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Content validity and psychometric characteristics of the Thai translated version of the physical activity questionnaire for children (PAQ-C) and adolescents (PAQ-A)

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ABSTRACT

Background: Physical inactivity in young people which increases with age have been linked to increased risks of non-communicable diseases. Therefore, assessment and monitoring of physical activity (PA) in young populations is needed. However, a valid and feasible self-report measure for large-scale PA for Thai children and adolescents is limited.

Objectives: To determine the content validity and psychometric characteristics of the Thai translated version of the Physical Activity Questionnaire for Children (PAQ-C) and Adolescents (PAQ-A).

Materials and methods: The 10-item of PAQ-C and 9-item of PAQ-A were translated into a Thai version and the cross-cultural adaptations were included. These questionnaires were conducted with children aged 8-<14 years and adolescents aged 14-<20 years that were recruited from one large private and two public schools in Amphur Muang, Chiang Mai Province. Each group of children and adolescents was classified by age, gender, and school type, equally. After that, the content validity was assessed using a content validity index. Furthermore, psychometric characteristics, including the scale's internal consistency, test-retest reliability, and agreement of measurements were also determined.

Results: Both PAQs had an excellent content validity index for scale (S-CVI was 0.91 for PAQ-C and 0.96 for PAQ-A) with an acceptable content validity index for item (I-CVI) ranging from 0.83-1.00. The internal consistency and the reproducibility of measurements of the PAQs were acceptable (α = 0.71, ICC = 0.67 for PAQ-C and α=0.84, ICC=0.78 for PAQ-A; P<0.001). The standard error of measurement (SEM) between the two trials for administration of both PAQs were smaller than the smallest detectable change (SDC) (SEM=0.36, SDC=0.99 for PAQ-C; SEM=0.35, SDC=0.96 for PAQ-A).

Conclusion: Having an excellent content validity and acceptable psychometric properties, both PAQ-C and PAQ-A have the potential to be applied for research purposes and surveillance of PA in Thai children and adolescents.

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Introduction

Lack of physical activity (PA) in young people has become a public health concern worldwide. It has been reported that insufficient PA generally occurs with aging, and might consequently lead to increased risk of morbidity and mortality.[1] In Thailand, a national survey on PA in children and adolescents found that 23% of them were insufficiently active according to the global PA guidelines.[2] Their PA levels were also associated with several factors including sex, age, body mass index (BMI), geographical regions, and participation in sports and recreation.[3] However, a systematic review[4] of PA and sedentary behavior have shown that PA studies among children and adolescents remained scarce and there was a lack of the specified and validated instruments for surveillance and monitoring of PA in Thai children and adolescents. A valid instrument could be used to understand the health behaviors of young people and identify the effectiveness of interventions designed to enhance PA.

The use of a self-report questionnaires for measuring PA among young people has raised interest because it is practical, economical, time-efficient, and feasible for use in a large-scale study. A systematic review[5] of PA instruments reported that the Physical Activity Questionnaire for Children and Adolescents (PAQ-C/PAQ-A, PAQs) is one of the most suitable tools for assessing levels of PA for young population. The PAQ has acceptable reliability (ICC=0.82-0.96 for PAQ-C and 0.71-0.78 for PAQ-A; kappa=0.51-0.68 for PAQ-A) and validity (α=0.72-0.82 for PAQ-C and 0.67-0.85 for PAQ-A) for measuring PA.[6-13] Both PAQS have shown the association with health-related fitness. For example, the total PAQ-A score showed a moderate validity with peak oxygen uptake[12] and the activity monitor.[10] However, PAQ-C showed a low to moderate association with accelerometer,[6, 9, 13, 14] activity monitor,[10] body fat percentage,[7, 15] and cardiovascular fitness.[7, 8, 15] The PAQ was translated and is used in many countries including Italy,[6] Japan,[7] United Kingdom (UK),[8] Hong Kong,[9] United States,[10, 15] Belgium,[12] Spain,[13] and Canada.[14] Prior to using the PAQ in the Thai population, cross-cultural adaptation and psychometric properties must be evaluated. The aim of this study was to examine the content validity and psychometric characteristics of the Thai version of both PAQs.

Materials and methods

Participants

A school-based survey was conducted on healthy children aged 8-<14 years and adolescents aged 14-<20 years who reside in Amphur Muang, Chiang Mai Province. These purposing samples were recruited from three schools including a large private school, a public primary school, and a public high school which contacted participants for permission prior to the beginning of the study. Participants with illness or other limitations to regular activity occurring one week prior to data collection were excluded from the study. A sample of 48 children and 48 adolescents were recruited for the content validity process, and 120 children and 110 adolescents were enrolled for the reliability process in accordance with previous guidelines.[16] In each process, participants in each group were randomly assigned according to the allocation orders by school type, age, and sex. All children and their parents provided written inform consent. Data was collected in February-March of 2018. Ethical approval was granted by the Research Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University.

Instruments

The original Canadian PAQ was developed in 2004 by Kowalski et al.[17] It was structured to evaluate the level and the frequency of moderate to vigorous physical activity (MVPA). This questionnaire has two versions: one for children aged 8-<14 years and one for adolescents aged 14-<20 years. PAQ-C has demonstrated good internal consistency and test-retest reliability (α=0.79-0.89 and ICC=0.75-0.82). Both versions of the PAQ moderately correlated with the objective activity measures such as Caltrac motion sensor (r=0.39 for PAQ-C and r = 0.33 for PAQ-A).[18] Both PAQs are a self-measuring seven-day recall of PA during leisure time, school time, and the weekends. The PAQ has ten question items designed for children (C) and nine for adolescents (A). Both PAQs have similar question items, except that the question item asking for MVPA in morning break was excluded for PAQ-A. The first question item of the PAQ is comprised of a checklist of 22 common leisure and sport activities and two other fill-ins using 33 choices. This question is scored as the average of all activities. The remaining PAQ question items were distinguished by time of day and time during the weekends. Each activity item was scored on a five-point Likert scale, with higher scores indicating higher levels of PA. The summary score is the average of the nine question items for PAQ-C and eight for PAQ-A. The last item of each PAQ, asking for other reasons that prevented the participant from engaging in regular PA, was not used to calculate the summary score.

Procedure

The study was divided into two phases. Phase one was a qualitative method designed to determine the test content and response process validity of both PAQs. Phase two assessed the psychometric characteristics of the PAQs. These procedures were administered to participants during school hours. In phase one, all translation processes were comprised of five steps and were conducted based on previous guidelines.[16] Initially, the original English PAQ-C/PAQ-A was translated to produce two forward-translated Thai versions by two independent bilingual and bicultural Thai translators. Both translators are Ph.D. lecturers in the Departments of English and Physical Therapy, Chiang Mai University. The two forward-translated Thai versions and the original version were then compared by the same translators along with a third bilingual and bicultural Thai translator regarding ambiguities and discrepancies of words, sentences, and meanings generated in the preliminary translated version (PI-TL). The third translator is a Ph.D. lecturer in the Department of Occupational Therapy, Chiang Mai University. The PI-TL was then back-translated into the English by two additional independent translators. They are Ph.D. lecturers in the Departments of English and Physical Therapy, Chiang Mai University. The semi-final Thai version of PAQ-C/PAQ-A was synthesized by a seven-member expert committee including

the five translators involved in generation of the preliminary translated version of the PAQ and two researchers. The original English version of PAQ-C/PAQ-A, the PI-TL, and two back-translated versions were reviewed, revised, and verified to achieve the cross-cultural equivalence based on sport and exercise disciplines. Finally, a pilot testing of the final version of Thai PAQ-C/PAQ-A was performed using a focus group interview to determine the response process validity of the PAQs in order to evaluate the instructions, response format, and the clarity of items of the PAQ. A small group of three to five participants were assigned to a well-trained staff that sought to obtain evidence for test content and response process validity. Testing lasted for 15-20 minutes per session. For primary school students, the content of PAQ was read and explained by the staff. A six-member expert committee including two senior physical education lecturers, two physical education teachers, and two senior physical therapy lecturers who had the background in sports science and/or exercise physiology were asked to rate each item of PAQ-C and PAQ-A to determine content validity.

In Phase two, participants completed the final version of Thai PAQ-C/PAQ-A twice with a two-week interval scheduled between tests to determine reproducibility of measurements. Of those, the second responses to the modified PAQ-C and PAQ-A were used to explore the internal consistency of the questionnaire according to the methods of Gauthier et al.[19] Also, the measurement error and the degree of test-retest agreement were determined using the smallest detectable change (SDC) and Bland-Altman plot, respectively. Data collection for each age group developed according to the children's capabilities and maturity was done during school class time. Participants aged 8-<11 years were asked to complete the PAQ-C in the presence of a research staff in a proportion of 5 to 1. Participants aged older than 10 years completed the questionnaire with a class teacher. A total of eighteen class teachers from both private and public schools were provided explanations regarding the study and were assigned to distribute the PAQ questionnaires to their children aged 11-<14 years (n=6) and adolescents aged 14-<20 years (n=12).

Statistical analysis

Data distribution was examined using the Shapiro Wilk test. After that, descriptive statistics were generated to describe sample characteristics. The content validity index for items (I-CVI) was determined by asking the expert committee to rate each question item of both PAQs in terms of its relevance to the underlying construct based on a 4-point ordinal scale (i.e. 1: not relevant; 2: somewhat relevant; 3: quite relevant; and 4: highly relevant). Subsequently, the I-CVI was calculated for each item as the number of experts who rated the scale of 3 or 4 divided by the total number of experts. The content validity index for scale (S-CVI) was computed for each PAQ as the average of the I-CVIs for all items on the scale. The I-CVIs of 0.78 or higher and an S-CVI of 0.90 or higher were considered as excellent content validity.[20] The intraclass correlation coefficient (ICC) was used to examine the test-retest reliability. ICC values of >0.90 are considered excellent, 0.75-0.90 good, 0.50-0.75 moderate, and <0.50 poor.[21] The internal consistency of the questionnaire was analyzed using Cronbach's alpha coefficient (α), with a value of 0.70 or greater deemed acceptable.[22] Every single question item was removed to confirm redundancy of the individual items, using Cronbach's alpha. The agreement between two measurements of the PAQ was determined by two methods based on previous guidelines.[23] First, the Bland-Altman analysis which indicate random error and bias was graphically plotted. The 95% limits of agreement were calculated as mean difference +1.96 SD of the differences. Second, the standard error of measurement (SEM) which depicts the within-subject variability and the smallest detectable change (SDC) were both determined in order to indicate a real change was calculated as SEM=SD x [square root (1-ICC)] and SDC=SEM x 1.96 x square root(2), respectively. For interpretation, the measurement error should be smaller than SDC to ascertain that a real change has occurred. Statistical analyses were carried out using SPAA version 19.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

Table 1 Descriptive characteristics.

	Children			Adolescents		
	Male (n=57)	Female (n=58)	Total (n=115)	Male (n=49)	Female (n=47)	Total (n=96)
Age (yrs)	10.36 (1.87)	10.29 (1.87)	10.32 (1.87)	16.10 (1.62)	16.04 (1.63)	16.07 (1.62)
Stature (m)	1.44 (1.34)	1.42 (1.11)	1.43 (0.12)	1.54 (0.48)	1.51 (0.24)	1.53 (0.37)
Body mass (kg)	42.30 (16.09)	36.60 (9.96)	39.38 (13.54)	64.41 (17.52)	51.97 (10.31)	58.05 (15.53)
BMI ($kg.m^{-2}$)	19.88 (4.57)	17.95(3.16)	18.89 (4.01)	22.69 (5.70)	21.79 (4.08)	22.23 (4.93)
A summary PAQ score	2.80 (0.56)	2.53 (0.63)	2.67 (0.61)	2.61 (0.81)	2.20 (0.61)	2.41 (0.74)

Note: *Values are presented as mean±SD, BMI: body mass index, PAQ: physical activity questionnaire.*

Sample characteristics

Data for five children who had an ankle sprain or illness during the second set of reproducibility testing were excluded. Fourteen adolescents aged 17-19 years (6 male and 8 female) refused to participate in the study and there were no adolescents with age ranges of 19-<20 years in the private school. This resulted in a final sample size of 115 children and 96 adolescents. Participants' characteristics are shown in Table 1.

Table 2 I-CVI and S-CVI scores for the Thai PAQ-C.

Item	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	I-CVI
Q 1. Activity checklist	4	3	4	4	3	4	1.00
Q 2. Physical education	4	3	3	3	4	4	1.00
Q 3. Recess	3	3	4	4	2	4	0.83
Q 4. Lunch	3	3	4	3	1	4	0.83
Q 5. After school	4	2	4	4	4	4	0.83
Q 6. Evenings	4	4	4	4	4	4	1.00
Q 7. Last weekend	4	4	4	4	4	4	1.00
Q 8. Self-description	4	2	3	3	3	4	0.83
Q 9. Weekly activity	4	2	4	4	4	4	0.83
						S-CVI	0.91

Note: *I-CVI: the content validity index for items, Q: question, S-CVI: the content validity index for scale.*

Phase one: Translation and Adaptation processes

Response validity process

Approximately 94.8% of children (n=48) and adolescents (n=43) participated in this process. The remaining 5.2% (n=5) were adolescents aged 19-20 years that could not be found during data collection. According to participants' feedback, several changes were made to the questionnaire including removing the name of classroom teacher, adding the school name, and changing the format for sex from an underline to a tick box. The instructions were added to clarify the way participants should answer questions, such as "please fill out the following how you usually do". In terms of cultural adaptation, four uncommon activities in Question One were removed: football, street hockey, cross-country-skiing, and ice hockey/ringette. Six activities commonly conducted by Thai children and adolescents including table tennis, sepak takraw, tennis, chair ball, petanque, and the hula hoop were added. The definition for "tag" was defined. Question Two involved the frequency of performing activities was clarified by adding a percentage to each written frequency: don't do (0%), hardly ever (20%), sometimes (<50%), quite often (>50%). and always (80%). Question Ten for the PAQ-C and Question Nine for the PAQ-A were the last questions and were concerned with participant illness. These questions were modified for clarity.

Table 3 I-CVI and S-CVI scores for the Thai PAQ-A.

Item	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	I-CVI
Q 1. Activity checklist	4	3	4	4	3	4	1.00
Q 2. Physical education	4	3	4	3	4	4	1.00
Q 3. Lunch	3	3	4	3	2	4	0.83
Q 4. After school	4	2	3	3	4	4	0.83
Q 5. Evenings	4	3	4	4	4	4	1.00
Q 6. Last weekend	4	3	3	4	4	4	1.00
Q 7. Self-description	4	4	4	3	4	4	1.00
Q 8. Weekly activity	4	3	4	4	3	4	1.00
						S-CVI	0.96

Note: *I-CVI: the content validity index for items, Q: question, S-CVI: the content validity index for scale.*

Content validity

Both PAQs had I-CVIs ranging from 0.83-1.00. For PAQ-C, I-CVI was highest for Questions One, Two, Six, and Seven and were rated as average for the remaining questions. For PAQ-A, I-CVI was highest for Questions One, Two, Five, Six, Seven, and Eight. The remaining two questions were rated as average. Both PAQs showed a high S-CVI (0.91 for PAQ-C and 0.96 for PAQ-A) (Tables 2 and 3).

Table 4 Test-retest reliability and internal consistency of the Thai PAQ.

Activity	PAQ-C (n=115)		PAQ-A (n=96)	
	ICC (95%CI)	α if each item deleted	ICC (95%CI)	α if each item deleted
Total PAQ-score	0.67 (0.54-0.77)	0.71	0.78 (0.68-0.85)	0.84
Q 1. Activity checklist	0.70 (0.46-0.83)	0.75	0.55 (0.37-0.68)	0.88
Q 2. Physical education	0.57 (0.43-0.68)	0.78	0.53 (0.32-0.68)	0.90
Q 3. Recess	0.61 (0.47-0.71)	0.76	NA	NA
Q 4. Lunch	0.44 (0.28-0.58)	0.76	0.65 (0.52-0.76)	0.87
Q 5. After school	0.46 (0.30-0.59)	0.75	0.62 (0.47-0.73)	0.85
Q 6. Evenings	0.40 (0.23-0.54)	0.73	0.47 (0.29-0.61)	0.85
Q 7. Last weekend	0.44 (0.28-0.58)	0.75	0.42 (0.24-0.57)	0.87
Q 8. Self-description	0.37 (0.20-0.52)	0.75	0.59 (0.44-0.71)	0.85
Q 9. Weekly activity	0.57 (0.42-0.69)	0.73	0.45 (0.28-0.60)	0.85

Note: *: ICC of all items have p value <0.001, α: Cronbach's alpha, A: adolescents, C: children, CI: confidence interval, ICC: Intraclass correlation coefficient, NA: not applicable, PAQ: physical activity questionnaire, Q: question.*

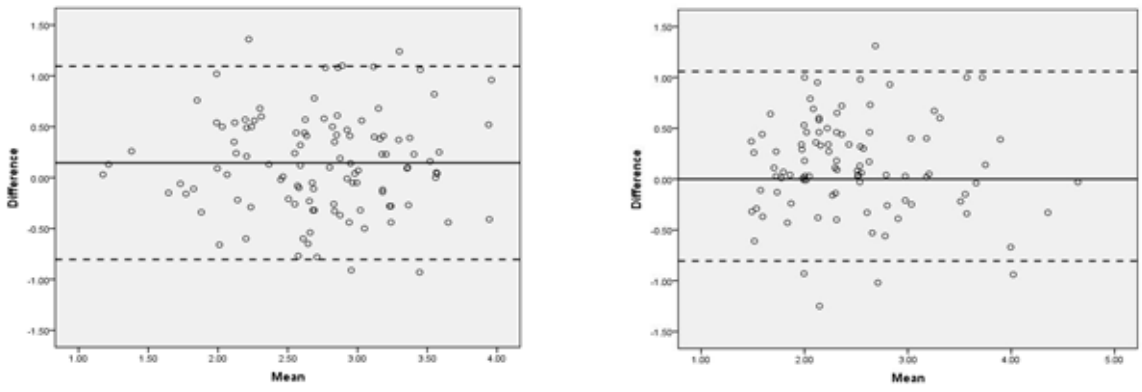
Phase two: Reliability process

Test-retest reliability

The ICC values for the total score of the PAQ-C and PAQ-A were 0.67 and 0.78, respectively. The reliability values of Questions Four to Eight of the PAQ-C were less than 0.50. The reliability values of Question Five, Question Six, and Question Eight of the PAQ-A were less than 0.50 (Table 4).

Internal consistency

PAQ-C and PAQ-A generated a Cronbach's alpha of 0.71 and 0.84, respectively. Both PAQs showed that the internal consistency had slightly increased after deleting every single question item, compared to that of the total PAQ score. This indicates that no redundant items are included in the questionnaire. PAQ-A obtained higher values for internal consistency than the PAQ-C for all questions and the total score (Table 4).



(A) PAQ-C ***(B) PAQ-A***

Figure 1. *Bland-Altman plots showing the agreement between two trials for PAQs measurement. Solid line: mean difference between test and retest, dashed lines: limits of agreements (± 1.96 * standard deviation (SD)).*

Agreement of measurements

The mean difference of PAQ-C scores for two measurements was 2.73. The SEMs and SDC for PAQ-C activity were 0.36 and 0.99, respectively. The Bland-Altman analysis showed that the mean difference (±SD) among two trials for PAQ-C measurement was 0.15±0.48 (95% CI=0.054-0.237) (Figure 1A). The mean difference of PAQ-A scores for two measurements was 2.47. The SEMs and SDC for PAQ-A activity were 0.35 and 0.96, respectively. The Bland-Altman analysis showed that the mean difference (±SD) among two trials for PAQ-A measurement was 0.13±0.48 (95% CI = 0.304-0.223) (Figure 1B). There were four children (3.48%) and five adolescents (5.21%) whose results were not within the limit of agreement.

Discussion

In this study, we translated the English version of the PAQ-C and PAQ-A into Thai. We also performed cross-cultural adaptation and examined its psychometric characteristics. An excellent content validity and an acceptable internal consistency and test-retest reliability suggests that both PAQs are reliable tools for measuring physical activity in Thai children and adolescents. The contextual and cultural–specific modifications of the Thai PAQs including the instructions, questions, response format, and physical activities checklist were done to derive a validated PAQs that is appropriate for young Thai people. Additionally, the agreement of measurement between two trials observed for both PAQs indicate the PAQs abilities to detect changes in PA between time periods.

Three types of the reliability results of the Thai PAQs were reported. Firstly, we found that the Cronbach's alpha values of both PAQ-C and PAQ-A were within acceptable range, indicating good internal consistency of results across questionnaire items. These results were similar to results obtained from previous studies.[8-12, 15] Secondly, the test-retest reliability which denote the stability of results across time was moderate for PAQ-C and its ICC value was lower than that of children in other countries.[8-10, 15] Furthermore, the observed PAQ-A showed good reliability similar to a study done on English youth. Thirdly, the present study showed a mean difference (±SD) between the first and second trials of the PAQ-C and PAQ-A measurements that was greater than the original English version (-0.08±2.21 and -0.02±0.07, respectively).[17] These measurement errors in both PAQs were small, whereby the value of SDC remained lower than the mean score of the PAQs. The Bland and Altman plot also showed minimal range in the limit of agreement compared to the mean score of both PAQs. Taken together, this data confirms the stability of the PAQs scores over time. However, these reliability results of children seemed inferior to that of adolescents. This might be explained by their cognitive limitation in recall ability or comprehension.[5, 24, 25] Thus, the measurement of children's PA should be carefully handled. It should be noted that a research assistant and images using picture illustrations of each activity in Question One might be required for better validation of results.

We found that all Thai children and adolescents except boys failed to meet the criteria for PAQ-score which corresponds to 60 minutes of MVPA as obtained in the study done by Benetez et al[26] (a cut-point of 2.75 for PAQ-A and 2.73 for PAQ-C). However, different results were obtained when using the Voss et al[27] cut points (2.9 for boys and 2.7 for girls). Both boys and girls in this study failed to meet that criteria. Likewise, the observed summary PAQ score of Thai children was lower than that of children from western countries such as the UK or Canada, but were higher than that observed in Hong Kong children.[8, 9, 15, 18] In addition, a lower level of PA in adolescents was observed compared to children and males engaged in PA rather than for females in both groups. These results indicate that PA of Thai children seems to decrease with age and also has sex disparities, which was consistent with previous studies.[10, 12, 27] Therefore, PAQs score cut-off values should be established at a national and/or international level for monitoring PA of both children and adolescents. The individual PA type and patterns based on information obtained from the PAQs might be analyzed and used for compliance and as interventions to increase their level of physical activity.

This study's strengths included the rigorous protocols that were employed during the translation and sampling processes and made use of a broad sample range of samples that was distinguished by sex and age that improves the generalizability of the findings. The validity and reliability of the PAQ for children and adolescents were established, as well. However, some limitations should be considered in this study. First, the PAQ is a subjective measure of PA and could not be used to provide measurements of time or intensity relative to PA guidelines. Further study is needed to validate the PAQ against the objective measures of PA to confirm its feasibility as an effective tool. Secondly, data collection in classes was performed at the teacher's discretion even after permission had been granted from the school principal. Additionally, the research staff was not allowed to meet participants in some classes. This might interpose error into measurement. Lastly, participants in the study were recruited from urban areas, so these results do not imply that similar results could be obtained from other areas. Likewise, seasonality should be considered when determining physical activity in children. A previous study[28] has shown that seasonal differences in physical activities were observed among healthy children, but not for adolescents. Children had significantly higher mean physical activity levels in Spring than in Winter and Fall.

Conclusion

Excellent content validity and acceptable reliability suggests that the Thai version of PAQs could be used in local studies measuring the overall level of PA in children and adolescents and for monitoring change in PA over time.

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Conflict of interest

There are no conflicts of interest.

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