

Using different physical activity measurements in eight European countries. Results of the European Physical Activity Surveillance System (EUPASS) time series survey

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Abstract

Objectives: The European Physical Activity Surveillance System (EUPASS) research project compared several physical activity (PA) measures (including the International Physical Activity Questionnaire (IPAQ)) in a time series survey in eight countries of the European Union. The present paper describes first results provided by the different instruments regarding PA participation, frequency and duration, both at the European and national levels. The purpose of the present study is to explore and compare the specific quality and usefulness of different indicators rather than to provide valid and reliable prevalence data. Thus, the main focus is on discussion of the methodological implications of the results presented.

Methods: A time series survey based on computer-aided telephone interviewing (CATI) was carried out in eight European countries over a six-month period. The study provided for about 100 realised interviews per month in each country (i.e. ~600 per country). Descriptive statistical analysis was used to: (1) report IPAQ results on vigorous, moderate and light PA and sitting, as well as on the overall measure of calories expenditure (MET min^{-1}), in the different countries; (2) compare these results with national PA indicators tested in EUPASS; and (3) compare IPAQ results with other European studies.

Results: First, the scores for the different PA categories as well as for the overall measure of calories expenditure provided by the IPAQ appeared rather high compared with previous studies and public health recommendations. Second, the different PA measurements used in EUPASS provided completely different results. For example, national indicators used in Germany and The Netherlands to date neither corresponded in absolute values (e.g. means of PA or sitting) nor correlated with the IPAQ in any significant way. Third, comparing EU countries, the ranking for vigorous, moderate and light activities by use of the IPAQ differed from that of other European studies. For example, in the present analysis, German respondents generally showed higher scores for PA than the Finns and the Dutch, while, in contrast, findings from other studies ranked Finland before The Netherlands and Germany.

Conclusions: The present analysis highlights some methodological implications of the IPAQ instrument. Among other things, differences in overall scores for PA as well as in the ranking of nations between the present results using IPAQ and other measures and studies may partly be due to the concepts of PA behind the measurements. Further analysis should investigate if the range of PA-related categories provided by the IPAQ is fully appropriate to measure all relevant daily activities; it may also consider the public health implications of mixing up different contexts of PA (e.g. work, leisure-time, transportation) in the IPAQ short version.

Keywords
Physical activity
Measurement
Public health
International comparison

In the last two decades, international research has provided plenty of studies to underline the evidence of health effects related to physical activity (PA)^{1–3}. At the same

time, it became increasingly clear that the type, frequency, duration and intensity of PA are major determinants of its health impact. Accordingly, recommendations to guide

the PA of the population from a public health perspective have been developed⁴ and the specific concept of 'health-enhancing PA' was created⁵. Most recently, international efforts have started to concentrate on development of the right instruments to measure 'health-enhancing PA'⁶.

Nevertheless, to date there is a great diversity of health indicators in general and of PA measurements applied in national monitoring activities within the European Union (EU). A recent inventory of PA measures used in the eight countries participating in the EUPASS project, i.e. Belgium, Finland, France, Germany, Italy, The Netherlands, Spain and the UK, revealed that no single key dimension of PA (i.e. type, frequency, duration, intensity) is covered by all of those countries to date. Accordingly, the focus of questions varies considerably between countries even when related to the same dimension. For example, in one survey, frequency questions very much relate to sporting activities while in others the frequency of stair climbing or housework PA is asked for. Also, in most cases, different reference periods are used to report the frequency of PA (e.g. last week, usual week, past 12 months). Moreover, many types of measurement scales (e.g. nominal, ordinal, interval scales) have been applied in the surveys examined⁶.

The International Physical Activity Questionnaire (IPAQ) was developed to overcome this type of diversity. Nevertheless, as the international consensus group who developed this new instrument had to make many decisions regarding the concept of PA, such as its key dimensions, reference period and scales, the IPAQ itself presents a certain perspective of PA investigation. First of all, this perspective includes the investigation of various contexts of PA, i.e. PA at work, for transportation, around the home and during leisure time. In particular, the short (last 7 days) telephone interview version of the IPAQ (IPAQ-S7T), which has been especially recommended for international monitoring purposes, does not differ between the different contexts but integrates aspects from all of them, e.g. when asking for the duration of moderate PA (min week^{-1}). Second, the IPAQ especially focuses on an investigation of total time of PA and caloric expenditure (MET min^{-1}), as these PA indicators were associated with reduced cardiovascular disease incidence and mortality in previous studies and therefore have been applied in public health recommendations for health-enhancing PA⁴. Third, the IPAQ-S7T measures differ between four levels of activity/inactivity, i.e. vigorous PA, moderate PA, walking and sitting.

The main purpose of the present paper is to explore some methodological implications of the perspective of PA investigation covered by the IPAQ instrument. Therefore we present first results of an international survey in eight EU countries using the IPAQ-S7T as well as different PA measures applied in these countries to date. To investigate the specificity of the IPAQ perspective, a comparison is made between IPAQ-S7T outcomes and the results of both

national measures applied in EUPASS and other European studies.

Methods

A time series survey based on computer-aided telephone interviewing (CATI) was carried out in eight European countries over a six-month period. The study provided for about 100 interviews per month in each country (i.e. ~ 600 per country)⁶.

The EUPASS questionnaire included both indicators of PA behaviour from relevant national health surveys and indicators of PA behaviour developed by the IPAQ group⁶.

A major task of the IPAQ measurement is to sum up the single indicators to an overall indicator of PA-related energy expenditure (MET min^{-1}). Ainsworth *et al.*⁷ have recommended energy expenditure estimates assigned to each of the self-reported PA categories (vigorous, moderate, walking and sitting). Regarding the IPAQ-S7T version, the following MET estimates have been applied: vigorous PA = 8 METs, moderate PA = 4 METs, walking on average = 3.3 METs. For calculating the overall MET PA, each activity category was multiplied with its special MET estimate value. Finally, the overall MET PA of the different categories were summed up to the Sum MET PA.

Descriptive statistic measures (mean, standard deviation (SD), median) and correlation analysis (Spearman's correlation coefficients) were applied to describe and compare PA patterns found in the eight EU countries by using different PA measurements.

In addition, as one major goal of developing an international comparable PA measurement is to facilitate international comparisons, the ranking of the eight participating EU countries according to the outcome of the IPAQ-S7T measures in the present study was compared with outcomes of other European studies.

Results

Response rates ranged from 54.5% for Finland and 50.5% for Germany to 29.1% for France and 25.5% for the UK (for details of sample description, see Rzewicki *et al.*⁸). As the actual response rates from some countries were rather low, the results of the following analyses have to be interpreted with caution. However, for the explorative purposes of the study, the current data appeared to be sufficient.

Table 1 shows the mean and SD for each level of PA covered by the IPAQ-S7T. The highest mean for days per week of vigorous PA is reported for Germany (~ 3 days) followed by Finland (~ 2.5 days) and Belgium (~ 2 days); lowest means are reported for Spain and Italy (~ 1 day). Regarding minutes of vigorous PA the ranking is quite similar. Germany ($500.31 \text{ min week}^{-1}$) shows the highest mean followed by Finland (435.49 min

Table 1 IPAQ-S7T: means (SDs) of vigorous and moderate PA, walking and sitting (days, minutes per week) for eight countries in the European Union

Variable	All nations (n = 4995)	Belgium (n = 611)	Finland (n = 603)	France (n = 599)	Germany (n = 653)	Italy (n = 600)	The Netherlands (n = 606)	Spain (n = 600)	United Kingdom (n = 723)
Days vigorous PA	1.79 (2.22)	1.96 (2.31)	2.46 (2.27)	1.88 (2.35)	2.89 (2.47)	1.15 (1.91)	1.42 (2.05)	1.08 (1.65)	1.44 (1.96)
Sum vigorous PA (min)	281.73 (631.15)	333.12 (671.20)	435.49 (689.35)	308.45 (681.66)	500.31 (792.69)	84.63 (265.71)	233.81 (599.29)	197.31 (549.99)	158.25 (354.56)
Days moderate PA	2.76 (2.61)	2.82 (2.62)	2.87 (2.40)	2.22 (2.55)	3.72 (2.66)	2.67 (2.50)	3.57 (2.86)	2.04 (2.23)	2.10 (2.44)
Sum moderate PA (min)	318.74 (115.49)	388.99 (658.04)	405.63 (587.51)	307.43 (645.84)	526.82 (748.93)	191.73 (392.92)	310.50 (544.22)	210.95 (452.92)	203.04 (442.22)
Days walking for at least 10 min	5.72 (1.98)	5.67 (2.02)	5.46 (1.98)	5.77 (2.04)	5.90 (1.90)	5.29 (2.11)	5.99 (1.92)	6.45 (1.33)	5.18 (2.12)
Sum walking (min)	600.31 (878.32)	880.27 (1180.58)	588.67 (786.27)	794.80 (1098.63)	698.36 (986.67)	355.80 (594.01)	697.39 (846.89)	482.94 (613.79)	322.71 (531.68)
Sum sitting (min)	2033.11 (1115.67)	1741.70 (1077.67)	1852.35 (1015.78)	1883.40 (1065.72)	2127.15 (1249.30)	1763.58 (977.17)	2237.43 (1023.44)	2539.68 (1069.59)	2097.30 (1171.93)

IPAQ – International Physical Activity Questionnaire; IPAQ-S7T – short (last 7 days) telephone interview IPAQ; SD – standard deviation; PA – physical activity.

week⁻¹). The lowest mean is reported for Italy (84.63 min week⁻¹).

Turning to days of moderate PA, Germany and The Netherlands show the highest means (~3.5 days week⁻¹). The lowest mean is shown for Spain (2.04 days week⁻¹).

Regarding minutes of moderate PA, the Germans are moderately active for 526.82 min week⁻¹ on average, followed by the Finns (405.63 min week⁻¹) and the Belgians (388.99 min week⁻¹); Italians show the lowest mean of moderate activity (191.73 min week⁻¹).

For days of walking, the Spanish mean is the highest (~6.5 days week⁻¹). The Dutch are walking for ~6 days week⁻¹, followed by the Germans. UK participants walk less on average (5.18 days week⁻¹). For minutes of walking the ranking is quite different. Belgians walk on average 880.27 min week⁻¹ followed by the Germans and the Dutch. Least walking duration is reported for the UK.

Spanish participants show the highest mean in the sitting category. They are sitting on average for 2540 min during the week and at the weekend. The lowest mean for sitting is reported for Belgium (~1740 min). It is interesting to note that Italians, generally the least physically active group in this study, show the second lowest mean for sitting as well.

Table 2 shows means, SDs and medians for Sum MET PA. The highest mean is reported for Germany (8534 METs) followed by Belgium (~7100 METs) and Finland (~7000 METs). The lowest mean is shown for Italy (2617.33 METs) followed at a distance by the UK. Turning to the medians, 50% of all respondents reported 2970 METs and more per week. The highest median is shown for the Germans (5070 METs) followed by the Finnish; the lowest is reported for Italy followed by the UK.

Due to the diversity of current PA measurements applied in the different EU countries, any comparison of results provided by the different instruments appears to be extremely difficult if not impossible. Moreover, although the IPAQ was developed to overcome current divergencies in PA measurement, the instrument itself represents a new approach that is again different from other measures; thus making it difficult to compare IPAQ results with others as well.

Regarding the national indicators used in the EUPASS study, only very few items showed enough similarity with the IPAQ. Finally, two questions, one from the German health survey and one from the Dutch, were selected for the purpose of such a comparison. In the German case, the question focuses on time on average spent per day on vigorous, moderate and light PA and on sitting; in the Dutch case, frequency and duration of PA within the last 14 days are asked for.

For comparison, means (reported for the different IPAQ-S7T PA categories as well as for the German and the Dutch national items) have been recalculated (min day⁻¹).

Table 3 presents results of the comparison between IPAQ-S7T and the German national questionnaire and

Table 2 IPAQ-S7T: means, SDs and medians of caloric expenditure (MET) per week for eight countries in the European Union

	Sum MET PA								
	All nations (<i>n</i> = 4995)	Belgium (<i>n</i> = 611)	Finland (<i>n</i> = 603)	France (<i>n</i> = 599)	Germany (<i>n</i> = 653)	Italy (<i>n</i> = 600)	The Netherlands (<i>n</i> = 606)	Spain (<i>n</i> = 600)	United Kingdom (<i>n</i> = 723)
Mean	5605.94	7105.80	6999.52	6686.05	8534.21	2617.33	5543.95	4175.91	3238.31
(SD)	(7332.54)	(8475.00)	(7610.44)	(8376.14)	(9024.51)	(4363.71)	(6931.69)	(5665.65)	(4524.17)
Median	2970.00	4021.00	4212.00	3826.00	5070.00	1173.00	3384.75	2359.50	1653.00

IPAQ – International Physical Activity Questionnaire; IPAQ-S7T – short (last 7 days) telephone interview IPAQ; SD – standard deviation; PA – physical activity.

between IPAQ-S7T and the Dutch national questionnaire. The scores for the different PA categories provided by both the German national item and IPAQ-S7T items in Germany are rather high e.g. compared with the Dutch result. For example, the median for minutes of moderate PA in the IPAQ-S7T questions in Germany is 30 min day⁻¹ and the median of vigorous PA is 26 min day⁻¹. Considering the German national PA indicator, the median for moderate PA is 150 min day⁻¹ and even for vigorous PA is up to 60 min day⁻¹ (Table 3).

Moreover, it should be emphasised that the lowest mean and median for min day⁻¹ are shown for the Dutch national indicator (Table 3), i.e. for the most general question (average of PA for the past 14 days). On the other hand, the highest mean and median are reported for the German national indicator, which at the same time is the most differentiated instrument, e.g. asking for a complete report of 24 hours divided into the four categories of activity/inactivity mentioned before plus sleeping/resting.

The comparability between PA measurements used in national health monitoring of EU countries to date and the IPAQ-S7T has already been discussed in another EUPASS paper⁶. However, in the present context it appears to be especially interesting to investigate how far items that focus on quite similar issues (e.g. measuring duration of PA at different levels) correlate. The decision to use Spearman's rank correlation (ρ) was based on the fact that the data were not normally distributed. For Germany, only one correlation between the moderate PA item of the national questionnaire and the vigorous PA item of the IPAQ-S7T was rather low and not significant ($\rho = 0.097$,

$P < 0.10$). All other coefficients were very low and not significant ($\rho = -0.046$ to 0.035). In the Dutch case no significant correlation between the national item and the IPAQ-S7T was found as well ($\rho = 0.021$).

Table 4 presents results of a comparison between the nations' ranking from three studies, i.e. EUPASS, MAREPS (a European study on health policy and health behaviour including PA⁹) and the pan-EU study on consumer attitudes which also included questions on PA¹⁰.

Table 4 shows the ranking of PA participation rates for each nation. Finland comes first in all three studies followed by The Netherlands in the MAREPS and pan-EU study, but followed by Germany in the EUPASS study. The lowest rank is presented by Spain in the EUPASS and MAREPS studies and by Belgium in the pan-EU study.

Regarding duration of PA, Germany has the highest rank in the EUPASS study but is only fourth in the pan-EU study. Belgium comes second in the EUPASS and eighth in the pan-EU study.

Turning to vigorous PA, in the EUPASS study German respondents show higher scores than the Finns and the Dutch, while, in contrast, findings from the MAREPS study ranked Belgium before the Spanish and the Dutch.

For moderate PA, Germany is again ranked highest in the EUPASS study followed by the Finns and the Belgians. In the MAREPS study the results are quite different: the Finns come first followed by the Germans and the Belgians. Spain presents low ranks in both studies.

Turning to light PA, the EUPASS study shows the highest scores for Belgium followed by France and Germany. In MAREPS the Finns comes first followed by the Dutch and

Table 3 Means, SDs and medians of vigorous and moderate PA, walking and sitting for selected variables of German and Dutch national PA questionnaires and IPAQ-S7T (min day⁻¹)

Variable	National questionnaire			IPAQ-S7T		
	Mean	SD	Median	Mean	SD	Median
German						
Vigorous PA (min day ⁻¹)	124.13	180.15	60.00	71.47	113.24	25.71
Moderate PA (min day ⁻¹)	170.28	125.46	150.00	75.26	107.00	30.00
Light PA/walking (IPAQ) (min day ⁻¹)	268.18	143.41	240.00	99.77	140.95	45.00
Dutch						
PA (min day ⁻¹)	23.00	47.97	4.29	25.30	26.63	17.76

SD – standard deviation; PA – physical activity; IPAQ – International Physical Activity Questionnaire; IPAQ-S7T – short (last 7 days) telephone interview IPAQ.

Table 4 Comparison of three European studies: ranking of nations for PA participation, duration and different levels of intensity (vigorous, moderate, light) (– indicates that question or nation is not included in the study)

Variable	Belgium			Finland			France			Germany			Italy			The Netherlands			Spain			United Kingdom		
	E	M	C	E	M	C	E	M	C	E	M	C	E	M	C	E	M	C	E	M	C	E	M	C
Participation	7	4	8	1	1	1	5	–	5	2	3	4	4	–	7	3	2	2	8	5	6	6	–	3
Duration	2	–	8	3	–	1	4	–	5	1	–	4	8	–	7	5	–	2	6	–	6	7	–	3
Vigorous PA	3	1	–	2	5	–	4	–	–	1	4	–	8	–	–	5	3	–	6	2	–	7	–	–
Moderate PA	3	5	–	2	1	–	4	–	–	1	2	–	8	–	–	4	3	–	7	4	–	7	–	–
Light PA	1	4	–	5	1	–	2	–	–	3	3	–	7	–	–	4	2	–	6	5	–	8	–	–

PA – physical activity; E – European Physical Activity Surveillance System (EUPASS) study (eight countries included); M – MAREPS study (five EUPASS countries included); C – European consumer attitudes study (all eight EUPASS countries included).

the Germans. Low ranks are shown for Spain in both studies.

Discussion

The means and medians for vigorous PA, moderate PA and walking provided by the IPAQ-S7T in the present study are rather high compared with current public health recommendations. For example, the mean for moderate PA for all nations is more than 300 min week⁻¹ and the median for calories expenditure is about 3000 kcal week⁻¹. With regard to international public health recommendations, which e.g. aim at increasing PA in the general population up to 150–180 min week⁻¹ or about 1000–1400 kcal week⁻¹, most participants of the present study would already meet these recommendations. Other studies that used the IPAQ for reliability and validity studies seem to confirm this result. Thus, previous concepts and recommendations, which had a primary focus on leisure-time PA and sport, should be reconsidered against the background of the new integrated approach of IPAQ which also includes various other forms of PA such as PA for transportation and work around the home.

The German national question about how much time on average is spent on PA per day (including a 24-hour framework to fill in) provided even higher scores than the IPAQ-S7T tested in the same questionnaire. This may indicate again that a still more differentiated approach considering all daily activities under this perspective may increase the overall scores of duration of PA and caloric expenditures related to it. Correspondingly, the more general Dutch question on average PA in the past 14 days provide for the lowest scores in this comparison.

Another issue that arises in this context refers to the PA categories covered by the IPAQ-S7T, i.e. vigorous and moderate PA, walking and sitting. In particular, the Italian results, which in a comparison of the eight EU countries were almost the lowest in all PA categories and the same time showed the second lowest scores for sitting, may indicate that Italian participants assign significantly less of their daily activities to the different categories offered by

the IPAQ. Further analysis will investigate if Italian respondents just would score higher in an additional category such as 'sleeping, resting' or if specific cultural differences in interpreting the questions are involved here.

Conclusions

Of course, the limitations of the present study have to be considered before interpreting the results. Nevertheless, even if the samples provided for the different EU countries are not fully representative for the whole population, they are fairly appropriate for exploring the specificity of the different PA measurements used in the EUPASS project. In particular, this study helps to understand some methodological implications of the IPAQ instrument. For example, the differences in overall scores for PA, as well as in the ranking of nations between the present results using IPAQ and other measures and studies, may be related to the methodological concepts of measuring PA behind the instruments. While many extant measurement methods focus mainly on leisure-time PA, the IPAQ explicitly integrates PA at work, around the home and for transportation. Among other things, this methodological shift may explain some of the differences found in this analysis. At least two major research questions are highlighted by the present results. First, further investigation is needed to find out if the range of PA-related categories provided by the IPAQ (from vigorous PA to sitting) is fully appropriate to measure all relevant daily activities. The Italian results (lowest in PA and in sitting) may refer to specific cultural differences in the perception of PA and/or the IPAQ, which should be considered by elaborating an internationally comparable PA indicator. Second, further analysis should investigate the public health implications of mixing up different contexts of PA (e.g. work, leisure-time, transportation) in the IPAQ short version. For example, the same amount of calories expenditure of PA at the workplace and of leisure-time PA may have significantly different health effects. Thus, an additional question on context as used in the present study may be helpful to complement the recommended short IPAQ instrument.

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