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The Iranian Version of International Physical Activity Questionnaire (IPAQ) in Iran: Content and Construct Validity, Factor Structure, Internal Consistency and Stability

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Abstract: Objective International physical activity questionnaire (IPAQ) was suggested as the instrument of physical activity international measurement by WHO and CDC. The aim of this current study was to establish content and construct validity and reliability of IPAQ based on data from female employees of Tabriz University. Setting 200 female employees of Tabriz University constituted the research sample. Design and method In this cross- sectional study, the construct validity of IPAQ was conducted using exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA). The mean of CVI and CVR was 0.85 and 0.77 respectively and indicated a good content validity for IPAQ. Viramax rotation was used for factor analysis and five factors were defined for IPAQ. Cronbach's Alpha coefficient (0.7) indicated a good internal consistency for this instrument. Spearman Brown correlation coefficient (0.9) showed good test retest reliability. The findings of current study support the face, content and construct validity and the internal consistency and stability of IPAQ-L. This scale intends to fill an important gap long existed for researching and measuring PA among Iranian women employees.

Key words: Physical activity · Validity · Reliability · IPAQ · Female employees · Exploratory factor analysis · Confirmatory factor analysis

Abbreviations:

IPAQ	:	International physical activity questionnaire
IPAQ- L	:	International physical activity questionnaire long form
EFA	:	Exploratory factor analysis
CFA	:	Confirmatory factor analysis
MET	:	Metabolic equivalent
CVI	:	Content validity Index
CVR	:	Content validity Ration
Vig	:	vigorous activity
Mod	:	moderate activity
L-T	:	leisure time

INTRODUCTION

There is strong scientific evidence showing that physical activity (PA) could generate a number of health benefits for all ages [1, 2]. PA has been associated with a decrease in cardiovascular diseases [1], diabetes, obesity, cancers [3, 4], hypertension, osteoporosis and other chronic diseases [3]. It is further stated to be crucial for

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health promotion, rehabilitation, prevention of different illnesses [5-7] and reduction of mortality rate [1, 8]. PA could improve body fitness, balance, muscular power and mental performance and function [9, 10].

There are different techniques for assessing PA, such as questionnaires, labeled water, motion sensors, diaries, seven-day reminders. Most of these methods measure the PA-related energy consumption [11], but they are expensive [11-13].

The limitations related to the reminders of PA are also documented, especially in the case of moderate and light activities [14]. Questionnaires are extensively used for obtaining PA information, as a cheap, simple and brief method [11, 13]. There are many questionnaires to measure PA but there needs to be a standard, practical and suitable scale for measuring PA [13].

International physical activity questionnaire (IPAQ) was suggested as the instrument of PA International measurement for the age range of 15- 69 years old by WHO and CDC in Geneva in 1998. Its validity and reliability has been endorsed by many studies [6, 11, 12, 15-18].

There are two forms of IPAQ, i.e. long and short, which can be used depending on different research targets [19]. However, the long form of IPAQ (IPAQ-L) has attracted more attention recently, compared to IPAQ-S, because of its proportionality with more studies [15-18].

IPAQ has a multidimensional structure including activities at work, commuting, housework, leisure time (L-T) and measures the activities during walking and severe or moderate levels. IPAQ protocol and its equal scoring have enforced the comparison of PA in different studies have generated more applications for the protocol [19].

Given the growing importance of PA, the researchers selected their study group in a way that they are able to answer the questions at all four domains of IPAQ. The validity of this instrument is mostly investigated and reported in different cultures and population [20]. However, Tabriz, a city with Azari culture, where this study is carried out is largely unexplored. Certain population groups are at greater risk for inactivity including women [21]. As the studies have shown that women have less mobility than men [7, 21], application of computer and internet technology at worksite decrease employees PA and increase risks related to their unhealthy behavior [22] the current study aimed to establish content and construct validity and reliability of IPAQ based on data from female employees of Tabriz University.

MATERIALS AND METHODS

Study Participants: A number of 200 women were chosen from Tabriz University located in Azerbaijan province at North West of Iran using convenience sampling technique. Their age ranged from 24 to 56 and their BMI from 18.95 to 41.19 (mean: 27.69, standard deviation: 4.27). Around 27.5 per cent of the subjects had a normal BMI, 48.4 per cent were overweight and 24.1 per cent were fat.

All employees were informed by an internet message (email) of the study purposes (to evaluate PA through a questionnaire, vo2max test and to assess body fat percent and BMI). The researchers personally sought employees' participation one week later.

Research Instrument: IPAQ-L was used for the study. It has 24 items and measures activities at four domains. One of its sections also calculates time spent while sitting. IPAQ Research committee has defined its scoring protocol [19]. This instrument classifies the population into three groups with low, moderate and high activities on the basis of MET (Metabolic equivalent) -min/week's scores or the frequency of activities at week days and the time spent on each time. One MET is equal to energy consumption during rest and is equal to 3.5 ml o2/kg/min. MET can be calculated by weighing each type of activity by its energy requirements. METs are multiples of the resting metabolic rate and a MET-minute is computed by multiplying the MET score of an activity by the minutes performed [19]. The computation of MET's scores and PA classifications are shown in the literature [19].

Validity of IPAQ: Validity of IPA is ensured through five stages, including scale translation, face validity, content validity, construct validity and criterion validity.

Scale Translation: We used the procedure of forward-backward translation for this purpose [23]. First, the questionnaire was translated from English language into Persian by two bilingual persons, independently. Then, one health education and one exercise sciences specialist, both fluent in those languages, translated the questions back from Persian to English.

The translators and researchers both checked and agreed on the final version. It then was revised by five health education and promotion and six exercise specialists/experts inside the country. Panel members were asked to review each item and evaluate the appropriateness of translated items for face validity, in order them to be understandable by the research target group.

Content Validity: The content validity of IPAQ-L was investigated both quantitatively and qualitatively by the same experts (since they were all Turkish speaking and from the same culture with the target group members). We asked the experts to evaluate the quality and quantity of each item of IPAQ. Necessity, relevancy, simplicity and clarity of each item were assessed using Likert's 4-point type scale. An open question was also asked to elicit the opinions of the experts concerning each item.

The scores of Content validity Index (CVI) were computed on the basis of the simplicity, clarification and relevancy of each item. A CVI score of higher than 0.75 was considered as reasonable.

Content validity Ration (CVR) scores were calculated based on the necessity of each item. A CVR score of equal to/higher than 0.59 was envisaged a good content validity by 11 experts [24].

The mean of CVI and CVR was 0.85 and 0.77 respectively, signifying a good content validity for IPAQ-L.

Construct Validity: The construct validity of IPAQ was conducted using exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA).

Criterion Validity: We compared the data resulted from IPAQ with some PA-related criteria: Body fat percent, BMI and Vo2max.

The criterion validity was evaluated by computing Pearsonian correlation among the measures.

Reliability of IPAQ: Cronbach's Alpha coefficient was employed to calculate internal consistency (25). Alpha coefficient of 0.7 or more is acceptable. Spearman Brown coefficient was used to assess the stability over time of the scale. Spearman coefficient of 0.7 or greater is considered acceptable.

Statistical Analysis: 200 female employees of Tabriz University constituted the research sample. SPSS 17 and LISREL 8.80 help analyze the study data.

The IPAQ Factor structure was conducted using exploratory factor analysis (EFA), utilizing principal component analysis and Viramax rotation. A cut of value of 0.3 considered as the considerable relationship between item and scale.

EFA is argued to be useful in defining the base structure of the instrument. Two primary tests were conducted to survey data fit. The KMO showed reasonable fit (0.6). The values equal to 0.6 and higher in KMO test is acceptable for doing factor analysis [26] and Bartlet test [27] was significant ($P<0.000$) pointing to data fit and to detectable relations between variables which are to be factor analyzed. Confirmatory factor analysis (CFA) was undertaken to evaluate how well the EFA model fits into the observed data [23], that is, whether the proposed model fits the data. The practical indicators of fit, according to CFA, include Chi-Square, Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residual (RMSR), Goodness-of-fit index (GFI), comparative fit index (CFI) and adjusted goodness-of-fit index (AGFI).

The values for GFI, AGFI and CFI range from 0 to 1 and are derived from comparing a hypothesized model with the independent model; with a value greater than 0.90 indicating an acceptable fit to the data. Conventionally, there will be a good model fit if RMSEA is less than/equal to 0.08 and RMSR is less than 0.05. There is adequate fit if the RMSEA is less than/equal to 0.08 and RMSR is less than 0.05 [28-30]. CFA and EFA techniques were used to determine construct validity of IPAQ.

We compared the data resulted from IPAQ with some PA-related criteria: Body fat percent, BMI and Vo2max which shows the cardiovascular fitness [31. 19, 32-34] and is an index of PA.

Vo2max is the best criterion of cardiovascular fitness and aerobic exercise [35] and a valid index of cardiovascular limitations to carry oxygen from the air to tissues at specific level of physical condition and access to oxygen [12]. The highest values of vo2max are between the ages 15 to 30, after which a decrease of 8-10 per cent happens for every ten years [36, 37]. The correlation was proved between self reported PA and vo2max [14, 33, 38, 39]. Queens's college step test is a standard test to measure PA, whose validity is acknowledged [40, 41], within which the participant steps on and off a stair with a height of 41.7cm for 3 min by special metronome measuring his heart beat rate for 15 seconds. This is computed for each participant by using Vo2max formula 65.81-(0.1847*heart rate*4).

Caliper was used to measure body fat percent from 3 places of Abdomen, upper Iliac and Triceps, then the fat percent was computed using body fat percent formula $0.4156*(\text{sum of 3 point})-0.00112*(\text{sum of 3 point})^2+0.03661*\text{age}+4.03653$.

BMI is obtained through dividing weight (kg) by height (m) and squaring the result.

RESULTS

The women reported about their education, 3.4 per cent did not have high school diploma, 17.2 per cent were high school graduate, 8.3 per cent had associate degree, 53.8 per cent with a BSc, 15.2 per cent with MSc and finally 2.1 per cent had a doctorate degree.

A percentage of 38.7 per cent were formal employees of the government, 43.7 per cent worked on contract-based situation, 10.6 per cent had semi-formal and 7 per cent were of private employment status. Of them 22.3 per cent were single and the rest were married. As such, 35.9 per cent had no child, 33 per cent one, 28.3 per cent two, 1.4 per cent three and 1.4 per cent had four children.

The Vo2max of 0.8 per cent was very low, 6.3 per cent low, 23 per cent less than average, 32.5 per cent average, 24.6 more than average, 10.3 per cent good and 2.5 per cent was excellent. The Body fat percent of 1.4 per cent was very low, 2.1 per cent low, 3.5 per cent less than average, 7 per cent average, 21.1 per cent more than average, 33.1 per cent high and 31.7 per cent was very high.

According to the IPAQ protocol, the median was calculated for different domains and intensities of PA. The results are displayed in Table 1.

Eighteen percent of participants reported low level of PA, 50 per cent reported moderate PA and 32 per cent reported vigorous PA.

Viramax rotation was used for factor analysis and five factors were defined with their total variance equal to 72.53 (Table 2).

The factor 1 (PA at work), factor 4 (PA at domestic conditions or in garden) and factor 5 (PA at L-T) were according to Table 2 and in the same classification and the results were correlated to theory. The second classification which was loaded on the factor 2 and included the moderate PA at work, L-T and walking and transportation showed that this classification could be in one section because all of them were moderate and that the different domains of PA correlated together. Moderate PA at yard was loaded on factor 3 separately. We used CFA to test whether the identified model by EFA is fit. The results approved that the model is fit (Table 3) and the extracted data of sample confirmed the theoretical structure of IPAQ.

There was a weak but significant correlation between PA and BMI, vo2max, body fat percent and abdominal fat. In addition, weak and significant correlations were seen between PA at work and body fat percentage, total PA and Vo2max, vigorous PA and abdominal fat percentage.

Table 1: The median for different domains and intensities of PA

PA (MET- min week-1)	Med (Q1-Q3)
PA at work	100 (0-350)
PA transport	198 (0-355.5)
PA domestic and yard	460 (140-1080)
PA L-T	354.2 (103.1 1362)
PA total	1770 (745-3718.5)
Intensities	
Vig PA	0 (0-300)
Mod PA	595 (210-1320)
walking	634.5 (231-1534.5)

Table 2: Factor analysis results for IPAQ

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Vig PA at work	0.898				
Walking PA at work	0.744				
Mod PA at work		0.799			
Mod PA at L-T		0.789			
Walking PA at transport		0.359			
Mod PA at yard			0.609		
Vig PA at yard				0.887	
Mod PA at home				0.606	
Walking PA at L-T					0.469
Vig PA at L-T					0.877

Table 3: Results of fit index CFA of IPAQ

x2	df	X2/df	RMR	RMSEA	CFI	GFI	AGFI
78.18	28	2.7	0.069	0.095	0.83	0.93	0.86

All item scale relationships were statistically significant (P<0.005)

Cronbach's Alpha coefficient (0.7) indicated a good internal consistency for this instrument. Spearman Brown correlation coefficient (0.9) showed good test retest reliability.

DISCUSSION

Immobility/inactivity has become an issue in the world [42, 43] and as such a need to perform a correct measurement and comparison among population has led into the development of IPAQ. This study is the first of its type that has used EFA and CFA techniques on IPAQ. The results of this study support the validity and reliability and initial feasibility of Iranian IPA in the selected women employees.

Spearman correlation coefficient has been reported from 0.32 in South Africa to 0.88 in the USA [15]. Another study also indicated to a coefficient of 0.6 for IPAQ [44]. Martı´nez-Gonza´ lez *et al*. [11] reported 0.45 coefficient

for total PA. Spearman correlation coefficient of our IPAQ-L, which we found that 0.9, was comparable with the original reliability studies of this questionnaire [15]. Cronbach's Alpha coefficient was acceptable (0.7) pointing to a good internal consistency for this instrument. That is consistent with Vasheghani et al.'s study [45]. This coefficient was reported 0.3 by Carriage *et al*. [15].

Alpha coefficient higher than 0.9 might require shortening the instrument length [46], which did not seem necessary in current study.

A five factors structure was defined for IPAQ using EFA in this study. These factors were nearly similar to the original structure of the IPAQ and its different domains. Moderate PA at work, L-T, walking and commuting all were at the same classification and loaded on factor 2, which was theoretically justifiable and showed that the different domains of the PA correlated together. Vigorous PA at work and walking at work loaded on factor 1. As such, the vigorous PA in garden and moderate PA at domestic activities loaded on factor 4. In addition, vigorous PA L-T and waking L-T loaded on factor 5 that were in accord with theory and consistent with the original IPAQ.

The results of EFA revealed that the five factors structure was perfect and supported the construct validity of IPAQ-L. Nunnaly and Bernstien [46, 47] stated that EFA should not be used for confirming the factor structure because it is a data-driven method for exploring the factor structure. Therefore, we utilized CFA to confirm the results of our EFA. The CFA approved the five factors structure of IPAQ-L and showed that the identified model supported the construct validity of IPAQ. Correlation between the factors disclosed that there was correlation among the different domains of PA.

Given the lack of a 'gold standard' [35], Vo2max is used to illustrate the cardiovascular fitness in PA studies. Several studies have reported different results between PA and Vo2max. A powerful correlation between PA and Vo2max has been seen with regard to vigorous activities as compared to low and moderate ones [14, 34, 48-50].

There was a weak but significant correlation between moderate and total PA and aerobic fitness [18]. A similar correlation was seen between total PA and Vo2max in our study.

Among the different domains of PA, our results reported a significant correlation between PA during a commute and Vo2max. Vasheghani *et al*. [45] found a weak correlation between Vo2max and all domains of PA.

The mean of Vo2max which reported less levels of PA 2 standard deviation was lower than that reported levels of PA and almost was extracted that. This pattern was used as approach for evaluating validity or criterion validity [12].

There was a significant negative correlation between BMI and PA during the commute, but no correlation was seen between BMI and intensities of the PA. Vasheghani *et al*. [45] also reported no correlation between BMI and vigorous activity. While we expected those with high level of PA have had low or normal BMI, the result was different. This maybe because of the groups' over-reporting of their moderate and vigorous activities and walking [51]. Some studies have also found that women tend to report their low activities as moderate [52] [53-55]. Hagstromer [56] also argues that individuals might not have correct information about the intensity of their activities. There was significant correlation between body fat percentage and vigorous PA and PA during commute. However, no correlation was seen between body fat percentage and the variables of PA [17]. The result of our study concur Vasheghani *et al*. [45] reporting 18.8 per cent of women as inactive, 60.7 per cent minimally active and 20.5 per cent active. It also accords with Eyler *et al*. [57] who found sedentary prevalence rate to be 8-23 per cent among women.

Our study has several limitations. First, this study was carried out based on a sample of women employees from Tabriz, Iran. This issue might reduce the generalizability of findings to other parts of Iran and other groups of women such as homemaker. The difficulty is further because the target group of this study was from age range of 24-55 and had a high level of education. Second, the CFA and EFA have not been implemented about construct validity of IPAQ and are now needed for other studies.

CONCLUSION

The findings of current study support the face, content and construct validity and the internal consistency and stability of IPAQ-L. This scale intends to fill an important gap long existed for researching and measuring PA among Iranian women employees.

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