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International Physical Activity Questionnaire: validation and assessment in an Italian sample

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Abstract

Background: A standardized method for the assessment of physical activity, the International Physical Activity Questionnaire (IPAQ), was developed in the late 1990s as instrument for cross-national assessment. This study aims to evaluate the reliability and validity of the IPAQ short and long version questionnaire in a Italian sample.

Methods: The long and short versions of IPAQ questionnaires were administered twice, with an interval of one day between each administration, to 2 different random samples. Cronbach's alpha was used as a measure of the internal consistency of the two versions.

Results: The long version was administered to 60 subjects and the short version to 58. The Cronbach's alpha on items about physical activity in the long version was 0.73, and 0.60 for the short version. The referred comments on short and long version were not very different both in number and content though they suggest a better understanding of the short version compared to the long one.

Discussion: IPAQ short and long versions show acceptable reliability properties in the Italian adult setting. The utilization of a questionnaire seems be more influenced by time of administration and number of requested information. In terms of internal consistency and validity they appear to have similar performance.

Key words: IPAQ, physical activity, questionnaire, validation

Introduction

Scientific literature shows how physical activity (PA) can reduce the risk of many diseases: it is estimated that insufficient PA causes 1.9 million premature deaths per year globally [1]. So, at present, physical inactivity is considered a global health concern. Despite that, no standardized approaches to its measurement exist, and in Craig et als study many countries report the lack of a tool for comparison and surveillance [2]. In response to the demand for a comparable and valid instrument, in 1997, the International Physical Activity Questionnaire (IPAQ) was developed as a surveillance tool to measure multiple domains of physical activity. This was the first attempt to develop an instrument suitable for "surveillance activities and to guide policy development related to health-enhancing physical activity across various life domains" [3]. The goal was to identify a common questionnaire that all countries could use that would permit comparability among countries on various domains of PA [4]. At the moment IPAQ has been developed as an instrument for cross-national assessment of PA and has now been validated in 12 countries [2]. Moreover, a Chinese version of IPAQ appeared to have acceptable reliability and validity, compared to other PA instruments used in various large epidemiological studies [5]. A recent International Prevalence Study on Physical Activity (IPS) collected and compared, for the first time, nationally representative prevalence estimates of PA from different countries through the use of IPAQ on a large-scale [4]. These instruments have acceptable measurement properties for monitoring population levels of PA among 18–65 years old adults in diverse settings. Long and short versions of the IPAQ are available and can be administered by telephone interview or self-administration. In 2004, an Australian study compared four different self-report PA measures and IPAQ survey showed reasonable and acceptable repeatability properties [6]. In Italy, the change in lifestyle habits , like the

rapid changes in patterns of work, transport and recreation, have made the population susceptible to a large number of non communicable diseases and medical conditions like obesity, diabetes, metabolic syndrome etc. [7-10]. The aim of this study is to evaluate the reliability and validity of the IPAQ short and long version questionnaire in the Italian setting in order to make this instrument available for the determination of PA level in the different domains of everyday life.

Methods

Questionnaire

The two versions of the questionnaire (long and short) are a translation of the English version of IPAQ [3]. The IPAQ is present in two versions: long and short.

The *short version* comprises 7 items on PA providing information about time spent on walking, on vigorous and moderate intensity activity, on sedentary activity and demographic information (gender, age, educational level and work); 4 items relate to demographic data (age, gender, educational level, type of work) and the 7 last items concern comprehension of the questionnaire.

The *long version* of IPAQ presents 27 questions concerning PA, accompanied by 4 questions on demographical information (gender, age, educational level and type of work) and 6 on the comprehension and comments about the questionnaire.

Concerning PA, 5 areas of activity domains were considered:

- job-related PA;
- transportation PA;
- housework, house maintenance and caring for family;
- recreation, sport, and leisure- time PA;
- time spent sitting.

The information about PA in the questionnaire was expressed in minutes per day and/or days per week.

The questionnaires were self-administered twice with a 24/32 hour interval between the first and second compilation.

The IPAQ was designed to be used by adults aged 18–65 years. Data were collected during the period between July and September 2009 and were put in a database created ad hoc by using DBIV.

Statistical analysis

Two separate types of analyses were planned to validate the Italian version of the questionnaire: one for the short form of IPAQ and the other one for the long form.

Cronbach's alpha was used as a measure of the internal consistency for both versions. In addition for checking whether any item was not consistent with the rest of the scale, and could thus can be discarded, a reliability analysis was performed. The item-total correlation and the variability of the alpha between items, adding and eliminating items one at a time, was performed.

In order to describe the sample, frequency tables were compared, using percentage for categorical variables, mean and standard deviation (SD) for quantitative ones. The normality distribution was evaluated to guarantee the applicability of parametric or non parametric test, using Kolmogorov-Smirnov's Test. Every variable resulted normally distributed.

In order to assess the agreement, McNemar's Test was used for qualitative dichotomic variables, Wilcoxon Signed Ranks Test and Spearman correlation coefficients for continuous data.

The level of significance was set $p<0.05$.

The software used to analyse data was SPSS 12.00 for Windows.

Results

IPAQ short version

Fifty-eight pairs of the short form questionnaire were submittedtwice, with an interval of one day between each compilation. Of these, 53 were completely filled out. Respondents were mainly male (65%) and the mean age of the sample was 40.40 ±12.53 (Table 1).

The Cronbach's alpha, using the questionnaires at time interval T1 (second submission), on all 7 items concerning PA, was 0.363 and the reliability analysis is shown in Table 2. The elimination of the 7th question ("during the last 7 days, how much time did you usually spend sitting on a weekend day?") improved the alpha from 0.363 to 0.673 (Table 2).

The correlation analysis using Spearman's coefficient reported a significant association ($p<0.001$) between the first and the second questionnaire for all 7 items.

Table 1 illustrates the descriptive statistics concerning socio-demographic information and the answers of the questionnaire. There weren't significant differences between items between first and second submission of the questionnaire and just one question was at the limit of statistical significance ($p=0.055$) ("during the last days, on how many days did you do moderate physical activities as part of your work?").

The comments about the questionnaire from the 58 respondents were as following: 98% understood the language and 91% said that the intent of the single question was clear; 23% had doubts about

Table 1. IPAQ *short versions*. Statistical description and univariate analysis (test of the answers according) of socio-demographical variables and physical activity at To and T1 (absolute frequencies).

Socio-demographical variables			To N			T1 N			p
Gender		M	38			35			0.999^
		F	20			18			
Age (years)		N (mean ± SD)	58 (39.98 ±12.65)			52 (40.40 ±12.53)			0.999°
Educational Level		Primary school	3			3			1.000^
		High school	22			22			
		Degree	27			27			
Questionnaire		**Measure unit**	**N**	**mean (SD)**		**N**	**mean (SD)**		
PART 1. PHYSICAL ACTIVITY:									
1	During the last 7 days, on how many days did you do vigorous physical activities as part of your work?	Days per week	58	1.36	(1.79)	53	1.49	(1.86)	0.458°
2	How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?	Minutes per day	58	68.97	(119.26)	53	72.83	(116.69)	0.586°
3	During the last 7 days, on how many days did you do moderate physical activities as part of your work?	Days per week	58	2.03	(2.18)	53	2.47	(2.15)	0.055°
4	How much time did you usually spend on one of those days doing moderate physical activities as part of your work?	Minutes per day	58	60.78	(70.59)	52	79.90	(117.76)	0.288°
5	During the last 7 days, on how many days did you walk as part of your work?	Days per week	58	5.29	(2.15)	53	5.36	(2.01)	0.670°
6	How much time did you usually spend on one of those days walking as part of your work?	Minutes per day	56	106.09	(159.69)	51	116.80	(203.75)	0.722°
PART2. TIME SPENT SITTING									
7	Usually spend sitting on a weekend day?	Minutes per day	58	354.83	(172.75)	53	340.43	(205.00)	0.801°

N= absolute frequencies; ^p-value of McNemar Test; °p-value of Wilcoxon Signed Ranks Test

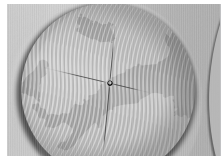

Table 2. Item-total correlation and variability of Cronbrach's alpha, if one item was deleted (short version).

Items PA in questionnaire of sort version (T1)*	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	
1	0.375	0.370	(1.79)
2	0.611	0.050	(119.26)
3	0.206	0.371	(2.18)
4	0.606	0.053	(70.59)
5	0.114	0.372	(2.15)
6	0.440	0.034	(159.69)
7	-0.248	0.679	(172.75)

*The number correspond to the items shown in Table 1.

the questionnaire, or thought the questionnaire was not clear or, for example, the last question wasn't comprehensible. Someone suggested to use dichotomous answers (yes/no) and to insert a question to ask if the week was a typical or special week in one's habit. Two respondents affirmed that they felt uncomfortable to answer the questionnaire; 5.22% (9 persons) declared that there were other activities to consider in the questionnaire: domestic, gardening, sexual activity and the necessity to quantify the time spent on means of transport (car, bus, train, motorbike, etc.).

IPAQ long version

Sixty pairs of questionnaire were submitted, using the IPAQ Long Version, with an interval of one day between the first and the second administration. The sample was mainly comprised of females (55%) and the mean age was 36.7 (SD=12.35) (Table 3a).

The Cronbach's alpha, using the questionnaires at time interval T1 (second submission) , on all 27 items about PA was 0.793. The reliability analysis is illustrated in Table 4 and with the exclusion of the 3rd question ("How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?") , the 26th question ("during the last 7 days, how much time did you usually spend sitting on a weekday?") and the 27th question ("during the last 7 days, how much time did you usually spend sitting on a weekend day?"), the value of the alpha coefficient improved and changed from 0.793 to 0.821, 0.815 and 0.840 respectively.

The correlation analysis using Spearman's coefficient reported a significant association ($p<0.001$) between the first and the second questionnaires for all items.

The Table 3a shows the descriptive statistics concerning the socio-demographical information of the study sample and the answers to the questionnaire. Moreover, the statistical analysis for the evaluation of the accordance between the first and the second administration was also reported (Table 3b).

Significant differences between the two different administering times can be observed only in relation to two questions:

- "How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?" in the first administration showed an average of 101.04 minutes (SD=123.95) of vigorous physical activity and 81.90 minutes in the second administration (SD=69.90), respectively, (p=0.050).
- "How much time did you usually spend on one of those days travelling in a car, bus, train or other kind of motor vehicle?", in administration one had an average of 89.09 minutes (SD=61.46) and in administration two an average of 115.82 minutes (SD=91.37) (p=0.030).

The comments about the questionnaire showed that 30% out of 60 respondents had understood

Table 3a. IPAQ *long versions*. Statistical description and univariate analysis (test of the answers according) of socio-demographical variables and physical activity at To and T1.

Socio-demographical variables			To N			T1 N			p
Gender		M	27			27			1.000^
		F	33			32			
Age (years)		N (mean ± SD)	60 (36.7 ±12.23)			57 (36.95 ±12.35)			0.317°
Educational Level		Primary school	2			2			1.000^
		High school	21			21			
		Degree	35			35			
Questionnaire		**Measure unit**	**N**	**mean (SD)**		**N**	**mean (SD)**		
PART 1. JOB-RELATED PHYSICAL ACTIVITY:									
1	Do you currently have a job or do any unpaid work outside your home?	Total and workers's number	57	48	53	41	0.219^	(1.86)	0.458°
2	During the last 7 days, on how many days did you do ***vigorous*** physical activities as part of your work?	Days per week	50	1.72	(2.51)	47	1.45	(2.32)	0.096°
3	How much time did you usually spend on one of those days Doing ***vigorous*** physical activities as part of your work?	Minutes per day	24	101.04	(123.95)	21	81.9	(69.90)	0.050°
4	During the last 7 days, on how many days did you do ***moderate*** physical activities as part of your work?	Days per week	53	1.47	(2.04)	46	1.33	(1.92)	0.615°
5	How much time did you usually spend on one of those days doing ***moderate*** physical activities as part of your work?	Minutes per day	27	81.3	(82.60)	21	112.62	(81.17)	0.171°
6	During the last 7 days, on how many days did you ***walk*** as part of your work?	Days per week	53	3.75	(2.34)	47	3.36	(2.40)	0.307°
7	How much time did you usually spend on one of Those days ***walking*** as part of your work?	Minutes per day	45	94.11	(113.21)	40	83.2	(78.87)	0.962°
PART 2. TRANSPORTATION PHYSICAL ACTIVITY:									
8	During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus, car or tram?	Days per week	60	5.7	(1.72)	56	5.79	(1.70)	0.470°
9	How much time did you usually spend on one of those days traveling in a car, bus, train or other kind of motor vehicle?	Minutes per day	58	89.09	(61.46)	55	115.82	(91.37)	0.030°
10	During the last 7 days, on how many days did you bicycle to go from place to place??	Days per week	55	0.45	(1.09)	53	0.47	(1.14)	0.480°
11	How much time did you usually spend on one of those days to bicycle from place to place?	Minutes per day	19	36.84	(44.239)	20	39.85	(47.46)	0.414°
12	During the last 7 days, on how many days did you walk to go from place to place?	Days per week	59	3.73	(2.64)	54	3.96	(2.70)	0.848°
13	Time did you usually spend on one of those days walking from place to place?	Minutes per day	52	64.13	(65.18)	46	67.20	(83.73)	0.687°

N= absolute frequencies; ^p-value of Mc Nemar Test; °p-value of Wilkoxon Signed Ranks Test

Table 3b. IPAQ *long versions*. Univariate analysis (test of the answers according) of socio-demographical variables and physical activity at To and T1.

Univariate analysis			To			T1			p
Questionnaire		Measure unit	N	mean (SD)		N	mean (SD)		
PART 3.HOUSEWORK, HOUSE MAINTENANCE AND CARING FOR FAMILY:									
14	During the last 7 days, on how many days did you do ***vigorous*** physical activities in the ***garden or yard***?	Days per week	58	0.98	(1.94)	53	0.79	(1.65)	0.708°
15	How much time did you usually spend on one of those days Doing ***vigorous*** physical activities in the ***garden or yard***?	Minutes per day	23	96.09	(98.75)	24	78.04	(88.40)	0.124°
16	During the last 7 days, on how many days did you do moderate activities in the ***garden or yard***?	Days per week	57	1.25	(2.01)	54	1.31	(2.13)	0.774°
17	How much time did you usually spend on one of those days Doing ***moderate*** physical activities in the ***garden or yard***?	Minutes per day	30	85.63	-89.96	28	94.64	(80.71)	0.589°
18	During the last 7 days, on how many days did you do ***moderate*** activities inside your ***home***?	Days per week	57	3.54	(2.69)	54	3.41	(2.61)	0.490°
19	How much time did you usually spend on one of those days Doing ***moderate*** physical activities inside your ***home***?	Minutes per day	50	119	(94.39)	49	110.92	(92.99)	0.697°
PART4. RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY:									
20	Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?	Days per week	58	2.38	(2.32)	55	2.42	(2.39)	0.851°
21	How much time did you usually spend on one of those days walking in your leisure time?	Minutes per day	48	71.35	(61.57)	42	73.81	(78.95)	0.437°
22	During the last 7 days, on how many days did you do vigorous physical activities in your leisure time?	Days per week	55	1.33	(2.037)	51	1.12	(1.93)	0.273°
23	How much time did you usually spend on one of those days doing vigorous physical activities in your leisure time?	Minutes per day	29	67.24	(50.14)	24	65.42	(60.72)	0.588°
24	During the last 7 days, on how many days did you do moderate physical activities in your leisure time?	Days per week	53	1.09	(1.81)	53	1.06	(1.63)	0.657°
25	How much time did you usually spend on one of those days doing moderate physical activities in your leisure time?	Minutes per day	32	99.69	(156.42)	27	86.48	(171.564)	0.593°
PART5.TIME SPENT SITTING									
26	During the last 7 days, how much time did you Usually spend sitting on a weekday?	Minutes per day	60	334.5	(166.58)	57	326.39	(156.155)	0.666°
27	During the last 7 days, how much time did you Usually spend sitting on a weekend day?	Minutes per day	59	263.39	(165.49)	57	261.49	(153.20)	0.828°

N= absolute frequencies; ^p-value of McNemar Test; °p-value of Wilcoxon Signed Ranks Test

Table 4. Item-total correlation and variability of Cronbrach's alpha, if one item was deleted (long version).

Items concerning PA long version (T1)*	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	-0.953	0.794
2	0.212	0.794
3	-0.541	0.821^
4	0.212	0.794
5	0.117	0.796
6	-0.673	0.794
7	0.296	0.793
8	-0.953	0.794
9	0.938	0.743
10	0.953	0.794
11	0.949	0.779
12	-0.852	0.795
13	0.885	0.750
14	0.952	0.793
15	0.938	0.743
16	0.953	0.793
17	0.933	0.735
18	0.598	0.793
19	0.885	0.737
20	0.222	0.794
21	0.998	0.784
22	-0.086	0.794
23	0.974	0.768
24	0.222	0.794
25	0.997	0.743
26	0.224	0.815^
27	-0.137	0.840^

*The number correspond to the items showed in Table 3a-b; ^ Without these items the level of alpha, in according with Fayers and Machin [11], is good.

the language; 71% out of 60 reported the intent of the single question was clear; 10% had doubts about the questionnaire, 11 out of 60 suggested to change the organization and format (for example using check list or short formulation of the items). The questions weren't obtrusive and 6.6% out of 60 declared that there were other activities to consider in the questionnaire: sexual activity and the time spent standing up.

Discussion

The Long version of questionnaire appeared less pleasant and more confusing in comparison with the short one. This is in accordance with Craig and colleagues' 2003 study of validity in 12 countries: more IPAQ countries expressed a qualitative preference for using the short form as they seemed to be more acceptable to both investigators and survey respondents [2]. However, in accordance with Fayers and Machin [11], the alpha of 0.793 was taken to indicate acceptable internal consistency for the long version, but a value of 0.363 is not acceptable for the short form. This strong difference may be due to the short version having 20 items less.

In both versions the items concerning time spent sitting, made Crombach's alpha worse. One possible interpretation is that these questions pertained to an antagonist argument, time spend sitting. Fayers and Machin's interpretation suggest that these items could be discarded, but they are retained important for describing overall PA behaviour.

The referred comments, on short and long versions, in number and content were not very different, though they suggest a slightly better understanding of the short version compared to the long one. Indeed, 98% of respondents declared to have understood this questionnaire versus 83% who were satisfied with the long one, 91% found it clear versuss 71%, 23% had doubts versus 10% and 5.2% reported the presence of defects versus 6.6%.

Regarding validity, a substantial concordance was seen between the two administrations which may have been due to both the short time elapsing between administrations (about one day, one day and half) or to the repetition of administration (not pleasant to many respondents). This is inferred also by the failed increase expected for the second time administration in all questions (Tables 1 and 2). In the long version, the difference found in the question "How much time did you usually spend on one of those days doing vigorous physical activities as part of your work?" can be attributable to the missing presence and to the difficulty of quantifying, in hours and minutes, the time dedicated to this activity or maybe due to a better understanding of the distinction between vigorous and moderate activity in the working environment in the second administration. In the question "How much time did you usually spend on one of those days travelling in a car, bus, train or other kind of motor vehicle?", the time difference reports can probably be ascribed to the information type, easily subject to variability and difficult to remember, compared to the simple request of numbers of days per week.

The utilization of a questionnaire seems be more influenced by time of administration and by the amount of information required: in terms of internal consistency and validity they appear to have different performance.

In the EUPASS study, a big project carried out in eight European countries, the test-retest reliability scores for the IPAQ (short version, last 7 days telephone interview) showed that Spearman's correlation coefficients in general ranged from 0.3 and 0.5, which appears to be rather low for reliability. They concluded that more research was needed to further investigate and improve the quality of IPAQ [12].

About the reproducibility of the IPAQ short version, Kurtze reported that the reliability ranged from good for sitting and vigorous PA, to moderate for walking and to fair for moderate activity [13]. Papathanasiou found that the reliability of the IPAQ short version was high for total and vigorous, and good for moderate and walking activities [14].

In the Chinese version of IPAQ, the test-retest reliability was completed twice with a three-day interval among college students and validity investigated by Caltrac accelerometer. They concluded that both long and short versions had acceptable reliability and validity, compared to other PA instruments [15].

In this study, there were certain limitations that have to be mentioned. The size of the sample may have affected results and it remains necessary to carry out further research to extend the study of IPAQ reliability properties to the general Italian population or other special groups. Moreover, some authors have raised concern that use of the IPAQ may be associated with over-reporting of PA. In one study, 75% of subjects reported less PA with the modified procedure than with the short IPAQ telephone survey [16]. Another study, that evaluated the validity of the IPAQ long form in HIV-infected people, using accelerometry, found a substantial overreporting [17]. It will be interesting for further research to investigate this aspect, administering different questionnaires to the same sample.

In conclusion, according to Craig and al., the short version of IPAQ does not have acceptable consistency but remains feasible to administer and handy to combine with other questionnaires. Instead, a satisfying-good consistency is obtained from the long form and it could be used for research purposes or studies requiring more detail on the separate domains or dimensions of physical activity [2]. Moreover, although some respondents found the long questionnaire difficult to answer, the data are reproducible and can provide reliable estimates for a range of PA domains.

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