Translation, cross-cultural adaptation and reliability testing of the barriers to physical activity and Disability survey (B-PADS) for Thai people with Spinal Cord injury

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ASSESSMENT PROCEDURE

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ABSTRACT

Purpose: The objectives of this study were to translate and culturally adapt the Barriers to Physical Activity and Disability Survey (B-PADS) into the Thai context and to assess its inter- and intra-rater reliability.

Methods: Participants were experts in the field of spinal cord injury (SCI, $n=3$), linguistic experts ($n=7$), Thai-English bilingual speakers ($n=40$), Thai physiotherapists ($n=8$), and people with SCI living in Thailand ($n=43$). The translation and cross-cultural adaptation of the B-PADS into the Thai context was conducted using a 6-step process; forward translation, reconciliation of the two translated versions, backward-translation, harmonisation, backward-translation of the revised version, and cognitive debriefing with potential users and target population. The reliability of the translated tool was assessed using Cohen's kappa (K) and McNemar's test.

Results: The inter-rater reliability test demonstrated high-range agreement for the majority of statements (27 out of 38; Cohen's $K>0.60$) in the Thai-B-PADS final version. The intra-rater reliability test revealed that the majority of the statements (29 out of 38) in the Thai-B-PADS final version obtained substantial (Cohen's $K=0.61$–0.80, $p<0.05$) to perfect agreement (Cohen's $K=1.0$, $p<0.05$). McNemar's test displayed no statistically significant differences amongst assessors ($p>0.05$) for nearly all statements.

Conclusion: The Thai-B-PADS final version was successfully translated and culturally adapted for people with SCI.

➤ **IMPLICATIONS FOR REHABILITATION**

- Multi-stakeholders, including academic experts, researchers, translators, clinicians, target users and clients, should be involved in developing health-related questionnaires' translation and cultural adaptation processes.
- The Thai version of Barriers to Physical Activity and Disability Survey (B-PADS) possessed high levels of inter- and intra-rater reliability to assess barriers related to undertaking physical activities or exercise in people with spinal cord injury.
- Interactional biases and perceived social status effects may not be avoided when deploying a face-to-face interview of health-related questionnaires in a culture where social hierarchy is present within the language.
- The translation and adaptation processes used in this study were thorough, systematic and comprehensive, providing a culturally competent exemplar for translating health-related questionnaires between languages of different root origins.

Introduction

Spinal cord injury (SCI) can reduce levels of physical activity and result in compromised physical health, aerobic fitness and strength [1,2], as well as affecting overall health-related quality of life [3,4]. The SCI population have a lower level of participation in recreational and exercise activities when compared to the able-bodied population due to various self-perceived personal and environmental barriers [5]. These barriers may include architectural barriers, discrimination, lack of social assertiveness, lack of supportive governmental policies, and/or inadequate access to specialised services for exercising. The Barriers to Physical Activity

and Disability Survey (B-PADS) was developed to identify the important barriers that people with disabilities experience undertaking physical activities [6]. B-PADS has proven to be a valid and reliable patient-reported outcome tool for identifying barriers to physical activity for people with different disabilities [7,8].

The English-version of the B-PADS has demonstrated moderate test-retest reliability (Cohen's *K* 0.76) and good inter-rater reliability (Cohen's *K* 0.86) [7]. It has been designed for administration *via* telephone or face-to-face interviews. The B-PADS has been used in various populations with different cultural backgrounds or within a specific sub-group of a population since it is practical to translate, modify, and add or remove some questions to make it appropriate for the target population [9–11]. To date, a modified B-PADS for people with SCI is available and has been used in Australia [9], the United States [10] and Malaysia [11]. However, rigorous translation and validation of a research tool within an appropriate cultural context is very important to ensure that the translated questions can be understood by the targeted audience, as well as to ensure that the translated tool is psychometrically sound and able to measure what it was created to measure [12].

The barriers to participation in leisure-time physical activity or exercise have never been surveyed in people with SCI within Thailand. This information is essential to provide an insightful understanding of the barriers that deter Thai wheelchair users from being more physically active. In addition, identifying barriers to physical activity would inform Thai healthcare providers and policymakers in the revision of clinical practice guidelines, as well as implementation of effective strategies to support and enhance physical activity participation in Thailand. Therefore, the present study sought to translate and culturally adapt the original English language version of the B-PADS into the Thai context, as well as to assess the inter- and intra-rater reliability of the translated Thai-version of the B-PADS for subsequent deployment in a national survey of individuals with SCI, as well as use in clinical context.

Methods

The study comprised two phases – a translation-adaptation phase and a reliability testing phase. Ethical approval for both phases was granted by the University of Sydney's Human Research Ethics Committee (HREC) under the HREC approval letter 2017/1066 and 2018/588 respectively. The authors complied with the published guidelines [12–19] to inform the translation-adaptation processes, which included multiple face-validation steps [16–19] to ensure that the translated B-PADS was comprehensible to monolingual Thai-language speakers. The first author (ACE)—a native Thai speaker and fluent in English—was the "*Moderator*" for the study. The reliability testing included the inter- and intra-rater reliability. The translation-adaptation phase was conducted at the University of Sydney, Australia, from February to August 2018 and the reliability testing phase was conducted in Bangkok, Thailand, from December 2018 to February 2019. The authors of the present study received written permission for using the original English-language version of B-PADS from its author.

Phase 1: Translation-adaptation

Participants

The participants for this study comprised the following:
- *Translators* were responsible for either forward- or backward-translations. There were three different

categories of *Translators*: (i) two independent professional commercial translators that met ISO17100 standards requirements (*Translator-1a and 1b*); (ii) three independent non-professionally trained translators (*Translator-2a, 2b and 2c*). (iii) two language and linguistic experts for cross-checking the translations performed by Translator-1a and 1b. *Translator-1a* (with medical background) and *Translator-1b* (without medical background) were blinded to each others assessments. *Translator-2a* (with medical background), *Translator-2b* and *Translator-2c* (without medical background) were recruited based on their professional qualifications, experience and availability to participate from a list of Australian-employed scholars provided by the Thai Office of Educational Affairs, Canberra, Australia.
- *Assessors* were responsible for rating the accuracy and quality of the translations. There were three different categories of *Assessors*: (i) two senior researchers working in the field of SCI based in Australia (*Assessor-1a*: GMD and *1b*: JWM, native English-language speakers); (ii) an early-career physiotherapy researcher working in the field of SCI (*Assessor-2*: CQDO, English as a second language and non-Thai language speaker); and (iii) a group of bilingual Thai-English speakers who are fluent in English in their everyday living and work environments (*Assessor-3 group*).
- *Target Users* who represented two groups for using B-PADS in Thailand: (i) Thai physiotherapists working in the field of SCI (*Thai-PT*) and (ii) Thai people with SCI (*Thai-SCI*).

The eligibility criteria for each group of participants are shown in Table 1.

Recruitment

Advertisements to participate were posted *via* internet social media to the Thai Spinal Cord Injury Society, the Thai Physiotherapy Council, and to the Thai expatriate community in foreign countries for Thai-SCI, Thai-PT and bilingual Thai-English speakers, respectively. All participants ($n = 51$) who expressed interest were given a copy of participant information sheet and were screened for eligibility criteria (see Table 1). After obtaining the signed consent form, all participants ($n = 51$) were involved in this study.

Assessments

The original English version of the B-PADS has 13 primary questions. Six of these questions also ask participants to provide further response either as open-ended probes or when triggered by specific responses to some primary questions. The *Moderator* of this study divided the 13 primary questions of the B-PADS into 51 statements for the purpose of scoring and comparability.

The following assessment scales were used to identify the problematic words, phrases, and statements during each step of the translation-adaptation phase:

The Comparability and Interpretability Rating Scale (CIRS) [16] is a 7-point likert scale with two items related to comparability of language and similarity of interpretation (see Supplementary Appendix 1). Each item was scored from 1 (extremely comparable/similar) to 7 (not at all comparable/similar). The three assessors

Table 1. Eligibility criteria of the participants.

Category	Sub-category	n	Profile	Native English speaker	Non-native English speaker	Native Thai Speaker	Activity performed
Phase 1: Translation-adaptation							
Moderator	-	1	Responsible for running the study	✗	✓	✓	n = 1, facilitated each step during the study
Assessors	Assessor-1a and 1b	2	**Senior researchers** in the field of SCI.	✓	✗	✗	n = 3, rated E2 and E3 against E1 version using CIRS
	Assessor-2	1	**Early-career clinical researcher** in the field of SCI.	✗	✓	✗	
	Assessor-3 group	40	**Bilingual Thai-English speakers** born and live in Thailand for more than half of their lifetime.	✗	✓	✓	n = 20, rated T3 against E1 version using AIRS n = 20, rated T4 against E1 version using AIRS
Translators	Translator-1a and 1b	2	**Professional commercial translators** (with medical and non-medical background) providing certified translation (ISO17100).	✗	✓	✓	n = 1, performed English to Thai translation (T1) n = 1, performed Thai to English translation (E2)
	Translator-2a, 2b and 2c	3	**Non-professionally trained translators** based in an English-speaking country (with medical and non-medical background).	✗	✓	✓	n = 1, performed English to Thai translation (T2) n = 2, performed Thai to English translations (E3, E4 and E5)
	Language and linguistic experts	2	**Professional commercial translators** providing certified translation (ISO17100).				n = 2, language and linguistic experts cross-checked the T1 and E2 translations
Target Users	Thai-PT	6	**Thai physiotherapists** with experience in treating people with SCI, graduated from a Thai university, holding an active license to practice as a physiotherapist in hospital, clinic, home-visit services or community-based services in Thailand.	✗	✗	✓	Participated in the cognitive debriefing of T4
	Thai-SCI	5	**Monolingual Thai adults with SCI** (18 years or more), having access to mobile phone and internet, as well as do not have a pre-existing medical condition that affect the cognitive function.	✗	✗	✓	n = 5 participated in the cognitive debriefing of T4
Phase 2: Reliability testing							
Assessors		2	**Thai physiotherapists** with experience in treating people with SCI as well as have expertise in research.	✗	✓	✓	n = 1, is the same person who moderated the study and assess the participants at two different occasions, 7 days apart. n = 1, assessed the participant at one occasion.
	Participants	38	**Monolingual Thai adults with SCI** (18 years or more), having access to mobile phone and internet, as well as do not have a pre-existing medical condition that affect the cognitive function.	✗	✗	✓	n = 38 participated in the reliability testing phase of the study

B-PADS: the barriers to physical activity and disability survey; SCI: spinal cord injury; AIRS: Accuracy and interpretability rating scale; CIRS: Comparability and interpretability rating scale; Acronyms used for different version of the B-PADS in this table are presented in Table 2.

(Assessors-1a, 1b, and 2) were responsible for independently rating each of the back-translated statements of the B-PADS against its original English language version using the CIRS items and were blinded to each other's rating. When an assessor gave a score of 3 or greater on CIRS, each assessor was asked to provide further justification.

The Accuracy and Interpretability Rating Scale (AIRS) is a modified version of the 7-point likert CIRS [16] that comprised two items related to accuracy of translation and the similarity of interpretation (see Supplementary Appendix 1). Each item was scored from 1 (extremely accurate/similar) to 7 (not at all accurate/similar). The *Assessor-3 group* participants were responsible for

independently rating each of the forward-translated statements of the B-PADS against its original English language version uisng the AIRS. They were also blinded to each other rating. When an assessor gave a score of 3 or greater on AIRS, each assessor was asked to provide further suggestions and a possible translation solution to the statement.

Procedure

The process of translation and cross-cultural adaptation [12–19] enables the detection of ambiguous or inappropriate statements that require further clarification before acceptance of the final
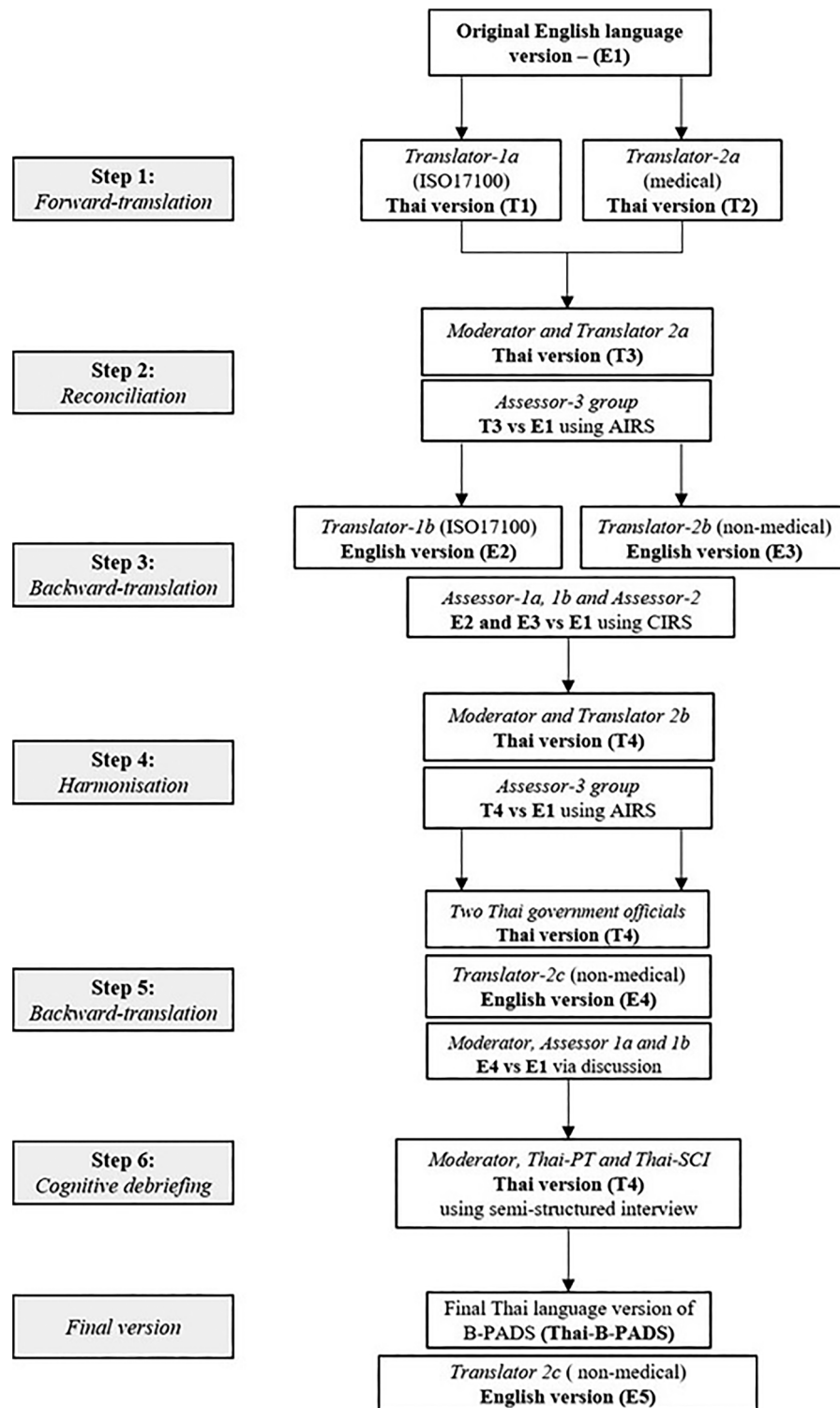
Figure 1. Flow diagram of translation and adaptation of B-PADS.

Thai version of the B-PADS in Thai context. This was repeated until a consensus was reached for the final Thai version of the B-PADS, which is interpretable to monolingual Thai *Target users*. The processes of translation and cross-cultural adaptation of the B-PADS comprises the following 6-step process (see Figure 1):

Step 1 – Forward translation: B-PADS original English language version (E1) was independently translated by *Translator-1a* and

Translator-2a to the Thai versions of the B-PADS (T1 and T2, respectively).

Step 2 – Reconciliation of the two Thai version of the B-PADS (T1 and T2): The Moderator and Translator-2a compared the T1 and T2 versions to identify and resolve any inaccuracies and dissimilarities of interpretation. A reconciled Thai B-PADS forward-translation version (T3) was created. The T3 version was then compared for accuracy of translation against original

Table 2. Acronyms used for different versions of the B-PADS.

Acromyn	Definition
E1	Original English language version of the B-PADS
T1	Translated Thai language version initial B-PADS
T2	Translated Thai language version initial B-PADS
T3	Reconciled Thai language version derived from T1 and T2
E2	Backward-translated English language version of T3
E3	Backward-translated English language version of T3
T4	Harmonised Thai language version of the T3
E4	Backward-translated English language version of T4
Thai-B-PADS	Final Thai language version of B-PADS
E5	Backward-translated English language version of Thai-B-PADS

English B-PADS (E1) using the AIRS by bilingual *Assessor-3 group*.

Step 3 – Backward-translation for English version of the B-PADS and its evaluation: Firstly, backward-translation of the T3 was performed by Translator-1b and Translator-2b independently to create the English version of the B-PADS (E2 and E3, respectively). Secondly, E2 and E3 versions were compared against the E1 using the CIRS by Assessor-1a, 1b and 2.

Step 4 – Harmonisation of the Thai version of B-PADS: The Moderator and Translator-2b reviewed the CIRS and AIRS scores, as well as the comments and suggestions received from the assessors. This facilitated further adjustment of T3 version to create a pre-final version of the Thai B-PADS (T4). At this stage, T4 was also compared against original English version (E1) using AIRS by *Assessor-3 group*.

Step 5 – Backward-translation of T4: Translator-2c backward-translated T4 version into the B-PADS English version (E4). At this step, the Moderator and Assessor-1a and 1b compared E4 version against E1 version and consensus were reached via discussion. Word choices, changes, and translation solutions were recorded. Finally, two Thai government officials reviewed the T4 version against E1 version and provided approval of T4 version for subsequent use in Thailand.

Step 6 – Cognitive debriefing with potential users and target population: Face-to-face semi-structured interviews (see Supplementary Appendix 2) were conducted in Bangkok, Thailand with the Target users, involving Thai-PT ($n=6$) and Thai-SCI ($n=5$). The Target users were asked to read the T4 version and were asked whether there were any words or statements that needed further justification. For example, "Do you find the words/texts/statements confusing?" or "How would you respond to that question/statement." The duration of the interviews ranged from 60 to 90 minutes and all interviews were recorded and transcribed verbatim. The T4 version was then revised and adjusted based on the comments received from the Target users, ensuring that it was contextually appropriate for monolingual Thai speakers. The final Thai language version of B-PADS was produced at this step (Thai-B-PADS). The back-translation of the final Thai language version of B-PADS (E5) was performed. Acronyms used for different versions of the B-PADS are presented in Table 2. The Thai-B-PADS final version was submitted to Thai government officials for future use in Thailand and E5 version was endorsed by *Assessor-1a* and *Assessor-1b*.

Data analysis

CIRS and AIRS: Point differences between the three assessors comparing E2 version against E1 version and E3 version against E1 version using CIRS will be presented for 51 statements as number (%). Maximum point difference with the Assessor-3 group ($n=20$) comparing the T3 version against the E1 version and the T4 version against the E1 version using AIRS will be presented for 51 quantified statements as a number (%). The data were analysed using the Microsoft Excel Software.

Qualitative analysis: The transcriptions of the semi-structured interviews were subjected to content analysis. The *Moderator* and *Translator-2* resolved all the disagreed statements by discussion and appropriate adjustments.

Phase 2: Reliability testing

Participants

Thai-SCI participants who responded to the social media advertisements were recruited in this phase of the study (Table 1). All participants ($n=38$) were screened for eligibility, underwent informed consent and provided basic injury characteristics and demographic information.

Measures

The final Thai language version of B-PADS (Thai-B-PADS) was administered to Thai-SCI participants on three separate occasions. The first was on the same day when informed consent was obtained. The second assessment occurred one hour later on the same day. Finally, the last assessment was undertaken seven days after the first and second assessments.

Procedure

Data collection occurred between December 2018 and January 2019. Injury characteristics and demographic information included age, time since injury, sex, marital status, employment status, living area, neurological level of injury according to the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) [20], and mode of mobility.

Inter-rater reliability of the Thai-B-PADS: Two independent assessors administered the Thai-B-PADS on the same Thai-SCI individuals one-hour apart. The data were compared to assess the inter-rater reliability.

Intra-rater reliability of the Thai-B-PADS: One assessor re-administered the Thai-B-PADS on the same Thai-SCI individuals one-week later. The data obtained on two different occasions (Day-1 and Day-7) were compared to assess intra-rater reliability.

Both assessors were appropriately trained to administer Thai-B-PADS and were blinded to each other's assessment. The duration of each assessment ranged from 15 to 20 min.

Data analysis

Cohen's kappa (K) [21] and McNemar's tests [22] were used to test inter- and intra-rater reliability of the Thai-B-PADS using the SPSS statistical package (IBM SPSS Statistics 25; Armonk NY, USA). Only the primary questions were analysed, as these were answered by all participants. The follow-up questions were answered only by some of the participants, when triggered. Any of these follow-up questions that were unanswered were considered as missing data, and where there was more than 50% of missing data for a question, statistical analysis was not performed on that question.

Cohen's kappa was used to quantify the agreement between the two raters who performed one survey each on the Thai-SCI

sample or for the same rater who undertook test-retest surveys on the group. Cohen's kappa can range from −1 to +1 where <0 indicated poor agreement, 0.00–0.20 slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement, and 0.81-.99 almost perfect agreement [21]. The kappa (K) coefficient was considered statistically significantly different from zero under $p < 0.05$.

McNemar's test was used to evaluate a change in proportion of rating scores for the paired data. McNemar's statistical significance was set at $p < 0.05$, as an indication that the result of paired data was statistically significantly different [22].

Results

Translation-adaptation phase

The final Thai language version of the B-PADS was considered comprehensible by monolingual Thai speakers. In Step 1 and Step 2, the *Moderator* and *Translator-2a* agreed that the literal and contextual translation of T1 and T2 were comparable. Differences in word choices for the "Yes/No" answers (questions 1 to 11) were identified, as they used different synonyms based on the Thai auxiliary verbs in the translated questions. For example, in question 2 ("คุณเคยออกกำลังกายหรือไม่" from O1 "Have you ever exercised?"), the translated answers of "Yes/No" were "เคย/ไม่เคย" (Translator-1a) and "ใช่/ไม่ใช่" (Translator-2a). Consensus agreement between the *Moderator* and *Translator-2a* was reached to create T3, a combination of the two forward-translated Thai version of the B-PADS (T1 and T2) done by two different translators at the same time.

In Step 3, point differences for *Assessor-1a, 1b, and 2* are presented as Table 3. *Assessor-1a*, *1b* and *2* have scored 19 and 32 statements (out of 51) with no point difference on the comparability scale and interpretability scale, respectively when comparing E2 version against E1 version. Similarly, they scored 11 and 16 statements (out of 51) with no point difference on the comparability and interpretability scale, respectively when comparing E3 version against E1 version. The above results also revealed that the *Assessor-1a, 1b and 2* were in less agreement with back-translation performed by Translator-2b when compared with translation performed by the *Translator-1b* (ISO17100 Standard). Some examples of statements that were not comparable as per *Assessor-1a, 1b, and 2* as below:

- "Do you know of a fitness centre that you could get to?" (E1 version) compared with "Do you know a fitness centre you can use?" (E2 version);
- "Lack of accessible facility" (E1 version) compared with "No exercise venue within travel distance" (E3);
- "Incontinence issues prevent me from exercising" (E1 version) compared with "Difficulty holding in urine/faeces stops me from exercising" (E3 version).

In Step 4, point differences for *Assessor-3 group* are presented as Table 4. *Assessor-3 group* have scored 22 and 23 statements (out of 51) with one point difference on the accuracry scale and interpretability scale, respectively when comparing the T3 version against the E1 version. Subsequently, *Assessor-3 group* have scored all 51 statements with no point difference on the accuracry scale and interpretability scale, respectively when comparing T4 version against E1 version. This implies that all assessors in the *Assessor-3 group* gave a score of 1 (best possible score) on the AIRS. In addition, while comparing the T3 version with E1 version, *Assessor-3 group* had concerns related to lack of cultural equivalency, wordiness, redundancy, informality and the flow of language after translation during daily Thai discourse.

In Step 5, the E4 version was compared against the E1 version and a consensus agreement was reached after discussion between the *Moderator, Assessor-1a and 1b*.

In Step 6, Thai-SCI individuals considered the T4 version as comprehensible with no need for further adjustments. On the contrary, Thai-PT participants deemed that the T4 version needed major adjustments. Thai-PT commented that some questions were not practical in the Thai context. Some of these changes that were made in the Thai-B-PADS final version are presented below:

- It was recommended that the question "Do you know of a fitness centre that you could get to?" should appear before or in close proximity to the question "Have you gone to a fitness centre, but it was not a positive experience?" for efficiency and logic in their deployment.
- Another recommendation was that the question "Have you ever exercised?" (E1 version) should be modified to "After the injury, do you currently engage in any exercise routine by yourself or with support from a personal assistant (Do not include physiotherapy or any rehabilitation session)"

Table 3. Scores of comparability and interpretability rating scale by all assessors (assessors = 3).

	Comparability and interpretability rating scale (CIRS)							
	Comparability scores (E2 vs E1); Statements, *n* (%)				Interpretability scores (E2 vs E1); Statements, *n* (%)			
Point difference	Assessors-1a vs 1b	Assessors-1a vs 2	Assessors-1b vs 2	All Assessors[a]	Assessors-1a vs 1b	Assessors-1a vs 2	Assessors-1b vs 2	All Assessors[a]
0	28 (54.9)	22 (43.1)	24 (47.1)	19 (37.5)	37 (72.5)	34 (66.7)	37 (72.5)	32 (62.7)
1	12 (23.5)	14 (27.5)	9 (17.6)	8 (15.7)	10 (19.6)	11 (21.6)	12 (23.5)	11 (21.6)
2	4 (7.8)	13 (25.5)	14 (27.5)	14 (27.5)	2 (3.9)	3 (5.9)	0 (0)	4 (7.8)
3	4 (7.8)	1 (2.0)	3 (5.9)	6 (11.8)	2 (3.9)	1 (2.0)	0 (0)	2 (3.9)
4 and more	3 (5.9)	2 (4.0)	1 (2.0)	4 (7.9)	0 (0)	2 (4.0)	2 (3.9)	2 (4.0)
Total statements	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)
Point difference	Comparability scores (E3 vs E1); Statements, *n* (%)				Interpretability scores (E3 vs E1); Statements, *n* (%)			
	Assessors-1a vs 1b	Assessors-1a vs 2	Assessors-1b vs 2	All Assessors[a]	Assessors-1a vs 1b	Assessors-1a vs 2	Assessors-1b vs 2	All Assessors[a]
0	23 (45.1)	16 (31.4)	23 (45.1)	11 (21.6)	24 (47.1)	19 (37.3)	24 (48.0)	16 (31.4)
1	21 (41.2)	21 (41.2)	14 (27.5)	21 (41.2)	6 (11.8)	8 (15.7)	14 (28.0)	6 (11.8)
2	4 (7.8)	8 (15.7)	10 (19.6)	10 (19.6)	9 (17.6)	12 (23.5)	7 (14.0)	9 (17.6)
3	2 (3.9)	2 (3.9)	2 (3.9)	4 (7.8)	8 (15.7)	10 (19.6)	4 (8.0)	14 (27.5)
4 and more	1 (2.0)	4 (7.8)	2 (3.9)	5 (9.8)	4 (7.8)	2 (3.9)	2 (4.0)	5 (9.8)
Total statements	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)	51 (100)

[a]Point difference between the assessors with the highest and lowest ratings.

Table 4. AIRS by all assessors (assessors = 40).

	Accuracy and Interpretability Rating Scale (AIRS)			
	Accuracy scores		Interpretability scores	
Maximum Point difference	T3 vs E1	T4 vs E1	T3 vs E1	T4 vs E1
	Statements, n (%)		Statements, n (%)	
0	0 (0.0)	51 (100)	0 (0.0)	51 (100)
1	22 (43.1)	0 (0.0)	23 (45.1)	0 (0.0)
2	24 (47.1)	0 (0.0)	26 (51.1)	0 (0.0)
3	3 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)
4 and more	2 (3.9)	0 (0.0)	2 (3.9)	0 (0.0)
Total statements	51 (100)	51 (100)	51 (100)	51 (100)

should include subsequent questions for further clarity. Therefore, if a person answered 'yes' to above statement he/she will then be prompted with newly added subsequent questions "what do you do in your exercise routine?" and "how often do you exercise? (times/week)?" in the Thai-B-PADS final version.

After all the above revisions were made, *Target Users group* considered the Thai-B-PADS final version was comprehensible, sensible and required no further adjustments. The Thai-B-PADS final version and its back-translation (E5) are presented as Supplementary Appendix 3 and Appendix 4, respectively.

Reliability testing phase

Thai SCI individuals ($n = 38$) participated in the reliability testing phase of this study. Their physical characteristics and demographic information are presented in Table 5. Thirty-eight statements from the Thai-B-PADS were tested for inter- and intra-rater reliability. The results of Cohen's kappa (K) and McNemar test are presented in Table 6.

The results revealed that three statements from the inter-rater reliability analysis and four from the intra-rater reliability analysis could not be calculated because one measure was a constant or almost always constant (questions with "§" in Table 6). The authors also considered that four statements from the inter-rater reliability analyses and three from the intra-rater reliability analyses were deemed as "non-discriminating" because almost all participants answered in the same category, which violated the assumptions of the test (questions with "†" in Table 6).

The inter-rater reliability demonstrated high-range agreement for the majority of statements in the Thai-B-PADS (27 out of 38 statements) ($K > 0.60$). Two statements (12.20 and 12.24) demonstrated perfect agreement ($K = 1.00$, $p < 0.05$). Five statements (7, 12.18, 12.19, 12.21 and 12.25) demonstrated almost perfect agreement ($K = 0.81–0.99$, $p < 0.05$). Twenty statements (2–4, 6, 12.1–12.13, 12.16–12.17 and 12.22) demonstrated substantial agreement ($K = 0.61–0.80$, $p < 0.05$). There were three statements (5, 9 and 12.14) that demonstrated moderate agreement ($K = 0.41–0.60$, $p < 0.05$). Three statements (1, 8 and 12.15) had a kappa coefficient that was not statistically significantly different from zero ($p > 0.05$), yet with fair agreement ($K < 0.41$).

McNemar's test demonstrated no statistically significant differences between assessors ($p > 0.05$) in almost all questions (with exception of the question "Are you worried going to a community recreation facility or a fitness centre?").

The intra-rater reliability revealed that the majority of the statements (29 out of 38) in the Thai-B-PADS obtained substantial ($K = 0.61–0.80$, $p < 0.05$) to perfect agreement ($K = 1.0$, $p < 0.05$). There were three statements (12.14, 12.17 and 12.22) that obtained moderate agreement ($K = 0.41–0.60$, $p < 0.05$) and only one

Table 5. Demographic characteristics of Thai-SCI who participated in the reliability testing phase 2 ($n = 38$).

Characteristic	
Age (year), mean (SD)	37.4 (10.4)
Time since injury (year), mean (SD)	12.7 (9.3)
Sex, n (%)	
Men	27 (71.1)
Women	11 (28.9)
Marital status, n (%)	
Single	27 (71.1)
Married	11 (28.9)
Employment status, n (%)	
Employed	25 (65.8)
Unemployed	13 (34.2)
Living area[a], n (%)	
Rural	3 (7.9)
Town	25 (65.8)
City	10 (26.3)
Level of SCI, n (%)	
Tetraplegia	13 (34.2)
Paraplegia	25 (65.8)
Mode of mobility, n (%)	
Manual wheelchair	30 (78.9)
Electric wheelchair	8 (21.1)

B-PADS: the barriers to physical activity and disability survey; SCI: spinal cord injury.
aCategorised using classification published by The National Statistical Office of Thailand.

statement (12.15) that obtained a fair agreement ($K = 0.21–0.40$, $p < 0.05$), although the kappa coefficient was not statistically significantly different from zero ($p > 0.05$). The McNemar's test indicated that there were no statistically significant differences between the seven-day test-retest data ($p > 0.05$).

Discussion

This study carried out the translation and cultural adaptation of the B-PADS into the Thai language and context using robust scientific translation and content validation procedures. Various studies have previously used the original English language version of the B-PADS or an adapted version of it to identify barriers to physical activity and exercise for people with disabilities within their cultural context [5,7–11]. An involvement of the assessors, translators and target users in the translation-adaptation phase provided unique perspectives to consolidate and ensure that the Thai language version of the B-PADS is contextually appropriate. For the reliability testing phase, most statements in the Thai-B-PADS obtained substantial to high-ranged agreement ($K > 0.60$). As a result of this project, a Thai language version of the B-PADS is now available to use for identifying personal, environmental and resource barriers, which limit the uptake of physical activities or exercise in Thai people with disabilities.

During the translation process, some unique difficulties were encountered. Whilst translated questions seemed comparable in both back translated version (E2 and E3), a major issue proved to be the interpretation of "Yes/No" answers throughout the translated questionnaire. The literal translation of "Yes/No" is "ใช่/ไม่ใช่." In Thai, however, it is also correct to use auxiliary verbs from the question as an answer [23]. It was agreed by the *Moderator* and *Translator-2b* to use an auxiliary verb specific to each question as a possible answer to reduce language inconsistency and confusion in subsequent questions.

Involvement of academic experts in the evaluation of each translation-adaptation process step entailing scoring, provision of feedback and discussion until reaching consensus, helped in

Table 6. Cohen's kappa and McNemar's test for inter- and intra-rater reliability for each question of the final Thai language version of B-PADS ($n = 38$).

#	B-PADS questions (Answer's type)	Time 1 (1st Interview)	Time 2 (Same day with 1st Interview)	Time 3 (7 days after 1st Interview)	Inter-rater reliability			Intra-rater reliability		
					K_{12}	P_{12}	McNemar$_{12}$	K_{23}	P_{23}	McNemar$_{23}$
1	Do you like to exercise (Yes/No)	Yes = 33 No = 5	Yes = 34 No = 4	Yes = 34 No = 4	0.37	0.21	1.0	1.0	<0.05	1.0
2	After injury, do you currently engage in any exercise routine by yourself or with support from personal assistant (Yes/No)	Yes = 35 No = 3	Yes = 33 No = 5	Yes = 32 No = 6	0.72	<0.05	0.5	0.89	<0.05	1.0
3	Do you have any exercise equipment at home (Yes/No)	Yes = 32 No = 6	Yes = 31 No = 7	Yes = 31 No = 7	0.72	<0.05	1.0	1.0	<0.05	1.0
4	Have you ever been injured from exercising (Yes/No)	Yes = 12 No = 26	Yes = 14 No = 24	Yes = 14 No = 24	0.77	<0.05	0.63	0.77	<0.05	1.0
5	Would you like to join an exercise program in a community recreation facility or a fitness centre (Not No/Not Yes)	Not No = 31 Not Yes =7	Not No = 31 Not Yes =7	Not No = 31 Not Yes =7	0.59	<0.05	1.0	1.0	<0.05	1.0
6	Do you know any community recreation facility or a fitness centre you can visit (Yes/No)	Yes = 25 No = 13	Yes = 25 No = 13	Yes = 25 No = 13	0.65	<0.05	1.0	1.0	<0.05	1.0
7	Have you ever visited a community recreation facility or a fitness centre (Yes/No)	Yes = 12 No = 26	Yes = 13 No = 25	Yes = 14 No = 24	0.94	<0.05	1.0	0.94	<0.05	1.0
8	Are you worried going to a community recreation facility or a fitness centre (Yes/No)	Yes = 32 No = 6	Yes = 18 No = 20	Yes = 19 No = 19	0.29	0.11	0.0	0.84	<0.05	1.0
9	Do you feel that your trainers in a community recreation facility or a fitness centre can make an exercise program that fits your needs or physical problems (Yes/No)	Yes = 27 No = 11	Yes = 28 No = 10	Yes = 29 No = 9	0.54	<0.05	1.0	0.93	<0.05	1.0
10	Do you feel that exercise programs can make your health better (Yes/No)	Yes = 38 No = 0	Yes = 37 No = 1	Yes = 37 No = 1	§	§	§	§	§	§
11	Have your doctors ever told you to exercise (Yes/No)	Yes = 38 No = 0	Yes = 38 No = 0	Yes = 38 No = 0	§	§	§	§	§	§
12	Which of the following concerns are why you cannot join an exercise program or cannot exercise as much as you want									
12.1	The cost of the exercise program (Yes/No)	Yes = 26 No = 12	Yes = 26 No = 12	Yes = 26 No = 12	0.76	<0.05	1.0	1.0	<0.05	1.0
12.2	The cost of the exercise equipment (Yes/No)	Yes = 21 No = 17	Yes = 22 No = 16	Yes = 22 No = 16	0.73	<0.05	1.0	0.89	<0.05	1.0
12.3	Bad weather (Yes/No)	Yes = 29 No = 9	Yes = 27 No = 11	Yes = 27 No = 11	0.73	<0.05	0.63	1.0	<0.05	1.0
12.4	Lack of transportation vehicles (Yes/No)	Yes = 30 No = 8	Yes = 27 No = 11	Yes = 23 No = 15	0.65	<0.05	0.38	0.65	<0.05	0.22
12.5	Lack of time (Yes/No)	Yes = 13 No = 25	Yes = 15 No = 23	Yes = 12 No = 26	0.77	<0.05	0.63	0.83	<0.05	0.25
12.6	Lack of interest (Yes/No)	Yes = 8 No = 30	Yes = 7 No = 31	Yes = 7 No = 31	0.75	<0.05	1.0	0.83	<0.05	1.0
12.7	Lack of energy (Yes/No)	Yes = 13 No = 25	Yes = 10 N=28	Yes = 9 No = 29	0.69	<0.05	0.38	0.79	<0.05	1.0
12.8	Lack of motivation (Yes/No)	Yes = 10 N=28	Yes = 10 No = 28	Yes = 9 No = 29	0.73	<0.05	1.0	0.65	<0.05	1.0
12.9	Lack of support from friends and family in doing exercise (Yes/No)	Yes = 9 No = 29	Yes = 11 No = 27	Yes = 8 No = 30	0.73	<0.05	0.63	0.65	<0.05	0.38
12.10	Lack of personal assistant who help exercising (Yes/No)	Yes = 19 No = 19	Yes = 17 No = 21	Yes = 15 No = 23	0.68	<0.05	0.69	0.79	<0.05	0.63
12.11	Lack of recreational centres that are easy to visit, or are not handicap accessible (Yes/No)	Yes = 24 No = 14	Yes = 27 No = 11	Yes = 28 No = 10	0.70	<0.05	0.38	0.80	<0.05	1.0
12.12	Exercise is boring or monotonous (Yes/No)	Yes = 6 No = 32	Yes = 6 No = 32	Yes = 6 No = 32	0.80	<0.05	1.0	0.80	<0.05	1.0

(Continued)

Table 6. Continued.

#	B-PADS questions(Answer's type)	Time 1(1st Interview)	Time 2(Same day with 1st Interview)	Time 3(7 days after 1st Interview)	Inter-rater reliability			Intra-rater reliability		
					K_{12}	P_{12}	McNemar$_{12}$	K_{23}	P_{23}	McNemar$_{23}$
12.13	Exercise does not make your condition any better (Yes/No)	Yes = 1 N = 37	Yes = 2 N = 36	Yes = 1 N = 37	0.66 †	<0.05 †	1.0 †	−0.04 †	0.81 †	1.0 †
12.14	Exercise makes your condition worse (Yes/No)	Yes = 2 No = 36	Yes = 2 No = 36	Yes = 2 No = 36	0.47 †	<0.05 †	1.0 †	0.47 †	<0.05 †	1.0 †
12.15	Exercise is too difficult (Yes/No)	Yes = 4 No = 34	Yes = 2 No = 36	Yes = 3 No = 35	0.28	0.06	0.63	0.36	<0.05	1.0
12.16	Do not know how to exercise (Yes/No)	Yes = 17 No = 21	Yes = 12 No = 26	Yes = 12 No = 26	0.62	<0.05	0.13	0.88	<0.05	1.0
12.17	Do not know where to exercise (Yes/No)	Yes = 5 No = 33	Yes = 8 No = 30	Yes = 12 No = 26	0.73	<0.05	0.25	0.47	<0.05	0.29
12.18	Your job makes you unable to exercise as much as you want (Yes/No)	Yes = 14 No = 24	Yes = 15 No = 23	Yes = 13 No = 25	0.94	<0.05	1.0	0.77	<0.05	0.63
12.19	The concern over your own health stops you from exercise (Yes/No)	Yes = 15 No = 23	Yes = 16 No = 22	Yes = 13 No = 25	0.84	<0.05	1.0	0.72	<0.05	0.38
12.20	The inability to hold urine stops you from exercise (Yes/No)	Yes = 9 No = 29	Yes = 9 No = 29	Yes = 9 No = 29	1.0	<0.05	1.0	1.0	<0.05	1.0
12.21	Pain stops you from exercise(Yes/No)	Yes = 20 No = 18	Yes = 21 No = 17	Yes = 21 No = 17	0.84	<0.05	1.0	0.89	<0.05	1.0
12.22	Your family responsibility makes you unable to exercise as much as you want (Yes/No)	Yes = 5 No = 33	Yes = 5 No = 33	Yes = 5 No = 33	0.77	<0.05	1.0	0.54	<0.05	1.0
12.23	You are too old to exercise (Yes/No)	Yes = 1 No = 37	Yes = 0 No = 38	Yes = 0 No = 38	§	§	§	§	§	§
12.24	You are afraid to leave your house. (Yes/No)	Yes = 4 No = 34	Yes = 4 No = 34	Yes = 3 No = 35	1.0	<0.05	1.0	0.84	<0.05	1.0
12.25	You feel uncomfortable or embarrassed when you are in a fitness centre. (Yes/No)	Yes = 11 No = 27	Yes = 10 No = 28	Yes = 7 No = 31	0.93	<0.05	1.0	0.78	<0.05	0.25
12.26	You are already satisfied with your body and think it is unnecessary to exercise.(Yes/No)	Yes = 1 No = 37	Yes = 2 No = 36	Yes = 0 No = 38	−0.04 †	0.81 †	1.0 †	§ §	§ §	§ §
12.27	It is not worth the time it takes to exercise (Yes/No)	Yes = 1 No = 37	Yes = 2 No = 36	Yes = 1 No = 37	−0.04 †	0.81 †	1.0 †	0.66 †	<0.05 †	1.0 †

§ = Value could not be calculated because one measure was a constant.
† = Not discriminating-interpret with caution.
The result in this table are presented using the final English back-translated (E4) version of the final Thai version of the B-PADS (Thai-B-PADS).

detecting problems arising from the cross-cultural translation of the questionnaire in relation to its health and medical contexts. The authors believe that the participation of academic experts is crucial for enhancing the quality and validity of the cross-cultural translation of such research tools [16]. The results revealed that the academic experts were in doubt about some of the back-translated statements in E2 and E3. It is possible that translators employed for this study were unfamiliar with certain health-related terms, and may have misinterpreted their intent or had difficulties finding precise words to describe "doctor," "energy," "personal care attendant," and "incontinence" in Thai. Also, some words might not have any direct translation between English and Thai languages due to the underlying disparity arising from different root origins, in this case Indo-European (English) compared to Sino-Tibetan (Thai) [24]. Alternatively, a possible direct translation may not be a lay term in Thai, whereby it was pragmatic to use an extensive description to reflect that word or phrase [25].

The AIRS score rated by the first 20 bilingual participants (*Assessors-3 group*) showed that they were satisfied and agreed with the Thai content in T3. However, they also provided anecdotal comments regarding the wordiness, flow, and formality of the Thai language in comparison to English. Khamkhien (2010) has noted that redundancy and inconsistency of words is common

when translating from languages with different root origins [24]. For example, inaccuracies are commonly introduced when translating a different language into Thai because in a Thai person's perception, language is constructed based on a hierarchical system, the relationship between speakers and a degree of politeness. In the Thai language, word and phrase choices vary according to age, background, occupation, and professional rank. Therefore, the complexity of the Thai language requires the translator to understand how the speaker places their identity and their addressee in the hierarchical social system, with degree of intimacy and the situation when a conversation happens [26].

Accordingly, minor adjustments were made to T3 based on the comments from the academic experts and bilingual participants to create T4. Although T4 was graded as a perfect AIRS score of 1 by the bilingual participants and was revised and accepted by the academic experts, it was considered inadequate by the Thai-PT group, who suggested many changes. Acquadro et al. (2008) observed that revision by bilingual and monolingual speakers was necessary to improve the quality of a translation and its validity, since the questions could be rearranged, simplified, divided, added or deleted according to the suitability of the target language [12]. Consequently, the involvement of bilingual participants to score and comment on the Thai-translated B-PADS was deemed vital,

since it ensured that the translated survey could be understood by Thai people of different social status and backgrounds. Thai-PT and Thai-SCI individuals also played an important role, as these monolingual speakers provided significant opinions from the different perspectives of potential users and target participants to ensure that the translated tool was an intelligible, practical, simplified, relevant and contextually appropriate [12].

There was high-range agreement for the majority of the Thai B-PADS final version questions with a high inter- and intra-rater reliability ($K > 0.60$, $p < 0.05$). Additionally, over 90% of results from McNemar's test showed no statistically significant differences between researchers, as well as for test-retest results ($p > 0.05$). Although some individual questions (denoted by "§" and "†" in Table 6) should be interpreted with caution due to the restriction of range to a single value, our study clearly demonstrated that most of the main questions from the Thai-B-PADS final version were reliable.

Interestingly, the questions with low-range agreement may have been influenced by interactional biases and perceived social status effects [27]. The participants may have been influenced by how the assessors behaved (interactional biases) in the assessment task. For example, unintentional non-verbal reinforcement like slight nodding of the head or intonation of speech could have indicated positive or negative expectations from the assessors, which may have influenced the participants' answers [28]. Closeness and relationships between assessors and the participants could also have biased the participants' responses. One of the assessors may have developed a closer relationship with participants during the screening and recruitment period, whereas the other only used the questionnaire to interview participants during the data collection phase. This psychological closeness contains a higher risk of mutual influence as an impression of a person can overshadow the answers (social status position effects) [29]. It was noted that the assessor team possessed different ages, sex, personality traits and roles in this study and these could have influenced the participants' answers [30]. As previously noted, a prominent feature of Thai language is its inherent hierarchical system [26] - the younger assessor used different pronouns and phraseology (indicating the sex of the speaker) compared to an older one, which may affect how the participants perceived and responded to the survey questions.

For future research utilising the Thai-B-PADS final version, employment of quality management is recommended when the study is of a large scale with multiple assessors. Techniques that could assist in minimising assessor's bias are standardisation of procedures, training of assessors to be culturally aware, performing routine checks of assessment quality, making a clear distinction for the data interpretation and rules for data integration.

A limitation of this study was that there is no other research tool that could be used as a comparable measure to test the convergent validity of the Thai-B-PADS final version. Lack of a convergent validity analysis means that the Thai-B-PADS final version might not be as sensitive to detect the information it was created for as the original English language version. Moreover, since the number of participants involved in the reliability testing phase was underpowered [31], the results should be interpreted with caution.

In conclusion, the Thai-B-PADS was successfully translated and culturally modified with a high degree of agreement in both inter- and intra-rater reliability for most questions. The Thai language version of the B-PADS was deemed to be a comprehensible, sensible, simplified, relevant and contextually appropriate survey instrument, with a high degree of confidence expressed in its content validity, being understood by Thai-PT and Thai-SCI. The Thai-B-PADS final version can be easily deployed to identify barriers to physical activity in Thai people with spinal cord injury. When different assessors intend to use the Thai-B-PADS, certain practices are recommended to reduce the risk of bias during use.

Ethical approval

This research was approved by the Human Research Ethics Committee, The University of Sydney, Australia (Project numbers: 2017/1006 and 2018/588).

Disclosure statement

No potential conflict of interest was reported by the authors.

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