Original Research

Validity and reliability of modified PAQ-A and LTEQ in adolescents of Karachi, Pakistan

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DOI: https://doi.org/10.4038/jccpsl.v26i4. 8384

Received on 26 August 2020

Accepted on 19 November 2020

Abstract

Introduction: Patient satisfaction is considered to be a vital component in the evaluation of the quality of care.

Objectives: To evaluate the validity and reliability of the modified versions of Physical Activity Questionnaire for Adolescents (mPAQ-A) and Leisure Time Exercise Questionnaire (mLTEQ) against gold standard objective assessment tool pedometer in adolescent population of Pakistan

Methods: A total of 265 adolescents (mean age=13 years; SD=0.98) were recruited. The participants of the study were selected through simple random sampling. Physical activity was assessed by using both objective (pedometer) and subjective instruments (mPAQ-A and mLTEQ questionnaires). Validity and reliability of modified tools were assessed by using Pearson's correlation coefficient (r), Cronbach's alpha and intra class correlation, respectively.

Results: For validity, the correlation between mPAQ-A/mLTEQ, mPAQ-A/pedometer step counts and mLTEQ/pedometer step counts were all statistically significant. Higher correlation between subjective assessment tools (mPAQ-A/mLTEQ) was observed. Likewise, the difference of time interval also had no effect on the validity of both questionnaires. The internal and test-retest reliability of mPAQ-A was found to be higher than mLTEQ. According to the graph of ROC the mPAQ-A is more slightly superior to the mLTEQ.

Conclusions: The questionnaire mPAQ-A in comparison to mLTEQ showed an acceptable to good validity and reliability among Pakistani adolescents.

Keywords: *physical activity, modified Physical activity Questionnaire for Adolescents, modified Leisure Time Exercise Questionnaire, pedometer, step counts*

Introduction

An essential component of a healthy life is physical activity (PA). It is positively associated with numerous health parameters like reduced disability, morbidity, mortality, coronary heart disease (CHD), cardiovascular disease, hypertension, diabetes, breast cancer, colon cancer, arthritis and joint swelling (1-2). In children of growing age and adolescence, PA is not only preventive against the risk factors of several non-communicable diseases (NCDs) but is also associated with high bone mineral accrual rate which causes development of strong bones and prevent from osteopenia and osteoporosis in their later life (3). In various countries, it is observed that the promotion of PA among population is one of the objectives of their public health policies (4). Throughout the world, there are an estimated 1.2 billion adolescents aged 10-19 years (5). Around 70 % of them are living in developing countries, which comprises the largest generation of young individuals (5). Annually, physical inactivity can be attributed to over one million deaths worldwide (6).

The assessment of physical activities in adolescents is a way more challenging than in adults. Subjective and objective techniques are used to assess physical activities in children and adolescents. Self-reporting questionnaires which are the subjective measures of PA, despite their limitations are helpful in gaining insight into individual's level of PA. However, they may underestimate or overestimate the level of PA and rates of inactivity. Among the objective measures of PA, pedometer is an objective surveillance tool which is now increasingly being used to assess the level and pattern of PA (7).

For developing effective programs to promote participation in PA, there should be a strong understanding of nature and the extent of the problem i.e., accurate assessment of physical activity. The first step in this process was development of a valid and reliable instrument for the assessment of PA among younger age groups (8). In Pakistan, unfortunately, there are limited studies which have assessed PA among adolescents (5, 9-11). A few of these studies have limitations in methodology as the questionnaires used to measure physical activities had not been preliminary validated (5, 12). The components of these questionnaires were taken from western questionnaires which had not been modified according to our setup and several questions in these questionnaires were irrelevant in our settings because the physical activities and sports mentioned in these questionnaires are very less common in this region of the world. Thus, environmental differences and specific sports and activities which are uncommon in our setup, had a potential to underestimate the physical activity, as most of our individuals would answer these questions on the lower side of the scale.

The validity and reliability of PAQ-A and LTEQ are evident in several studies conducted in different settings (13-14). PAQ-A is a detailed questionnaire which provides a general measure of physical activity including intensity, frequency and duration of adolescent's activities, whereas LTEQ is a brief four-item-based questionnaire of usual leisure time exercise habits. The reason behind selection of these two questionnaires was to identify the instrument that is more accurate, captures all the aspects of PA, less time consuming and user-friendly in the assessment of PA. Thus, the aim of this study was to evaluate the validity and reliability of modified Physical Activity Questionnaire for Adolescents (mPAQ-A) and modified Leisure Time Exercise Questionnaire (mLTEQ) among Pakistani adolescents by using the objective measurement tool pedometer as a gold standard.

Methods

A total of 265 adolescents aged 13-16 years of age (mean=13.67; SD=0.96) studying in grades 7 to 10 were enrolled from four randomly selected public and private schools of Karachi, Pakistan. In the selected schools, the total number of enrolled students who met inclusion criteria of age between 13-16 years were 265, 318, 289 and 225 in schools A, B, C and D, respectively. Out of those, 66 students from each school who had provided their assents and parental informed consents were selected simple randomly via computer generated random numbers. Those who reported any physical disability or were suffering from any acute illness were not recruited.

The sample size of this study was calculated by using Power Analysis & Sample Size (PASS) Software (version 110) to test for correlation for a sample size of 234 achieved, 80% power to detect a difference of 0.18 between null hypothesis, correlation of 0.05 (15) and alternative hypothesis correlation of 0.23 using confidence interval (CI) of 95%. The sample size was increased by 10% to avoid non-response, missing values and to minimize the effect of outliers. Hence, a total of 265 participants were selected for the study.

Subjective assessment tools

PAQ-A questionnaire is a slightly modified version of Physical Activity Questionnaire for Children (PAQ-C) (16). The only difference lies in the question regarding PA during recess which has been omitted from PAQ-A. It is a 7-day recall instrument which determines the general level of PA in adolescents. It assesses the frequency of participation in physical activities during spare time, physical education, at lunch, right after school, evening and on weekends. At the end, composite score is calculated by taking the mean of all eight items. The additional question is used to identify any unusual pattern of PA during a week, but it is not used in the calculation of composite score. It provides a summary of PA on a 5-point scale, in which score 1 indicates low PA and score 5 indicates high PA.

LTEQ is a self-explanatory, self-reporting, brief questionnaire, which consists of only two questions. The first question measures frequency of weekly leisure time strenuous, moderate and mild activities, which are performed for more than 15 minutes. The second question records the frequency of weekly activities which are continued long enough to produce sweat. For the health benefits, individuals are scored on unit scale, on the basis of frequency of strenuous and moderate activities recorded in the first question (17).

The limitation in application of PAQ-A and LTEQ in our setup was mainly due to inclusion of activities of spare time including sports and games such as ice skating, cross-country skiing, ice hockey/ringette, rowing/canoeing, baseball, soft ball, in-line skating, vigorous swimming, easy swimming, alpine skiing, yoga, archery, fishing from riverbank, horseshoes, golf and snow-mobiling. All these activities are quite uncommon in our region of the world and particularly in Pakistan. Any estimation of PA based on these questions would clearly be an underestimation of PA among adolescents because participants are likely to score low on these activities, hence these questionnaires were not suitable in our setting in their current form. Instead, it was pertinent to add sports and games which are commonly played by adolescents in our setting.

To modify the responses of PA contained in question no. 1 of both questionnaires, a pilot survey was conducted in four different schools of Karachi including both public and private sectors. A total of 30 students of grade 7-10 who met the inclusion criteria were recruited from each school. The questionnaires were distributed to the students to test the validity of activities mentioned in both LTEQ and PAQ-A questionnaires, and to suggest the activities which they do in their spare time. The modifications in both questionnaires were made in accordance with the results of the pilot study. Those sports and activities such as ice skating, cross-country skiing, ice hockey/ringette, rowing/canoeing, baseball, soft ball, in-line skating, vigorous swimming, easy swimming, alpine skiing, yoga, archery, fishing from river bank, horse shoes, golf and snow-mobiling, for which response rate was less than 5% were then equally replaced by the commonly played games of our setting, such as cricket, karate, taekwondo, throw ball, table tennis, squash, scottie, hide and seek, baraf pani, pakram pakrai, kho kho, frisbee, hula hoop, for which the response rate was greater than 5%. All other questions in both questionnaires were relevant, so no further modifications were made. The modified versions of both questionnaires (i.e., mPAQ-A and mLTEQ) were then formally translated in Urdu by two individuals who were well versed with both languages. The same questionnaires were back translated into English language by two independent translators who were expert linguists and had no knowledge of the underlying concept as well as the original questionnaire.

Both modified questionnaires were initially administered at the time of recruitment of all the

participants and same questionnaires were re-administered in a sub sample of 25% (n=69) after one week of baseline assessment.

Objective assessment tool

Ymax Digi Walker SW-200 are small (2.0 in. x 1.5 in. x 0.75 in.), light weight (21 g) pedometer which had been used because of its accuracy and reliability reported in various studies (18). It counts number of steps taken while walking or jogging within a range of 0-99,999. The pedometer was worn around the waist in-line with the midline of thigh for a period of seven days. Unsealed pedometer was used during this study because no significant difference in reactivity between sealed and unsealed pedometers was observed in previous studies (15, 19). Before providing the devices, a brief explanation for device safety was provided. Those instructions included positioning of the device, resetting the device and removing the device only before sleeping and during water-based activities (e.g., showering, swimming). The record sheets were provided to sports teacher/doctor in each school for recording weekday step counts. For weekends, special instruction cards for recording the step counts were sent to parents. In order to replicate the timings of weekday's steps recording, they were instructed to record weekend steps the first thing on Saturday and Sunday mornings. In consideration of reminding students to wear their pedometers at home, a phone call reminder was given every evening. Students were instructed not to wear pedometer for the rest of the day if he/she forgot to wear in the morning. In such conditions, zero was recorded in the record sheet, which was then replaced by calculating the mean of weekday's step counts. This rule was only followed for weekdays but if someone forgot to wear it on the weekend, the device was given again for the next weekend to record the step counts.

The pedometers data were collected from 227 (85.7%) students who wore pedometers for all 5 weekdays; 26 (9.8%) for 4 days; and 12 (4.5%) for 3 days. However, 100% response rate was recorded for weekends.

The referenced cut-off criteria (20) for mPAQ-A scores used in this study were as follows: 1.0-1.9 as 'low physical active'; 2.0-3.9 as 'moderate physical active'; and 4.0-5.0 as 'high physical active'. Based on cut off criteria (17) of mLTEQ, those who scored <14 units were 'insufficiently active' (less substantial or low benefits); 14-23 units as 'moderate active' (some benefits); 24 units or more as 'active' (substantial benefits). Based on the cut off points (21) of pedometer step counts, those who achieved <10,000 steps on all the days of a week were 'inactive'; 10,000 steps on at least half of the days of the week were 'moderate active'; and 10,000 steps on all days of week were 'active'.

Data analysis

The analyses were conducted in the Statistical Package for Social Sciences (SPSS) Software (version 21). Pearson's correlation analysis was used to assess the relationship between pedometer step counts, mPAQ-A and mLTEQ composite scores as well as for evaluating the validity evidence for pre- and post-administration of mPAQ-A and mLTEQ. Cronbach's alpha (α) with values ranging from 0 to 1 was used to determine the internal consistency of each questionnaire (22). Value of 0.7 or greater is considered as sufficiently reliable (22). Test-retest reliability of each questionnaire was also calculated via Pearson's correlation analysis and intraclass correlation coefficients (ICC) for overall sample. Two-way mixed-effects model and absolute agreement were used for calculating ICC in test-retest reliability because of repeated measures. Receiver Operating Characteristic (ROC) curve was used to identify the accuracy of each subjective assessment tool (i.e., mPAQ-A and mLTEQ). It was drawn for respective mPAQ-A and mLTEQ scores, which classifies adolescents into “high PA” to “low PA” groups, using pedometer step counts as the referenced cut off criteria.

Results

In total, 265 students were included in this study. Of them, 141 (53%) were girls with mean age of 14 years, whereas 124 (47%) were boys with mean age of 13 years. All of them completed both mPAQ-A and mLTEQ questionnaires at least once. The average

recorded step counts per day were 10,010 (SD=4926), whereas significant mean differences were observed between the genders (p<0.001). The mean PA composite score measured by mPAQ-A and mLTEQ were 2.87 (SD=0.8) and 49.9 (SD=37.83), respectively. According to mPAQ-A and mLTEQ scores, the boys were significantly more active (mean=3.19; SD=0.74) than girls (mean=2.58; SD=0.75) (p<0.001). Descriptive statistics for pedometer step counts, mPAQ-A activity composite scores and mLTEQ activity scores are shown in Table 1.

Validity

As shown in Table 2, strong correlation was observed between the PA scores for both mPAQ-A and mLTEQ (r=0.57; p<0.001), whereas moderate correlations were found between the pedometer step counts and PA scores of mPAQ-A (r=0.46; p<0.001) and mLTEQ (r=0.4; p<0.001), respectively. No significant mean differences were observed in the scores of pre- and post- administered mPAQ-A (p=0.43) and mLTEQ (p=0.27), suggesting that the difference of time interval had no effect on the validity of both questionnaires (Table 3).

Reliability

As shown in Table 4, the cumulative value of Cronbach's alpha for mPAQ-A was 0.89 which was greater than mLTEQ questionnaire of 0.62. No remarkable differences were observed in pre (α=0.89) and post- (α=0.82) administered mPAQ-A. However, reliability coefficient for post administered mLTEQ (α=0.64) was higher than pre-administered questionnaire (α=0.48). Correlation calculated from the scores obtained by the pre- and post-administration of mPAQ-A exhibited high reliability (r=0.67; p<0.001), whereas the corresponding of mLTEQ showed moderate reliability (r=0.42; p<0.001). Furthermore, on calculating intraclass correlation coefficient, good test-retest reliability was reported for mPAQ-A (ICC=0.8; p<0.001) than mLTEQ (ICC=0.62; p=0.001).

The overall accuracy of mPAQ-A (60.7%) was greater than mLTEQ (25%) when measured against pedometer step counts. The overestimation of PA was observed higher in mLTEQ (70.5%) than mPAQ-A (24.2%), whereas vice versa for the underestimation. The accuracy of both mPAQ-A and mLTEQ was also measured by ROC analysis (Figures 1 and 2). It was evident that PA measured by mPAQ-A was a way more accurate (area under ROC curve=0.56; 95% CI=0.48, 0.63) as compared to mLTEQ (area under ROC curve=0.28; 95% CI=0.2-0.36).

Table 1: Descriptive statistics for daily pedometer steps count, mPAQ-A and mLTEQ Physical Activity Scores (N=265)

Tool	Total (N=265)			Male (n=124)			Female (n=141)			p value*
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	
Pedometer Average steps/day	10010	4926	2427 - 27694	12513	5365	3708 - 27694	7809	3168	2427 - 18248	**<0.001**
mPAQA Physicalactivity composite score	2.87	0.8	1.13 - 4.7	3.19	0.74	1.13 - 4.7	2.58	0.75	1.15 - 4.56	**<0.001**
mLTEQ Weeklyleisure activity score	49.9	37.83	00 - 244	62.59	42.51	00 - 244	38.73	29.03	00 - 165	**<0.001**

SD=standard deviation; *p value calculated using independent t test

Table 2: Convergent validity of mPAQA and mLTEQ questionnaire with pedometer (N=265)

Tool	r	p value*
mPAQ -A - mLTEQ	0.57	**<0.001**
mPAQ -A - Pedometer	0.46	**<0.001**
mLTEQ - Pedometer	0.4	**<0.001**

r=Pearson's correlation coefficient; *p value calculated using Chi-Squared analysis

Table 3: Construct validity using pre- and post-composite scores from mPAQA and mLTEQ (n=69)

	Pre		Post		
Tool	**Mean**	**SD**	**Mean**	**SD**	**p value***
mPAQA	3.1	0.72	3.15	0.61	0.43
mLTEQ	53.79	33.75	59.73	37.65	0.27

SD=standard deviation; *p-value calculated for differing means between pre- and post-data sets

Table 4: Internal and test-retest reliability

	Internal reliability			Test -retest reliability	
	Cronbach's alpha			Pearson r	ICC (95% CI)
Tool	**Pre (n=69)**	**Post (n=69)**	**Total (N=265)**	**(n=69)**	**(n=69)**
mPAQA	0.84	0.82	0.89	0.67	0.8 (0.67 ,0.87)
				p<0.001	**p<0.001**
mLTEQ	0.48	0.64	0.62	0.42	0.62 (0.38, 0.76)
				p<0.001	**p<0.001**

Pearson **r**=Pearson correlation coefficient; ICC=intra class correlation coefficient

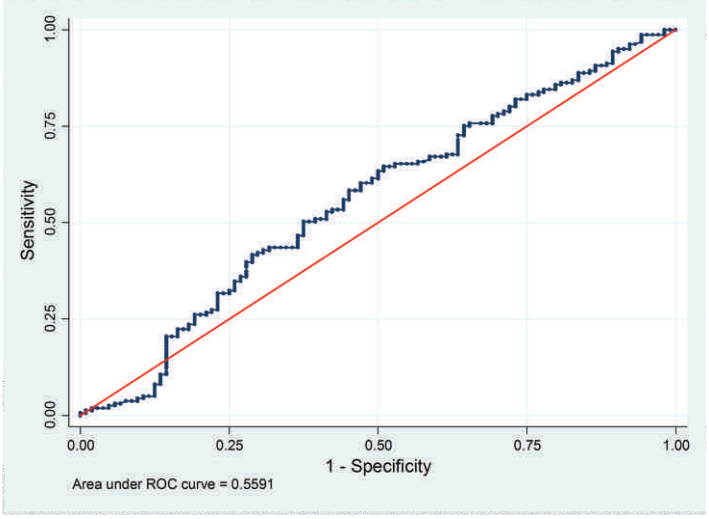

Figure 1: Accuracy measure of mPAQ-A with pedometer step counts

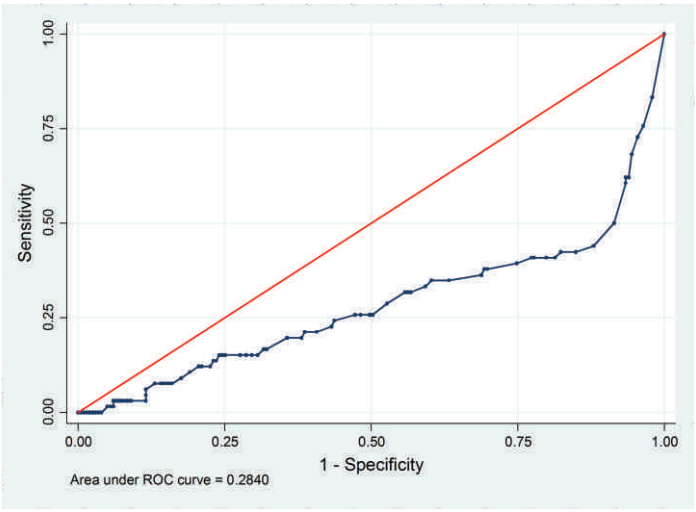

Figure 2: Accuracy measure of mLTEQ with pedometer step counts

Discussion

In this study, we observed moderately strong correlation between the two subjective assessment tools of PA, which is quite similar to the previously reported study (13). However, mPAQ-A revealed moderate correlation with pedometer, which is slightly higher than the previously reported association (23). In concurrence with the current findings, moderately strong correlation (0.56) was also observed previously between PAQ-A and Caltrac Activity Monitor (24). Daniel Aggio reported weak to moderate correlations between PAQ-A and other objective assessment tool (accelerometer) (25). Moreover, this study exhibited moderate correlation between mLTEQ and pedometer, which is found to be higher than the former study (r=0.05) conducted among children of 10 to 14 years (15). Limited literature reported the correlation of LTEQ with other objective assessment tools (Caltrac Motion Sensor). Scerpella et al observed low correlation between LTEQ scores and caltrac data (r=0.1) among gymnast and non-gymnast females of 7-11 years (26). Kowalski et al also reported lowcorrelations of LTEQ with Caltrac in children (r=0.24) (27), adolescents (r=0.19) (13) and adults (r=0.32) (28). Conversely, higher correlation with Caltrac (r=0.5) was reported by Eisenman et al in their study (29). The results of this study also showed no significant differences in validity of both mPAQ-A and mLTEQ questionnaires at two different time intervals.

The present study has also assessed the reliability of both modified subjective assessment tools of PA. Previously it was recommended that $\alpha > 0.7$ is indicative of a reliable questionnaire (24). The finding (α=0.89) suggested an excellent internal reliability of mPAQ-A in contrast to the findings of previous studies (24-25). In comparison, mLTEQ exhibited an acceptable level of internal reliability (α=0.62) in our study. On the contrary, good internal reliability of LTEQ was observed previously among asthmatic and non-asthmatic children (30). The overall test-retest reliability of mPAQ-A (r=0.67) was higher than mLTEQ (r=0.45), and this suggested that the mPAQ-A measured the PA consistently over time. The mPAQ-A test-retest reliability was higher than former studies (31-32). However, in contrast to the findings of this study, the published literature of mLTEQ exhibited higher test-retest reliability (33-34).

As the PA data were recorded by 2 different (subjective and objective) types of assessment tools in this study, the over- and under-estimation of PA were also observed among mPAQ-A/mLTEQ measurements against pedometer step counts. Previous study has highlighted that subjective assessment can lead to under- or over-estimation of PA compared with the objectively measured values (35).

To the best of our knowledge, this is the first study conducted in our region which has provided the modified versions of mPAQ-A and mLTEQ, which

are now valid and reliable for our setting. However, the limitation of this study includes its cross-sectional design and the small sample size which may have affected the generalizability of this study. However, this is the first attempt to modify and translate a PA questionnaire in Urdu language which is suitable for our setting, the current findings are still useful for larger studies. Hence, it is recommended that longitudinal studies with larger sample size should be conducted in order to strengthen the validity and reliability evidence of mPAQ-A and mLTEQ, because this design helps in identifying the changes in characteristics of target population over the extended period of time. The objective assessment tool i.e., pedometer has limited use in assessing physical activity as it cannot be worn during contact sports and water-based activities and can be easily forgotten to be worn in many studies, especially not as part of a student's daily routine. Therefore, during this study, it was difficult to know whether the pedometer was worn during the entire course of study. Hence, the low values of physical activity might be due to either low physical activity or forgetting to wear the pedometer. The limitation observed in the use of self-reporting subjective assessment tools was limited to recall ability which is an inherent characteristic of all the subjective measures. Irrespective of this, subjective tool has been used as an efficient tool for the assessment of PA in previous large-scale studies.

Conclusions & Recommendations

The current study suggests mPAQ-A as a reliable and accurate tool in comparison of mLTEQ for the assessment of PA among adolescents. The reasonably high correlation of mPAQ-A with pedometer step counts observed had been consistent in recording PA. Additionally, mPAQ-A is a better tool as it probes into a variety of physical activities at different time intervals during weekdays (PE class, lunch, afternoon and evening) and weekend. Future studies may administer these modified tools to measure PA among adolescents.

Public Health Implications

The questionnaire mPAQ-A is a detailed tool for the assessment of PA in comparison with mLTEQ, which is a brief questionnaire. Hence, mPAQ-A shows an acceptable to good validity and reliability among Pakistani adolescents.

Author Declaration

Competing interest: There was no competing interest in this study.

Ethics approval and consent to participate: Ethics approval was granted by the Institutional Review Board of Dow University of Health Sciences (Ref: IRB-680 / DUHS/ Approval/ 2016/ 170) prior to the conduct of this research. Informed written consent was taken from parents and verbal assent was obtained by the participant before recruiting in this study.

Funding: Self-funded

Author contributions: SN participated in the design of the study, data collection and drafted the manuscript. SZ performed the statistical analysis and interpreted the data. KS has supervised the whole project. All authors read and approved the final manuscript.

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