

Short Hebrew International Physical Activity Questionnaire: Reliability and Validity

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Data Interpretation
- E Manuscript Preparation
- F Literature Search
- G Funds Collection

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abstract

- Background** The International Physical Activity Questionnaire (IPAQ) aims to measure physical activity consistency throughout the world. It has been translated into many languages and its validity has been examined worldwide. However, the IPAQ has not been translated into Hebrew and the psychometric properties of the Hebrew version have yet to be evaluated.
- Material/Methods** The current study assessed the test-retest reliability of the short IPAQ in Hebrew (IPAQ-S-H) and its validity among college students. Intra-class correlation coefficients were computed to assess reliability, and survey responses were compared to $VO_2\max$ to determine concurrent validity.
- Results** The IPAQ-S-H's test-retest reliability was primarily high, particularly for total physical activity (ICC = 0.90; 95%CI = 0.87-0.93). While agreement for the physical activity components of the survey was higher (ICCs: 0.58-0.79), agreement for sitting time was lower (ICC = 0.39; 95% = 0.25-0.52). When comparing the survey scores to $VO_2\max$, total physical activity and vigorous intensity activity were significantly correlated with maximal oxygen uptake (Pearson's $r = 0.43$ and 0.40 , respectively), but not with other survey components.
- Conclusions** The IPAQ-S-H primarily exhibits moderate reliability and validity, which are comparable psychometric properties to other IPAQ validation studies. Further validation is warranted among more representative samples utilizing objective monitoring to determine criterion validity.
- Key words** physical activity, reproducibility of results, questionnaire

article details

- Article statistics** **Word count:** 3064; **Tables:** 3; **Figures:** 0; **References:** 43
Received: September 2014; **Accepted:** February 2015; **Published:** March 2015
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- Indexation:** Celdes, CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)
- Funding:** An internal grant from Ohalo Academic College 2009. No external funding was received.
- Competing interests:** Author has declared that no competing interest exists.
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INTRODUCTION

The effects of physical activity (PA) on health are well established. PA has been linked to the prevention of chronic diseases (e.g. type 2 diabetes, coronary heart disease, some cancers) and premature mortality [1-9]. For example, prospective observational studies and randomized controlled trials (e.g. Diabetes Prevention Program) have shown that moderate to vigorous intensity physical activity (along with a healthful diet) can significantly decrease the risk of diabetes incidence, even among pre-diabetics [10, 11].

Yet, despite these health benefits, in Israel only 32% of adults are sufficiently physically active in comparison to 51.7% of US adults [12, 13]. Recommended physical activity for chronic disease prevention involves engaging in at least 150 of moderate or 75 minutes of vigorous intensity aerobic physical activity (or a combination of both), with additional health benefits achieved through higher amounts of activity (i.e. dose-response effect) [9].

A prerequisite for measuring (and subsequently increasing) physical activity on the population level necessitates consistent and standardized surveillance of activity levels. In the past two decades an international group of scientist has developed a standardized survey, the International Physical Activity Questionnaire (IPAQ) [14], to measure physical activity worldwide; its reliability and validity has been examined [15-19] in numerous countries worldwide [20-24], yet not in Israel [25-29]. Consequently, the current study was undertaken to assess the reliability and validity of the Hebrew version of the IPAQ. While versions of the IPAQ exist in Arabic (the prevalent language in the Middle East(30)), to our knowledge the IPAQ version in Hebrew (the prevalent language in Israel) has yet to be examined.

MATERIAL AND METHODS

The current study examined the test-retest reliability and construct validity of the short IPAQ in Hebrew among a sample of college physical education students in Northern Israel (March to May 2010). Prior to beginning the study, approval was obtained from the College Institutional Review Board, and participants provided written informed consent. A total of 214 undergraduate college students attending the Academic College of Education who majored in physical education were approached. Of these, 145 completed the entire questionnaire twice (test-retest reliability), and a sub-sample ($n = 47$) completed a maximal exercise test ($VO_2\max$) to determine construct validity. All participants consented to participate in the study, were aged ≥ 18 years, had a medical health and fitness physician statement (required by Israeli law) that included no restriction on regular physical activity. In addition, prior to the study onset participants provided a specific consent statement concerning participation in the $VO_2\max$ test conducted on a treadmill.

The short, self-administered, version of the IPAQ (IPAQ-S), which measures total physical activity, was translated into Hebrew (IPAQ-S-H) by the study investigators while adhering to the recommended protocol in the IPAQ-S manual for translating self-reported PA into PA-related Energy Expenditure, as expressed in Metabolic Equivalent units (MET) [31]. Participants' responses to the questionnaire were scored based on scoring protocol, described elaborately elsewhere [32]. Briefly, the continuous score was used where all scores were

expressed in MET-minutes/week. For the calculations of the three continuous scores for each of the PA types, the following was used: type of activity in MET-minutes/week = MET score of the activity multiplied by the minutes performed. Total PA MET-minutes/week was the sum of all three types of activities in MET-minutes/week. All METs were continuous.

Cardiorespiratory fitness was measured via $VO_2\text{max}$ ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) testing based on the Bruce Protocol [33, 34]. Briefly, the treadmill test was initiated with a speed equal to 2.8 km/hour with no slope. The slope was then increased by 3% every three minutes up to 24% (stage 8). The test required participants to exercise at an increasing workload until volatile exhaustion, requiring substantial physical effort; i.e., each participant was encouraged to continue to the best of their ability particularly during the latter stages of the test. A Polar heart rate monitor S610i ($\pm 1\%$ measurement accuracy) was used to measure the heart rate for the duration of the test. Modified Balke formula [34] was used to calculate maximal aerobic power using the last heart rate measurement at the final test stage.

Participants' age, gender, ethnicity, and perceived general health were assessed via a questionnaire. The body mass index was calculated using participants' objectively measured weight in kilograms divided by measured height in meters squared.

All participants completed the IPAQ-S-H questionnaire at baseline (Time 1: T1) and then four weeks later (Time 2: T2) to determine test-retest reliability. MET-minutes/week continuous values from baseline and from the second completion were compared using Intraclass Correlation Coefficients (ICC) and 95% confidence intervals for each survey item and for the total score. In addition, to determine construct validity, participants completed a $VO_2\text{max}$ test two weeks after completing the questionnaire at baseline [35]. Spearman correlation coefficients were computed to estimate the association of survey responses with cardiorespiratory fitness as measured by $VO_2\text{max}$. SPSS, Inc., Chicago IL, version 17.0 was used for all statistical analyses and significance was set at 2 tailed, $\alpha = 0.05$ or lower.

RESULTS

Study participants' mean age was 24.2 years ($SD = 3.7$), slightly less than half were women (49%) and Arabs (45.6%). In addition, on average, individuals were of normal weight (mean BMI = 22.6, $SD = 2.7$), and 86.4% perceived their health as either very good or excellent.

Participants' total physical activity (MET-minutes/week) as well as physical activity by intensity level (walking, moderate, vigorous) and sitting time at T1 and T2 are presented in Table 1. Participants' average total physical activity well exceeded the Health and Human Services physical activity guidelines with a mean MET-minutes/week of 3,337 ($SD = 3,043$) for T1 and 3,440 ($SD = 3,259$) for T2.

Analysis for the test-retest reliability of the IPAQ-S-H survey components indicated a moderate to high agreement (ICC: 0.59-0.79), with the highest reliability observed for the total score (ICC = 0.90; 95%CI = 0.87-0.93) (cf. Table

2). In comparison, sitting time was the least reliable survey component (ICC = 0.399; 95%CI = 0.253-0.528). Furthermore, the correlation between survey components and cardiorespiratory fitness (to determine validity) is depicted in Table 3. Total physical activity was significantly and positively correlated with cardiorespiratory fitness (Pearson's $r = 0.43$; $p < 0.01$). When examining the survey components, results reveal that the sitting, walking and moderate intensity physical activity scores were not correlated with cardiorespiratory fitness, whereas vigorous intensity activity was positively and significantly correlated with cardiorespiratory fitness levels (Pearson's $r = 0.40$; $p < 0.01$).

Table 1. Mean and standard deviation of responses to the IPAQ-S-H components and total score for Time 1 (T1) and Time 2 (T2), $n = 145$

Survey Scores	n	Mean (SD) T1	Mean (SD) T2
MET-minutes/week Vigorous activity	145	228 (221)	218 (222)
MET-minutes/week Moderate activity	145	134 (206)	169 (206)
MET-minutes/week Walking	145	248 (485)	256 (469)
Sitting (minutes per day)	145	293 (213)	331 (228)
Total MET-minutes/week calculated	145	3175 (2719)	3265 (2910)

Abbreviations: IPAQ-S-H - International Physical Activity Questionnaire-Short-Hebrew; SD = Standard Deviation; MET = Metabolic Equivalent

Table 2. Test-retest reliability of the IPAQ-S-H: components and total score, $n = 145$

Questionnaire item	N=145 ICC	95% CI
MET-minutes/week Vigorous activity	0.794 *	0.726 - 0.847
MET-minutes/week Moderate activity	0.586 *	0.469 - 0.683
MET-minutes/week Walking	0.734 *	0.650 - 0.801
Sitting (minutes per day)	0.399 *	0.253 - 0.528
Total MET-minutes/week calculated	0.904 *	0.870 - 0.930

Abbreviations. IPAQ-S-H - International Physical Activity Questionnaire-Short-Hebrew; ICC = Intraclass Correlation Coefficients. CI= Confidence Interval; MET = Metabolic Equivalent
* = $p < 0.01$

Table 3. Construct Validity of the IPAQ-S-H: correlation of survey responses to VO_2 max, $n = 47$

Survey Scores	Pearson's r	95% CI
MET-minutes/week Vigorous activity	0.403 *	0.131 - 0.619
MET-minutes/week Moderate activity	0.221	-0.071 - 0.478
MET-minutes/week Walking	0.030	-0.259 - 0.314
Sitting (minutes per day)	-0.063	-0.344 - 0.228
Total MET-minutes/week calculated	0.430 *	0.163 - 0.638

Abbreviations. IPAQ-S-H - International Physical Activity Questionnaire-Short-Hebrew; MET = Metabolic Equivalent; VO_2 max = maximal oxygen uptake
* = $p < 0.01$

DISCUSSION

The present study aimed to establish the test-retest reliability and construct validity of the IPAQ-S-H. To our knowledge, this is the first study to translate the IPAQ into Hebrew based on the recommended protocol [36] and to subsequently evaluate its psychometric properties. Study findings indicate that the IPAQ-S-H total score exhibited high reliability for all physical activity survey components. However, sedentary behavior, measured via one survey question pertaining to daily sitting time exhibited markedly lower reliability. This is in accord with previous [37] findings that sedentary behavior is not synonymous with lack of physical activity. When examining the validity of the survey, a higher total survey score (indicative of higher physical activity levels) was moderately correlated with increased cardiorespiratory fitness levels. When examining the survey components, vigorous intensity physical activity was associated with cardiorespiratory fitness, but not the moderate, walking or sitting scores.

Current findings emphasize that the IPAQ-S-H primarily exhibits similar reliability traits to the 12-country IPAQ validation study [25]. Thus, in the current study the coefficient for total physical activity equaled 0.90, whereas in the 12-country study the coefficient ranged from 0.32 to 0.88 (depending on the country). However, the reliability of the sitting time question was primarily lower than the 12-country study (current study: 0.39; 12-country study: 0.35-0.95). Further, when examining the validity of the IPAQ-S-H the correlation between the total physical activity and cardiorespiratory fitness was moderate (correlation coefficient of 0.43), which is similar to the correlation coefficients of the 12-country study (0.02-0.57; depending on the country). Caution should be taken, however, when comparing the validity of the current study to the 12-country study since physical activity was compared to accelerometer estimates and not cardiorespiratory fitness (as in the present study). Other validation studies [38, 39] comparing IPAQ's total physical activity to cardiorespiratory fitness found similar or lower correlation coefficients with VO₂max than the present study. While cardiorespiratory fitness is an objective and direct consequence of physical activity, fitness is also impacted by genetic factors and weight status [40]. Thus, further validation of the IPAQ-S-H is warranted comparing the survey to objective monitoring of physical activity (e.g. accelerometry).

The current study has strengths and limitations. A notable strength stems from the fact that this is the first study to validate the IPAQ in the Hebrew language. Thus, once the Hebrew version of IPAQ is applied and utilized in Israel, this will enable international and consistent comparison of physical activity levels with other countries in the region and throughout the world. However, the current study offers an initial validation attempt examining a unique sample of college students majoring in physical education, who are not a representative sample of the general population in Israel. Furthermore, several studies [41, 42] have shown over-reporting PA that needs to be taken into consideration when interpreting PA questionnaire results. Hence further validation of the IPAQ-S-H is required among more representative samples in Israel. In addition, the study validated the short, self-administered, version of the IPAQ only; thus, validation of the telephone and long IPAQ in Hebrew are suggested. Finally, while consistent with other studies [43], the validation component of the study consisted of a subsample of participants rather than the larger sample utilized to examine the reliability of the survey.

CONCLUSION

This study offers the first Hebrew version of the IPAQ, which exhibits moderate reliability and validity, which is comparable to other validation studies of the IPAQ in the world. The IPAQ-S-H could be utilized in Israel to assess physical activity, which will enable consistent comparison both within Israel and abroad. Further validation of the IPAQ-S-H is warranted in more representative samples while utilizing objective monitoring to determine criterion validity.

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