

Original Research

Reliability Measures of the Short International Physical Activity Questionnaire (IPAQ) in Greek Young Adults

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Introduction: The short International Physical Activity Questionnaire (IPAQ-short) has frequently been used for national and international comparable physical activity (PA) prevalence studies. The purpose of this paper is to describe a Greek version of IPAQ-short (IPAQ-Gr) and present its reliability properties in Greek young and healthy adults.

Methods: Two hundred and eighteen health science students of the Athens Technological Educational Institute, aged 19-29 years, were randomly selected and participated in the study. An intra-examiner reliability study over time (8 and 30 days apart) was carried out to assess IPAQ-Gr repeatability. An inter-examiner reliability study was also performed to assess the consistency of IPAQ-Gr outcomes between examiners. At the same time, an intra-examiner reliability study using an independent sample of 175 medical students at the University of Ioannina was carried out in order to examine multi-centre IPAQ-Gr reliability. Intra-class correlation coefficients for IPAQ scores and kappa statistics and percent agreement for physical activity classification were used in the analysis.

Results: Intra-class correlation coefficients (ICCs) between day-1 and day-9 assessments for IPAQ total and vigorous PA were high in all groups examined (0.84 to 0.93). ICCs for walking PA, moderate PA and sitting hours were lower, but still good (0.69 to 0.81). Repeatability of IPAQ-Gr outcomes after one-month re-administration was high for total and vigorous PA (0.87, 0.81) and good for moderate (0.66) and walking PA (0.75). Inter-examiner reliability data showed that all correlations between examiners were greater than 0.70, up to 0.87 (paired t-test, $p=NS$), with the exception of moderate PA, where correlations were weaker (0.58 to 0.64). Similar results were found when intra-examiner correlations were compared between educational institutes (multi-centre inter-examiner reliability of IPAQ).

Conclusions: IPAQ-Gr was found to present acceptable reliability properties in Greek young adults. IPAQ-Gr showed high repeatability values for total and vigorous PA, and good for moderate and walking PA.

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In recent years, the importance of physical activity (PA) in the prevention and management of cardiovascular disease has acquired greater prominence. Accumulating evidence indicates that the prevalence of physical inactivity is increasing in Western countries, while sedentary behav-

iour is considered a global health concern. In the 2002 World Health Report of the World Health Organisation (WHO), overall physical inactivity was estimated to cause 1.9 million deaths and 19 million DALYs (disability adjusted life years) globally.¹ Physical inactivity was also estimated to be

responsible for 10-16% of cases of breast, colon and rectal cancers and diabetes mellitus, and about 22% of cases of ischaemic heart disease.¹

On the other hand, a plethora of epidemiological studies have underscored the importance of habitual PA in improving musculoskeletal function, controlling overweight, reducing symptoms of anxiety and depression, maintaining good health and promoting quality of life.² Clinical evidence has indicated that an increase in the amount of PA expenditure reduces the risk of cardiovascular disease, and of certain types of cancer and metabolic diseases.^{2,3} Self-reported PA is strongly associated with insulin resistance⁴ and certain cardiovascular risk factors,^{5,6} and is inversely related with cardiovascular morbidity and all-cause mortality.^{3,7,8}

Physical activity questionnaires (PAQs) are the most common and most practical approaches used for evaluating PA status in large study populations, since they are non-invasive, inexpensive and easy to administer. Numerous PAQs have been designed for epidemiological research; the National Cancer Institute of the USA lists 71 of them.⁹ One frequently used instrument is the International Physical Activity Questionnaire (IPAQ), which was developed in the late 1990s by a multinational working group, supported by the WHO, in order to assess PA cross-nationally in adults aged 18-65 years.¹⁰ Four long (31-item) and four short (9-item) questionnaire versions have been designed, which can be self-administered or answered by telephone interview.¹⁰ The recall period used by all long and short IPAQ formats is either the last seven days or a "usual week". IPAQ instruments have been tested in both developed and developing countries and have demonstrated good reliability and acceptable validity properties,¹¹ at least as good as other self-answered PAQs.¹²⁻¹⁵ The IPAQ committee suggests that the IPAQ-short, last seven days (last 7-d) version, is the format of preference for both national and internationally comparable prevalence studies.¹¹ Following the published work by Graig et al,¹¹ the self-answered, last 7-d, IPAQ-short, has been very popular and many studies during the last six years have examined its reliability and validity properties.¹⁶⁻²⁵

IPAQ-short has also been used in the Eurobarometer survey conducted by the European Union, in which a Greek version was included.²⁶ Recently, this version of IPAQ-short, modified and adapted for the Greek culture (IPAQ-Gr, Appendix I) was tested for criterion-related validity against exercise capacity with satisfactory results (unpublished data). The purpose of this paper is to describe IPAQ-Gr and present its reliability properties in Greek young and healthy adults. Our aim

is to use this instrument in order to assess PA in a number of studies seeking associations between physical inactivity, smoking prevalence and cardiovascular function in the Greek population. In addition, a broader awareness and use of the IPAQ-Gr instrument in the Greek setting would facilitate objective comparisons between studies and contribute to the validity of future meta-analyses.

Methods

Study population

Two hundred and fifty randomly selected health science students of the Athens Technological Educational Institute (TEI-A) and 200 medical students of the University of Ioannina were invited to participate in the study. Eligible for participation were all healthy subjects aged 19-29 years old, with a body mass index (BMI) of 18.5-29.9 kg/m². Based on the WHO classification, normal weight was defined as a BMI ranging from 18.5 to 24.9 kg/m² and overweight as a BMI ranging from 25 to 29.9 kg/m². Health status was assessed by a physician through medical history, clinical and physical examination. Twenty-five students of the 450 invited students were excluded on the basis of the eligibility criteria. Nine subjects did not show up on the second appointment day (day-9). Twenty-three subjects returned non-valid questionnaires. The personal characteristics of the non-participants (57 students, 12.7%) were similar to those of the subjects participating in the study. Finally, 218 TEI-A health science students (113 men and 105 women, Table 1) and 175 University of Ioannina medical students (77 men and 98 women, Table 2) fulfilled the inclusion criteria and completed all assessment protocols. A sample of 51 students of TEI-A, out of the 60 randomly selected and invited, participated in an inter-examiner reliability study. Written informed consent was obtained from all participants. The study protocol followed the principles of the Helsinki Declaration and was approved by the research and ethics committee of TEI-A.

Procedure

On the first appointment day (day-1), TEI-A participants filled in a standardised questionnaire recording personal data, smoking status and other health-related information.

Intra-examiner IPAQ-Gr reliability was assessed through a test-retest design. The same examiner ad-

Table 1. Personal characteristics and IPAQ-Gr outcomes in day-1, day-9 and day-30 assessments of TEI-A study population. IPAQ-Gr total, vigorous, moderate and walking data are expressed as physical activity scores in MET-minutes per week (MET.min.wk⁻¹) and presented as the median and (min-max) values. Personal data and sitting hours are presented as the mean \pm sd.

	Total Group (n=218)	Men (n=113)	Women (n=105)	P
Personal data:				
Age (yr)	23.0 \pm 2.3	23.4 \pm 2.4	22.6 \pm 2.2	
Height (cm)	172.9 \pm 8.8	179.3 \pm 6.0	165.9 \pm 5.2	
Weight (kg)	68.4 \pm 12.7	77.3 \pm 9.3	58.9 \pm 8.0	
BMI (kg/m ²)	22.7 \pm 2.7	24.0 \pm 2.3	21.4 \pm 2.5	
Day-1:				
Total	805 (0-5379)	1250 (0-5379)	693 (0-4782)	<0.05
Vigorous	0 (0-4800)	480 (0-4800)	0 (0-3600)	<0.05
Moderate	160 (0-2880)	180 (0-2880)	120 (0-1920)	NS
Walking	330 (0-2079)	297 (0-2079)	396 (0-1980)	NS
Sitting (hr)	7.1 \pm 2.6	6.9 \pm 2.6	7.2 \pm 2.6	NS
Day-9:				
Total	921 (0-6132)*	1140 (33-6132)	710 (0-4164)	<0.05
Vigorous	0 (0-3600)*	240 (0-3600)	0 (0-2400)	NS
Moderate	240 (0-2400)*	320 (0-2400)	120 (0-1800)	NS
Walking	396 (0-2772)*	330 (0-2772)	396 (0-2376)	NS
Sitting (hr)	7.1 \pm 2.4†	6.9 \pm 2.4	7.4 \pm 2.4	NS
Day-30:				
Total	1096 (0-5598)*	1252 (0-5340)	841 (0-5598)	<0.05
Vigorous	0 (0-3600)*	320 (0-3600)	0 (0-3600)	<0.05
Moderate	320 (0-2400)*	360 (0-3240)	240 (0-2400)	NS
Walking	347 (0-2772)*	347 (0-2079)	347 (0-2772)	NS
Sitting (hr)	7.0 \pm 2.2†	6.8 \pm 2.1	7.2 \pm 2.2	NS

BMI – body mass index. p-values refer to differences between IPAQ scores (chi-square) and sitting hours (t-test) for men and women.

*chi-square, p=NS for comparisons between day-9 and day-30 with day-1.

†t-test, p=NS for comparisons between day-9 and day-30 with day-1.

ministered IPAQ-Gr on day-1 and on day-9, so that a period of seven days intervened between the two assessments. IPAQ-Gr was re-administered by the same examiner one month after the first appointment day (day-30), so that the short-term stability of PA behaviour and the questionnaire's reliability properties for longer periods could be studied. On day-30, 177 subjects out of the 218 TEI-A participants completed the assessment protocol. Forty-one (19%) either did not show up or returned non-valid questionnaires.

An inter-examiner reliability study was performed to assess the between-examiner repeatability of IPAQ-Gr outcomes over time. The same examiner (examiner A) administered IPAQ-Gr to the 51 participating TEI-A students twice, eight days apart. Then, after an eight-day intervening period, the same subjects were readministered IPAQ-Gr by another examiner (examiner B) for two additional assessments, eight days apart (Table 4). Students were advised not to change their usual PA status within these 30 days.

At the same time, and under the same standardised protocol and administration procedures, a second intra-examiner reliability study in an independent sample of 175 University of Ioannina medical students was performed, in order to examine multi-centre IPAQ-Gr reliability.

Physical activity assessment

The adaptation of IPAQ-short into Greek followed the IPAQ committee guidelines (<http://www.ipaq.ki.se/cultural.htm>). A team of experts consisting of health science professionals, medical doctors, and a bilingual professional took care of all the necessary work. These included the translation, the development, the back-translation and the initial field-testing phases. The original self-answered, last 7-d, IPAQ-short (Appendix II) and a Greek-translated (by the European Union; Eurobarometer survey) IPAQ-short telephone format were kindly provided to us by the IPAQ group. These for-

Table 2. Personal characteristics and IPAQ-Gr outcomes in day-1 and day-9 assessments of University of Ioannina study population. IPAQ-Gr total, vigorous, moderate and walking data are expressed as physical activity scores in MET-minutes per week (MET.min.wk⁻¹) and presented as the median and (min-max) values. Personal data and sitting hours are presented as the mean \pm sd.

	Total Group (n=218)	Men (n=113)	Women (n=105)	P
Personal data:				
Age (yr)	20.7 \pm 1.8	20.8 \pm 2.0	20.5 \pm 1.7	
Height (cm)	172.6 \pm 8.9	179.8 \pm 6.8	166.8 \pm 5.5	
Weight (kg)	68.4 \pm 12.7	77.3 \pm 9.3	58.9 \pm 8.0	
BMI (kg/m ²)	22.5 \pm 2.9	23.9 \pm 2.5	21.5 \pm 2.7	
Day-1				
Total	710 (0-4917)	1031 (0-4917)	594 (0-3762)	<0.05
Vigorous	0 (0-4320)	240 (0-4320)	0 (0-2400)	NS
Moderate	160 (0-2160)	160 (0-2160)	160 (0-960)	NS
Walking	297 (0-1617)	248 (0-1617)	330 (0-1617)	NS
Sitting (hr)	7.3 \pm 2.5	7.2 \pm 2.5	7.3 \pm 2.5	NS
Day-9				
Total	739 (0-4275)*	808 (0-4275)	689 (0-3513)	NS
Vigorous	0 (0-3600)*	160 (0-3600)	0 (0-1920)	NS
Moderate	200 (0-1820)*	200 (0-1820)	220 (0-960)	NS
Walking	297 (0-2310)*	248 (0-2310)	297 (0-1617)	NS
Sitting (hr)	7.2 \pm 2.2†	7.2 \pm 2.1	7.2 \pm 2.3	NS

BMI – body mass index. p-values refer to differences between IPAQ scores (chi-square) and sitting hours (t-test) for men and women.

*chi-square, p=NS for comparisons between day-9 and day-30 with day-1.

†t-test, p=NS for comparisons between day-9 and day-30 with day-1.

mats were the basis for IPAQ-Gr development. Technical, linguistic and cultural adaptations were agreed in a consensus meeting. IPAQ-Gr was back-translated, attempting conceptual equivalence, acceptability and adaptation of wording to the target population. No conceptual differences were noted between the two versions. The back-translated version was tested for repeatability in a selected sample of 32 bilingual subjects and showed similar reliability properties to the original. Field-testing of the provisional version included its completion by a small sub-selection of subjects (n=20) of the target group, by means of one-to-one interviews, in order to examine the potential distribution of responses, comprehension, and to ensure linguistic and content validity.

The IPAQ-Gr is a 7-item instrument consisting of six questions that subjects are asked to answer in order to record the number of days (frequency) and the number of minutes per day (duration) of their participation in all kinds of vigorous, moderate and walking PAs during the last seven days. In addition, a seventh question records the time that subjects spend sitting during an average weekday. Our experience from the testing trials agreed with the reports of other investigators regarding

the subjects' difficulty in distinguishing between vigorous and moderate PAs.^{11,27} For this reason, a few more examples of vigorous (>6 metabolic equivalents, METs) and moderate (4 METs) PAs, based on Ainsworth's²⁸ published data and adapted to Greek culture, were added to those given in the original IPAQ. These cultural adaptations are allowed and indeed encouraged by IPAQ committee protocols.¹¹

The administration protocol, the guidelines and all explanations that were to be given to the subjects were standardised. Prior to IPAQ-Gr administration, the answering procedure was explained to the participants. Emphasis was given to the condition that only PAs that lasted at least 10 min should be recorded. The IPAQ criteria by which PAs are classified as of vigorous or moderate intensity were underlined. The physical activity score (PA_{score}) for each vigorous, moderate and walking PA was calculated and expressed in MET-minutes per week (MET.min.wk⁻¹). According to the IPAQ MET-scoring method,²⁹ vigorous PA_{score} is equal to vigorous weekly PA expenditure multiplied by 8 METs. Moderate weekly PA expenditure is multiplied by 4 METs and walking PA by 3.3 METs to calculate moderate and walking PA_{score}s, respectively. Total PA_{score} is

the sum of vigorous, moderate and walking PA_{scores}. Based on their total and/or vigorous PA_{score}, the subjects were classified into three PA categories (PA_{class}): low, moderate and high (Table 3).

Data analysis

Statistical analyses were performed using the SPSS v.14 software package (SPSS Inc, Chicago, IL, USA). Personal data and IPAQ-Gr sitting hours were normally distributed (as evaluated using the Kolmogorov-Smirnov test) and their values are given as mean \pm standard deviation. IPAQ-Gr PA_{scores} were not normally distributed and are given as the median, minimum and maximum values. The chi-square test was used to examine possible differences in PA_{scores} between men and women, and to compare day-9 and day-30 with day-1 assessments.

Intra-examiner IPAQ-Gr reliability was assessed by computing intra-class correlation coefficients (two way mixed - single measures, 2-1-1 model) with 95% confidence intervals, comparing day-9 and day-30 with day-1 PA_{scores}. The intraclass correlation coefficient (ICC) is a descriptive statistic that can be used with quantitative data organised into groups and it produces measures of consistency of values within cases. Cohen's kappa coefficient (kappa statistic) and percent agreement were used to test the repeatability of the PA classification between the appointment days. Kappa statistic and percent agreement are statistical measures of consistency for qualitative (categorical) data. The multi-centre reli-

ability of IPAQ-Gr was examined by comparing the respective intra-examiner ICCs between the two sample populations. Inter-examiner reliability was tested by computing the ICCs between PA_{scores} on day-1 and on day-9 recorded by examiner A compared with the respective PA_{scores} measured in the same subjects by examiner B eight days later. In all analyses, the values of ICCs and kappa statistic were characterised as follows: poor, 0.00-0.20; fair, 0.21-0.40; moderate, 0.41-0.60; good (substantial), 0.61-0.80; high (excellent), 0.81-1.00.³⁰

Results

Descriptives

Four hundred and forty-four young and healthy higher education students participated in the present study. The distributions of subjects' personal characteristics, PA_{scores} and their PA_{class} frequencies were similar to those of the target population from which participants were randomly selected (Papathanasiou G, et al. Prevalence of physical inactivity in Greek health science students, unpublished data).

Based on IPAQ classification criteria, the prevalence of low PA was strikingly high for both population groups of the present study, although the participants were young and healthy science or medical students. On day-1, 37.6% of the TEI-A participants were classified in the low PA_{class} and only 13.8% had high PA status (data not shown). Day-9 and day-30 assessments did

Table 3. IPAQ scoring guidelines and physical activity classification criteria.²⁹

A. Physical Activity Scoring

$$\begin{aligned} \text{Vigorous PA}_{\text{score}} &= 8 \times (\text{days with vigorous activities}) \times (\text{daily minutes of vigorous activity}) \\ \text{Moderate PA}_{\text{score}} &= 4 \times (\text{days with moderate activities}) \times (\text{daily minutes of moderate activity}) \\ \text{Walking PA}_{\text{score}} &= 3.3 \times (\text{days with walking activities}) \times (\text{daily minutes of walking}) \\ \text{Total PA}_{\text{score}} &= \text{Vigorous PA}_{\text{score}} + \text{Moderate PA}_{\text{score}} + \text{Walking PA}_{\text{score}} \end{aligned}$$

All PA_{scores} are expressed as MET.min.wk⁻¹

- Participants are instructed to record only those PA that last at least 10 min.
- The recorded PAs with duration less than 10 min.d⁻¹ are recoded to zero min.d⁻¹.
- The recorded PAs with duration more than 180 min.d⁻¹ are recoded to 180 min.d⁻¹.
- Questionnaires with missing data for time or days or "don't know"/"not sure" checked items are not included in data analysis.

B. Physical Activity Classification Criteria

- ♦ Low PA profile: Total PA_{score} < 600 MET.min.wk⁻¹
- ♦ Moderate PA profile: Vigorous PA_{score} \geq 480 MET.min.wk⁻¹ or Total PA_{score} \geq 600 MET.min.wk⁻¹
- ♦ High PA profile: Vigorous PA_{score} \geq 1500 MET.min.wk⁻¹ or Total PA_{score} \geq 3000 MET.min.wk⁻¹

PA – physical activity; PA_{score} – physical activity score

Table 4. Inter-examiner reliability correlation matrix (n=51).

		Examiner B										
		Day-1					Day-9					
Examiner A	Day-1	TPA	Vig	Mod	Walk	Sit	TPA	Vig	Mod	Walk	Sit	
		TPA	0.88*					0.85*				
		Vig		0.87*					0.83*			
		Mod			0.62*					0.62*		
		Walk				0.77*					0.75*	
	Sit					0.71*					0.70*	
	Day-9	TPA	0.87*					0.85*				
		Vig		0.92*					0.83*			
		Mod			0.64*					0.58*		
		Walk				0.76*					0.77*	
Sit						0.72*					0.73*	

TPA – total physical activity; Vig – vigorous physical activity; Mod – moderate physical activity; Walk – walking physical activity; Sit – sitting hours.
 * Chi-squared tested variability of the mean, p = NS. All correlations are significant (p<0.001)

not significantly change these findings. Respectively, on day-1, 41.9% of University of Ioannina students were classified in low PA_{class}, whereas only 11.2% had high PA status (data not shown).

The PA_{scores} and the sitting hours descriptives for all assessment days and study populations are presented in Tables 1 and 2. When data for the overall group (men and women) were analysed, no significant differences between total PA_{score} on day-1 and day-9 were found for either study population. Similarly, there were no significant differences found between day-1 and day-30 total PA_{scores} for TEI-A participants.

Regarding sex differences, a greater percentage of men than women were in high and moderate PA_{class} and a lower percentage were in low PA_{class} on all assessment days and in both study populations (data not shown). Total and vigorous PA_{scores} were, in most cases, significantly higher for men than for women (Tables 1, 2).

Reliability study

Reliability testing between the examiners of the TEI-A sample population was performed and the respective inter-examiner correlation coefficients are presented in Table 4. All computed correlations (with the exception of those between moderate PA_{scores}) were greater than

0.70, up to 0.87. Inter-examiner correlations between moderate PA_{scores} were lower, ranging from 0.58 to 0.64.

IPAQ-Gr intra-class correlation coefficients between day-1 and day-9 assessments for TEI-A participants are presented in Table 5. Good reliability was indicated when ICCs exceeded the criterion value of 0.60.³⁰ All computed correlations between day-1 and day-9 PA_{scores} exceeded the criterion value and ranged from 0.71 to 0.93. Total and vigorous PA_{score} on day-1 were highly correlated with the respective measures on day-9, both when data from the overall group were analysed, and in men and women separately (0.85 to 0.93). In all groups, (total, men and women), correlations of moderate PA and walking PA were lower, but were still good (0.74 to 0.80). Sitting hours recall had the lowest ICCs (0.71 to 0.72). The repeatability of the PA classification between assessments was good for the overall group (kappa statistic 0.70, 82% of agreement). In men, repeatability of PA classification was also good (kappa statistic 0.77, 86% of agreement). In women, the correlations were lower (kappa statistic 0.63, 78% agreement), implying that more women change PA_{class} between assessments.

IPAQ-Gr repeatability and the intra-class correlation coefficients between day-1 and day-9 assess-

Table 5. IPAQ-Gr test-retest reliability correlations between day-9 and day-30 with day-1 of TEI-A study population.

	Total Group (n=218)	Men (n=113)	Women (n=105)
Day-1 vs. Day-9:			
PA _{class} [*]	0.70 / 82.1%	0.77 / 85.8%	0.63 / 77.9%
Total PA [†]	0.92 (0.89-0.94)	0.93 (0.90-0.95)	0.89 (0.84-0.92)
Vigorous PA [†]	0.88 (0.83-0.91)	0.90 (0.81-0.94)	0.84 (0.77-0.89)
Moderate PA [†]	0.76 (0.69-0.82)	0.75 (0.65-0.86)	0.77 (0.68-0.84)
Walking PA [†]	0.78 (0.72-0.83)	0.80 (0.72-0.86)	0.75 (0.65-0.82)
Sitting hours [†]	0.72 (0.65-0.78)	0.72 (0.62-0.80)	0.71 (0.60-0.79)
Day-1 vs. Day-30:			
PA _{class} [*]	0.67 / 79.7%	0.70 / 81.7%	0.62 / 77.4%
Total PA [†]	0.87 (0.83-0.90)	0.87 (0.81-0.91)	0.88 (0.82-0.92)
Vigorous PA [†]	0.81 (0.74-0.86)	0.82 (0.72-0.88)	0.79 (0.70-0.86)
Moderate PA [†]	0.69 (0.57-0.77)	0.68 (0.58-0.80)	0.70 (0.57-0.79)
Walking PA [†]	0.75 (0.68-0.81)	0.74 (0.62-0.82)	0.77 (0.67-0.85)
Sitting hours [†]	0.66 (0.57-0.74)	0.68 (0.55-0.78)	0.64 (0.49-0.75)

PA_{class} – physical activity category; PA – physical activity.

*kappa statistic / % of agreement for PA classification between assessments.

[†]intra-class correlation coefficients (95% confidence intervals). All correlations are significant (p<0.001).

ments for University of Ioannina students are presented in Table 6. The results were similar to those found for TEI-A participants. All correlations between day-1 and day-9 PA_{scores} exceeded the criterion value and ranged from 0.69 to 0.93. Total and vigorous PA_{scores} on day-1 were highly correlated with the respective PA_{scores} on day-9 (0.91 to 0.93). Moderate and walking PA correlations were lower, but were still good, ranging from 0.72 to 0.81. The repeatability of the PA classification between assessments was good for all groups (kappa statistic 0.73 to 0.76).

In order to examine the reliability properties of IPAQ-Gr for longer periods, the questionnaire was re-administered by the same examiner on day-30. The

computed correlations for all IPAQ-Gr outcomes exceeded the criterion value and ranged from 0.68 to 0.88 (Table 6). Total and vigorous PA_{scores} in the overall group showed the highest correlations (0.87 and 0.81, respectively), while sitting hours repeatability had the lowest value (0.66).

Discussion

This is the first study to examine the reliability properties of IPAQ-short in a Greek population. IPAQ-Gr was tested in two independent study samples of young adults and was found to have good test-retest repeatability. The computed intra-class correlation coefficients

Table 6. IPAQ-Gr test-retest reliability correlations between day-1 and day-9 of University of Ioannina study population.

	Total Group (n=175)	Men (n=77)	Women (n=98)
PA _{class} [*]	0.75 / 85.7%	0.73 / 84.4%	0.76 / 87.0%
Total PA [†]	0.93 (0.89-0.95)	0.92 (0.87-0.95)	0.93 (0.90-0.96)
Vigorous PA [†]	0.92 (0.89-0.94)	0.91 (0.85-0.94)	0.93 (0.90-0.95)
Moderate PA [†]	0.75 (0.68-0.82)	0.78 (0.68-0.86)	0.72 (0.60-0.81)
Walking PA [†]	0.77 (0.71-0.83)	0.74 (0.62-0.83)	0.81 (0.73-0.87)
Sitting hours [†]	0.72 (0.64-0.79)	0.69 (0.55-0.79)	0.75 (0.65-0.83)

PA_{class} – physical activity category; PA – physical activity.

*kappa statistic / % of agreement for PA classification between assessments.

[†]intra-class correlation coefficients (95% confidence intervals). All correlations are significant (p<0.001).

for IPAQ-Gr total and vigorous PA were high in all groups examined, ranging from 0.84 to 0.93. Walking PA, moderate PA and sitting correlations were lower, but they were good and significant. Similar results were found when intra-examiner correlations were compared between educational centres.

Our results are in line with other studies indicating that IPAQ-short has good to high reliability properties in adults.^{11,19,22,24} Repeatability of the IPAQ-short vigorous PA questions²³ and total minutes PA index¹⁷ has also been found to be good. On the other hand, in a multinational European study, Rutten et al¹⁶ reported that the test-retest reliability scores of the telephone-administered IPAQ-short were moderate or even fair, ranging from 0.22 to 0.56. The authors explained their rather disappointing results by referring to methodological issues.

In most IPAQ-short reliability studies, the intra-examiner correlations for moderate PA are usually lower, compared with the correlations of vigorous PA. Macfarlane et al²² pointed out that all reliability correlations were above 0.75, with the exception of moderate PA, which was fair (0.31). Brown et al¹⁷ reported a lower repeatability for moderate PA duration (0.41) compared to vigorous PA duration (0.52). Kurtze et al²³ found good correlation values for the vigorous PA questions (0.61-0.62), but the repeatability of the moderate PA questions was only fair (0.34-0.30). In our study, moderate PA intra-class correlation coefficients were also lower compared to vigorous PA (Tables 5, 6). A number of issues could be associated with the higher ICC values found in the present study. Descriptive analysis of our data in the TEI-A sample population showed that on day-1 about 43% of men and 63% of women reported zero vigorous PA. The respective percentages for zero moderate PA reporters were much lower, 30% of men and 46% of women. Similar findings were found for the University of Ioannina participants: 42% of men and 62% of women reported zero vigorous PA on day-1, while 32% of men and 37% of women reported zero moderate PA at the same appointment day. The much higher frequencies of zero vigorous PA, compared to zero moderate PA, may partially explain the higher reliability correlations for vigorous PA found in our study, since it is easier, and therefore more reliable, to recall no physical activity. In addition, most of the vigorous PA reporters referred to systematic exercise and team sports activities. These structured vigorous PAs can be more accurately recalled compared to some vaguely defined moderate PAs, such as “carrying light loads” or “multiple household tasks at once”.

IPAQ-Gr maintained its good reliability properties even when it was re-administered after a one-month period. In the overall group, the intra-class correlation between day-1 and day-30 assessments for total PA was 0.87, implying a short-term stability of PA behaviour and a longer-term reliability over time for IPAQ-Gr. To the best of our knowledge, no other study has tested IPAQ-short for reliability with repetition over one month. Our results are comparable with previously published data for other popular PAQs, apart from IPAQ, indicating that PAQs usually have good to high reliability properties over a one-month testing period.³¹ Minnesota Leisure Time PAQ reliability correlations between assessments, approximately four weeks apart, ranged from 0.73 for light activities to 0.95 for heavy PAs.³² The repeatability of the College Alumnus PAQ over a 4-week period was 0.72,³³ while the Lipid Research Clinic questionnaire’s respective reliability correlations for overall study population were 0.85 (2-point scoring system) and 0.88 (4-point scoring system).³⁴

Strengths and limitations

The random selection of the subjects out of a well-defined and homogenous target population and the sizes of the sample population groups add strength to the results of the present study. In addition, IPAQ-Gr repeatability was examined in all groups (overall, men and women), an inter-examiner reliability study was performed, and IPAQ-Gr reliability properties were compared between two independent sample study populations.

On the other hand, there are certain limitations that have to be mentioned. Because of the long distance between centres, it was difficult to conduct inter-examiner reliability testing between the examiners of the two independent sample study populations. However, the study protocol and all IPAQ-Gr administration procedures were extensively discussed and standardised at the beginning of the study. One other limitation that may influence the extent to which our results may be generalised is that IPAQ-Gr was examined for reliability in a narrow age group of young adults and only in well-educated health science students, who usually have a better understanding of the purposes of such studies and are more motivated to participate. In addition, young adults are more reliable in reporting their physical activity, since they are usually involved in easier to recall structured PAs, such as systematic exercise or team sports activities. Therefore, it remains necessary to

extend the study of IPAQ-Gr reliability properties to other age and special groups and/or to the general Greek population.

Conclusion

In the present study, total and vigorous physical activity measured by IPAQ-Gr demonstrated excellent reliability properties. Moderate and walking physical activity correlations, although lower, were good. The reliability measures of IPAQ-Gr were comparable to the original version and other multi-cultural adaptations in the literature. Overall, it can be suggested that IPAQ-Gr might be a reliable tool for assessing physical activity in Greek young and healthy adults.

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Appendix I

International Physical Activity Questionnaire

Short - self answered - last 7 days recall

Greek Version

Οι παρακάτω ερωτήσεις αφορούν στο χρόνο που έχετε αφιερώσει για κάποια σωματική δραστηριότητα τις **ΤΕΛΕΥΤΑΙΕΣ 7 ΗΜΕΡΕΣ**. Περιλαμβάνουν ερωτήσεις σχετικά με δραστηριότητες που κάνετε κατά την εργασία σας, στις μετακινήσεις σας, στις δουλειές του σπιτιού, του κήπου και στον ελεύθερο χρόνο σας για ψυχαγωγία, άσκηση ή άθληση. Σας παρακαλώ να απαντήσετε όλες τις ερωτήσεις, ακόμα και εάν πιστεύετε ότι δεν είστε ένα σωματικά δραστήριο άτομο.

Πριν απαντήσετε τις ερωτήσεις 1 και 2, σκεφτείτε όλες τις **έντονες** σωματικές δραστηριότητες που κάνετε κατά τις **τελευταίες 7 ημέρες**. Μια έντονη σωματική δραστηριότητα αναφέρεται σε δραστηριότητες που απαιτούν έντονη σωματική προσπάθεια και σας κάνουν να αναπνέετε σημαντικά δυσκολότερα από ότι συνήθως. Σκεφθείτε μόνο τις **έντονες** σωματικές δραστηριότητες που κάνετε και είχαν διάρκεια **μεγαλύτερη από 10 λεπτά** κάθε φορά.

1. Κατά τις τελευταίες 7 ημέρες, πόσες ημέρες κάνατε κάποια έντονη σωματική δραστηριότητα, όπως σκάψιμο, έντονη άσκηση με βάρη, τρέξιμο σε διάδρομο με κλίση, γρήγορο τρέξιμο, aerobics, γρήγορη ποδηλασία, γρήγορη κολύμβηση, τένις μονό, αγώνας σε γήπεδο (ποδόσφαιρο, basketball, volleyball, handball);

— ημέρες ανά εβδομάδα

εάν δεν κάνατε έντονες σωματικές δραστηριότητες,

τότε προχωρήστε στην ερώτηση 3

2. Τις ημέρες που κάνατε κάποια έντονη σωματική δραστηριότητα, πόση ώρα αφιερώνατε συνήθως;

— λεπτά ανά ημέρα

δεν γνωρίζω/δεν είμαι βέβαιος

Πριν απαντήσετε τις ερωτήσεις 3 και 4, σκεφτείτε όλες τις **μέτριες έντασης** σωματικές δραστηριότητες που κάνετε κατά τις **τελευταίες 7 ημέρες**. Μια μέτρια έντασης σωματική δραστηριότητα αναφέρεται σε δραστηριότητες που απαιτούν μέτρια σωματική προσπάθεια και σας κάνουν να αναπνέετε κάπως δυσκολότερα από ότι συνήθως. Σκεφθείτε μόνο τις **μέτριες έντασης** σωματικές δραστηριότητες που κάνατε και είχαν διάρκεια **μεγαλύτερη από 10 λεπτά** κάθε φορά.

3. Κατά τις τελευταίες 7 ημέρες, πόσες ημέρες κάνατε κάποια μέτρια σωματική δραστηριότητα, όπως το να σηκώσετε και να μεταφέρετε ελαφρά βάρη (μικρότερα από 10 κιλά), συνολική καθαριότητα του σπιτιού, ήπιες ρυθμικές ασκήσεις σώματος, ποδηλασία αναψυχής με χαμηλή ταχύτητα, καλαρή κολύμβηση; Σας παρακαλώ να μη συμπεριλάβετε το περπάτημα.

— ημέρες ανά εβδομάδα

εάν δεν κάνατε μέτριας έντασης σωματικές δραστηριότητες, τότε προχωρήστε στην ερώτηση 5

4. Τις ημέρες που κάνατε κάποια μέτρια σωματική δραστηριότητα, πόση ώρα αφιερώνατε συνήθως;

— λεπτά ανά ημέρα

δεν γνωρίζω/δεν είμαι βέβαιος

Πριν απαντήσετε στις ερωτήσεις 5 και 6, σκεφτείτε το χρόνο που περπατήσατε κατά τις **τελευταίες 7 ημέρες**. Να συμπεριλάβετε το περπάτημα στο χώρο της εργασίας σας, στις μετακινήσεις σας και στον ελεύθερο χρόνο σας για ψυχαγωγία, άσκηση ή άθληση.

5. Τις τελευταίες 7 ημέρες, πόσες ημέρες περπατήσατε για περισσότερο από 10 συνεχόμενα λεπτά;

— ημέρες ανά εβδομάδα

εάν δεν περπατήσατε καμία ημέρα περισσότερο από 10 συνεχόμενα λεπτά, τότε προχωρήστε στην ερώτηση 7

6. Τις ημέρες που περπατήσατε, για περισσότερο από 10 συνεχόμενα λεπτά, πόση ώρα περπάτατε περπατώντας;

— λεπτά ανά ημέρα

δεν γνωρίζω/δεν είμαι βέβαιος

7. Πόσο χρόνο περπάτατε καθισμένοι σε μια συνηθισμένη μέρα κατά τη διάρκεια των τελευταίων 7 ημερών; Ο χρόνος αυτός μπορεί να περιλαμβάνει το χρόνο που περπάτατε καθισμένοι στο σπίτι, στο γραφείο, όταν επισκέπτεστε φίλους, όταν διαβάζετε, μελετάτε ή βλέπετε τηλεόραση, αλλά δεν περιλαμβάνει τον ύπνο.

— ώρες ανά ημέρα

δεν γνωρίζω/δεν είμαι βέβαιος

Τέλος του ερωτηματολογίου. Σας ευχαριστούμε για τη συμμετοχή σας.

Appendix II

International Physical Activity Questionnaire

Short - self answered - last 7 days recall
Original Version¹⁰

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?
 _____ **days per week**
 No vigorous physical activities → **Skip to question 3**
2. How much time did you usually spend doing **vigorous** physical activities on one of those days?
 _____ **hours per day**
 _____ **minutes per day**
 Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
 _____ **days per week**
 No moderate physical activities → **Skip to question 5**

4. How much time did you usually spend doing **moderate** physical activities on one of those days?
 _____ **hours per day**
 _____ **minutes per day**
 Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?
 _____ **days per week**
 No walking → **Skip to question 7**
6. How much time did you usually spend **walking** on one of those days?
 _____ **hours per day**
 _____ **minutes per day**
 Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?
 _____ **hours per day**
 _____ **minutes per day**
 Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

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