16]. The value in the present study is higher than those reported in the other adaptation versions, including the French (Cronbach's alpha = 0.30)[17], Brazilian Portuguese version (Cronbach's alpha = 0.63)[18], and German (Cronbach's alpha = 0.52)[19]. The Pain means Harm subscale demonstrated an inadequate internal consistency (Cronbach's alpha = 0.63). The reason for the low level of Cronbach's alpha of the Pain means Harm subscale is perhaps nature of the true/false format and could be susceptible to guessing[16].

No floor or ceiling effect was observed for the T-rNPQ total score. The findings are consistent with those reported for individuals with chronic

spinal pain using the English version[16], the French version[17], and the German version[19]. These results suggest that the T-rNPQ total score would be appropriate for assessing pain neurophysiology knowledge. However, the floor effect as high as 53% found in the Pain means Harm subscale in the group of individuals with chronic LBP would urge therapists to improve knowledge regarding injury and pain perception in this group so that it may have an impact on their pain condition.

The moderate test-retest reliability of the T-rNPQ total score and the Pain means Harm subscale in the individuals with chronic LBP (ICC = 0.71 and 0.65, respectively) with an average of 10 days apart. The measurement time longer than that of Demoulin et al. (2017) with seven days apart, report poor retest reliability (ICC = 0.48) for the 12 items[17]. However, the present result was lower than the English version (ICC = 0.97) that studied in the group of individuals with spinal pain before receiving pain neurophysiology education[16] and lower than the German version (ICC = 0.97) that studied in the group of individuals with chronic non-specific spinal pain[19]. The time window between the measurement times was 2-5 days[16] and 10 days[19]. Demoulin et al. (2017) postulated that short intervals would allow participants to remember their previous answers and would result in less variation in their repeated responses. Regarding the Neurophysiology Knowledge subscale, poor reliability coefficients was found[17]. This study is the first study to propose that the T-rNPQ consisted of two factors, i.e., the Neurophysiology Knowledge and the Pain means Harm factors. It is unclear why the Neurophysiology Knowledge subscale possessed poor reliability coefficients. Further studies are required to confirm our findings and to improve on test-retest reliability of the Neurophysiology Knowledge subscale.

The results indicated that the T-rNPQ total score and its subscale scores had satisfactory known-groups validity which supports those reported for the total score in French, German, and Brazilian Portuguese versions[17-19]. The consistent results across all adaptations provide evidence that the rNPQ can separate those with higher and lower levels of pain neurophysiology knowledge. Interestingly, more than 50% of the lecturers answered three from four questions (items 2, 7, and 8) in the Pain means Harm subscale incorrectly. This finding suggests that they should improve their knowledge in respect to injury and pain perception, although they had a good understanding of the responses of the neurological system to pain.

The results showed that level of pain neurophysiology knowledge, assessed by the T-rNPQ total score and its subscale scores, are conceptually not related to health-related quality of life measured by the T-PROMIS-29, supporting the discriminant validity of T-rNPQ. The findings of this study are consistent with a previous adaptation study showing non-significant low correlations between the pain neurophysiology knowledge and Physical, Psychic domain of the 12-Item Short-Form Health Survey; between the rNPQ and Hannover Functional Questionnaire Backache[19]. The fact that the correlation of the T-rNPQ total score and its subscale scores is very poor indicates that these measure independent parameters of the same construct. Additionally, the role of pain neurophysiology knowledge in both physical and psychological functions of individuals with chronic pain did not find in this current study.

A number of limitations of the present study should be noted and considered when interpreting the results. First, participants were limited to individuals with chronic LBP who lived in Bangkok, Thailand. The geography of participants reflects several aspects of sample, including culture, language, some demographic characteristics (e.g. occupation, education level, financial status). Thus, generalization of the findings to other individuals with LBP or other health conditions as well as healthy individuals should be made with caution. Second, the use of a convenience sample restricts the external validity of this study. Thus, generalization of the results from this study to other chronic LBP populations should be made with caution. Future studies may consider random sampling approaches to recruit study participants from community settings. Third, both internal consistency and test-retest reliability for the group of lecturers were not assessed. With the limitation of time and resources, only 45 lecturers

in musculoskeletal physical therapy from universities in Thailand participated in this study. This sample size was inadequate to assess these types of reliability and to perform an exploratory factor analysis of the T-rNPQ in the group of lecturers. A study with a larger sample size is needed to assess the internal consistency and test-retest reliability as well as to confirm the two factors found in the group of individuals with chronic LBP and the known-groups validity of the T-rNPQ found in the present study. Last, we did not evaluate the responsiveness analysis and the minimum important change scores for the T-rNPQ. Future studies might consider the assessment of responsiveness to change and minimum important change scores to be able to better interpret the change of the T-rNPQ total score and its subscale scores after the intervention to target the pain neurophysiology knowledge in individuals with chronic LBP.

Conclusion

Despite the study's limitations, the findings provide important initial support for the cultural appropriateness and recommend assessing and discriminating the level of pain neurophysiology knowledge between the individuals with chronic LBP and lecturers in musculoskeletal physical therapy in Thailand. However, the interpretation of the results of the T-rNPQ version must be taken with caution due to the absence of robust psychometric properties of the instrument. Additional research would be useful that replicates the current findings in samples of individuals with different chronic pain conditions, that evaluates the sensitivity of the T-rNPQ to treatment which is designed to change pain neurophysiology knowledge, and that identifies cut-offs that would be useful for identifying patients with chronic pain who might most benefit from treatment. Despite this, the measure may be useful for cross-cultural research evaluating the role that pain neurophysiology knowledge may play and may be used in both clinical treatment and research settings for evaluating the pain neurophysiology knowledge in adjustment to chronic pain.

Take home messages

The findings indicate that the Thai version of the Neurophysiology of Pain Questionnaire measures two knowledge domains, i.e., 'Neurophysiology Knowledge' and 'Pain means Harm'. The psychometric property assessment of the T-rNPQ indicated that using the scale in Thai individuals with chronic LBP should be undertaken with discretion.

Conflict of interest

The authors declare no conflict of interest.

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With respect to author contributions, P. Pasangkayo was involved in concept/research design, data collection, data analysis, and manuscript writing, and M.P. Jensen, R. Kanlayanaphotporn, and P. Janwantanakul were involved in concept/research design, data analysis, and manuscript writing. All authors read and approved the final manuscript.

References

1. Hirase T, Kataoka H, Inokuchi S, Nakano J, Sakamoto J, Okita M. Factors associated with chronic musculoskeletal pain in Japanese community-dwelling older adults: A cross-sectional study. Medicine (Baltimore) 2017; 96(23): e7069.
2. Henschke N, Maher CG, Refshauge KM, Herbert RD, Cumming RG, Bleasel J, et al. Prognosis in patients with recent onset low back pain in Australian primary care: inception cohort study. Br Med J 2008; 337: a171.

3. Hoy D, Brooks P, Blyth F, Buchbinder R. The epidemiology of low back pain. Best Pract Res Clin Rheumatol 2010; 24(6): 769-81.
4. Gore M, Sadosky A, Stacey BR, Tai KS, Leslie D. The burden of chronic low back pain: clinical comorbidities, treatment patterns, and health care costs in usual care settings. Spine (Phila Pa 1976) 2012; 37(11): E668-77.
5. Jensen MP, Galer PD, Johnson LL, George HR, Mendoza ME, Gertz KJ. The associations between pain-related beliefs, pain intensity, and patient functioning: hypnotizability as a moderator. Clin J Pain 2016; 32(6): 506-12.
6. Moseley GL, Butler DS. Explain pain. Adelaide, South Australia: Noigroup Publications; 2013.
7. Linton SJ, Shaw WS. Impact of psychological factors in the experience of pain. Phys Ther 2011; 91(5): 700-11.
8. Vlaeyen JW, De Jong JR, Onghena P, Kerckhoffs-Hanssen M, Kole-Snijders AM. Can pain-related fear be reduced? The application of cognitive-behavioural exposure in vivo. Pain Res Manag 2002; 7(3): 144-53.
9. Almeida M, Saragiotto B, Richards B, Maher CG. Primary care management of non-specific low back pain: key messages from recent clinical guidelines. Med J Aust 2018; 208(6): 272-5.
10. Moseley GL, Butler DS. Fifteen years of explaining pain: The past, present, and future. J Pain 2015; 16(9): 807-13.
11. Louw A, Zimney K, Puentedura EJ, Diener I. The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature. Physiother Theory Pract 2016; 32(5): 332-55.
12. Louw A, Diener I, Butler DS, Puentedura EJ. The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. Arch Phys Med Rehabil 2011; 92(12): 2041-56.
13. Watson JA, Ryan CG, Cooper L, Ellington D, Whittle R, Lavender M, et al. Pain neuroscience education for adults with chronic musculoskeletal pain: A mixed-methods systematic review and meta-analysis. J Pain 2019; 20(10): 1140.e1-2.
14. Barbari V, Storari L, Ciuro A, Testa M. Effectiveness of communicative and educative strategies in chronic low back pain patients: A systematic review. Patient Educ Couns 2020; 103(5): 908-29.
15. Moseley L. Unraveling the barriers to reconceptualization of the problem in chronic pain: the actual and perceived ability of patients and health professionals to understand the neurophysiology. J Pain 2003; 4(4): 184-9.
16. Catley MJ, O'Connell NE, Moseley GL. How good is the neurophysiology of pain questionnaire? A Rasch analysis of psychometric properties. J Pain 2013; 14(8): 818-27.
17. Demoulin C, Brasseur P, Roussel N, Brereton C, Humblet F, Flynn D, et al. Cross-cultural translation, validity, and reliability of the French version of the Neurophysiology of Pain Questionnaire. Physiother Theory Pract 2017; 33(11): 880-7.
18. Nogueira LAC, Chaves AdO, Oliveira N, Almeida RSd, Reis FJJ, Andrade FGD et al. Cross-cultural adaptation of the Revised Neurophysiology of Pain Questionnaire into Brazilian Portuguese language. J Bras Psiquiatr 2018; 68(4): 273–7.
19. Richter M, Maurus B, Egan Moog M, Rauscher C, Regenspurger K, Delank KS. German version of the Neurophysiology of Pain Questionnaire: Translation, cross-cultural adaptation, reliability and validity. Schmerz 2019; 33(3): 244-52.
20. Eremenco SL, Cella D, Arnold BJ. A comprehensive method for the translation and cross-cultural validation of health status questionnaires. Eval Health Prof 2005; 28(2): 212-32.
21. Deyo RA, Dworkin SF, Amtmann D, Andersson G, Borenstein D, Carragee E, et al. Report of the NIH Task Force on research standards for chronic low back pain. J Pain 2014; 15(6): 569-85.
22. Rawang P, Janwantanakul P, Correia H, Jensen MP, Kanlayanaphotporn R. Cross-cultural adaptation, reliability, and construct validity of the Thai version of the Patient-Reported Outcomes Measurement Information System-29 in individuals with chronic low back pain. Qual Life Res 2020; 29(3): 793-803.

23. Portney L, Watkins M. Foundations of clinical research: applications to practice 3rd ed. Upper Saddle River, Pearson and Prentice Hall; For printing house: add full stop 2009
24. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Edu 2011; 2: 53-5.
25. Weir JP. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. J Strength Cond Res 2005; 19(1): 231-40.
26. Koo TK, Li MY. A Guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med 2016; 15(2): 155-63.
27. de Vet HCW, Terwee CB, Knol DL, Bouter LM. When to use agreement versus reliability measures. J Clin Epidemiol 2006; 59(10): 1033-9.
28. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol 2007; 60(1): 34-42.

Supplementary

The FACIT translation methodology was used to develop the culturally appropriate translation of the revised Neurophysiology of Pain Questionnaire (rNPQ) (Eremenco, Cella and Arnold, 2005). There are 11 steps in the FACIT translation methodology, as described below.

1. Forward translation

The rNPQ was initially translated into Thai by two independent professional translators, who were native Thai speakers (both were from the Language Institute of University). They were asked to use simple and culturally appropriate language.

2. Reconciliation

A third native Thai speaker (one of the authors of the manuscript), who did not participate in the forward translation, evaluated the first two translated questionnaires and made an attempt to reconcile any discrepancies between the two translations to generate a third translation. The translator took notes to document his thinking behind the decisions made.

3. Back-translation

The reconciled Thai version of the rNPQ was then back-translated by a native English-speaking translator (a person from the Language Institute of University), who was also fluent in Thai. The back translator was not allowed access to, and had no knowledge of, the original English version. The translator was asked to translate using simple language that captured the key meaning of the items.

4. Back-translation review/quality control

A native English speaker who had experience in using the rNPQ in research (one of developers of English version of the rNPQ) performed a back-translation review. The goal of review was to evaluate the equivalence in the meaning of the English source and Thai translation. The Translation Project Manager (one of the authors of the manuscript), who was a health professional and a native Thai speaker, provided additional comments on any discrepancies between the back-translated and original versions. Both reviewers made suggestions regarding wording that might require changes to ensure equivalent meaning.

5. Independent reviews

Three native Thai speakers, who were healthcare professionals (three physical therapists), reviewed all information obtained from the preceding steps. The most appropriate translation for each item was selected or alternate translations were provided if the previous translations were found to be unacceptable.

6. Pre-finalization review

The Translation Project Manager (one of the authors of the manuscript) reviewed the translation recommended as a result of step 5, along with the reviewers' comments. The Translation Project Manager identified potential problems and made comments about the recommended translation to guide the Language Coordinator (one of the authors of the manuscript) in step 7.

7. Finalization process

The Language Coordinator (one of the authors of the manuscript), who was a health professional, with experience in the intent of the items and a native Thai speaker, determined the final translation. All of the preceding information were reviewed. The Language Coordinator provided explanations for the choice of final translation and performed the respective literal back-translation and more idiomatic back-translation for each item.

8. Harmonization and quality assurance

A native English speaker who was involved in the development of the rNPQ (one of developers of English version of the rNPQ) made a preliminary assessment of the accuracy and equivalence of the final translation by comparing the final back-translation with the source and verifying that documentation of the decision-making process was complete.

9. Formatting and proofreading

Formatting, typesetting, and proofreading of the rNPQ instructions and items of the final translation were checked for spelling and grammatical issues. Two proof-readers (two physical therapists) worked independently and reconciled the proofreading comments.

10. Cognitive testing and linguistic validation

The final version of the Thai version of the rNPQ (T-rNPQ) was pretested with 10 Thai individuals with chronic LBP. The goal was to ensure understandability and verify that the meaning of each item was equivalent to the English source after translation.

11. Evaluation of the participants' comments and finalization of translation

The Language Coordinator (one of the authors of the manuscript) compiled and summarized comments from step 10 (back-translated into English) and proposed any final changes in the translation. The native English speaker (one of developers of English version of the rNPQ) who was involved in the development of the rNPQ conducted a final quality review and the translation was finalized.

Reference

Eremenco SL, Cella D, Arnold BJ. A comprehensive method for the translation and cross-cultural validation of health status questionnaires. Eval Health Prof 2005; 28: 212-32.