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NUMBER OF STEPS PER DAY AND PHYSICAL ACTIVITY LEVELS OF ADULTS IN GREECE

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Abstract

This study compared self reported physical activity (PA) (MET min/week) with pedometer determined PA (steps/day). Participants in this study were 300 adults, (25 - 56 years of age). PA was assessed with the IPAQ long form and the number of steps was assessed with the Yamax model SW-200. Participants wore the pedometer for 7 consecutive days. Data (categorical score) was analyzed using cross-tabs analysis. Two-way ANOVA (gender 2 x level of PA 3) was performed on the number of steps/day. Significant main effect was reported only for the factor "level of PA" with adults in the moderate and the high activity group performing more steps/day than adults in the low PA group. Adults in Greece performed less steps/day than the international recommendations PA suggest even though the majority of them were assigned by IPAQ long form at the moderate and very high PA groups.

Keywords: physical activity recommendations, pedometer, self report

Introduction

The importance of physical activity (PA) in maintaining improved quality of life (USDHHS, 1996), increased longevity (Lee, & Paffenbarger, 2000; Lee, & Skerrett 2001) and a number of health benefits is well recognized (Blair, Cheng, & Holder, 2001; Morris, Clayton, Everitt, Semmence, & Burgess, 1990; Thune, Njolstad, Lochen & Forde, 1998).

The effects of PA on health can be mediated by changes in fitness, but the relationships among levels of physical activity and health are complex. Lifestyle behaviors physical and social environmental conditions, personal attributes and genetic characteristics can also determine their interrelations (Bouchard, Blair and Haskell, 2006).

Even though the precise amount and type of PA required to achieve specific health related outcomes remains unclear (Haskell, 1994; Freedson, & Miller, 2000), recommendations regarding the types and amounts of physical activity /exercise needed for health and fitness improvement have been suggested by different organizations for different population groups

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(ACSM, 1975, 1978; AHA 1975; USDHHS, 1996; ACSM/AHA 2007). These recommendations for health enhancing physical activity/exercise included information on the frequency, intensity and duration of either exercise or physical activity for the general population and segments of it.

The American College of Sports Medicine originally in 1975 recommended to sedentary adults exercising 3 days per week, for 15-60 min with 60-90% max heart rate and AHA suggested exercising 3-4 times per week for 20-60 min with 70-80 % max heart rate The ACSM and the USDHHS/CDC recommendation was later issued suggesting exercising 3-5 times per week with 40 - 85 % Vo_2max, recommending that every US adults should accumulate 30 min or more of moderate intensity physical activity on most preferably all days of the week (Pate, Pratt, Blair, Haskell, Macera, Bouchard, & King, 1995).

An alternative guideline traced back to Japanese walking clubs recommends the accumulation of 10.000 steps per day for healthy adults (Tudor-Lock, & Bassett, 2004). Additionally indices to classify pedometer determined physical activity suggest that <5000 steps per day is indicative of sedentary lifestyle, 5000-7499 steps/day is considered as low active since it is typical of daily activity excluding sports/exercise, 7500 steps per day might be considered as "somewhat active" since it likely includes some volitional activities , $\geq$ 10.000 steps per day indicates "active" individuals and finally individuals who take >12.000 steps per day are likely to be characterized as "highly active".

With the greater emphasis on the relationship of PA to health, there is an emerging need for accurate and reliable methods of estimating and assessing PA and energy expenditure, (Sallis, & Saelens, 2000). Questionnaires (self report instruments, daily logs and diaries) have always been a very popular approach in assessing PA in large population samples. IPAQ (Craig, Marshall, Sjöström, Bauman, Booth, Ainsworth, Pratt, Ekelund, Yngve, Sallis, & Oja, 2003) is a self-reported measure of physical activity suitable for assessing population levels of physical activity across countries. It has been used with confidence in developed countries or in urban samples in developing countries, but with some caution in rural or low literacy samples from developing countries. The primary target group for IPAQ was middle-aged adults and IPAQ measurement properties in older adults or adolescents are not known (Craig et al. 2003). This self report questionnaire provides both a continuous MET min/week score and a categorical according to which participants are assigned to 3 levels of PA: high, moderate and low. According to the IPAQ Research Committee the high PA level equates to approximately at least one hour per day or more, of at least moderate intensity activity above the basal level of PA and can be considered for as those who move at least 12,000 steps per day or the equivalent in moderate and vigorous activities. The moderate level of PA equates to "half and hour of at least moderate intensity PA on most days" and the low level of PA is the lowest level of PA and individuals who do not meet the criteria for the other two categories are assigned to this category.

Walking, is one of the most common forms of activity for US adults (Crespo, Keteyian, Heath & Stempos, 1996) and Canadians (CFLRI, 2004) and is readily captured by a pedometer. Public health initiatives in these countries have emphasized this activity (Pate et al. 1995; USHHS ,1996; CFLRI, 2004) since walking has been associated with lower risk of CHD (Manson, Nathan, Krolewski, Stampfer, Willett, & Hennekens, 1992) and coronary events (Hakim, Curb, Pertovitch, Rodrigez, Yano, Ross, White, & Abott, 1999). Pedometers have been useful for examining questions about walking and in particular distance covered on physical activity questionnaires (Bassett, Cureton, & Ainsworth, 2000). Pedometers are a type of motion sensor that are low-cost, unobtrusive, accurate (Basset et al., 1996; Crouter et al., 2003; Schneider et al., 2003), and their output (steps or distance) is easily comprehendible and thus are becoming increasingly popular in physical activity research and within the general population (Bassett, Cureton, & Ainsworth, 2000). Pedometers are typically worn on the belt or waistband and respond to vertical accelerations of the hip during gait cycles. They provide data on steps and some models estimate distance traveled and energy expenditure. Although pedometers measure

ambulatory activity, they do not capture all types of physical activity (swimming, weight lifting, bicycling, etc.).

They can also be used to distinguish between individuals whose physical activity level varies based on steps per day, to determine whether individuals meet step recommendations, to measure changes in physical activity with interventions, and address several other issues in physical activity research and applications. According to recent studies pedometer determined steps per day activity classifications have been proposed: _5000 sedentary, 5000–7499 inactive, 7500–9999 somewhat active and 10,000 active (Tudor-Locke, & Bassett, 2004).

According to the IPAQ scoring protocol – categorical score, the above recommendations are met by those that are included in the levels of moderate PA and high PA and not by those in the low PA level. It is unclear though whether these two recommendations are congruent or whether "10.000 total steps per day" is more than 30 min of moderate-intensity physical activity. It is also unclear if the individuals that are assigned to the 2 top levels of PA with the use of IPAQ – long form meet the cut-point of 10.000 steps per day. The aim of the present study was to determine the number of steps per day taken by adults in Greece assigned in the different PA levels that have been proposed by IPAQ and possible gender effects on the participants' level of PA.

Method

Participants

Participants in this study were 300 adults 150 men (44.5 $\pm$ 8.3 years of age) and 150 women (34.9 $\pm$ 7.5 years of age). They were requited through a posted advertising campaign that was initiated by the Municipal Center for Recreation in 3 Greek urban centers. Before taking part in this study participants were informed about the purpose and the content of this study and signed an informed consent form approved by the Dept of PESS, University of Thace's review board. Physical and demographic characteristics of the participants are presented in Table 1.

Instruments and Procedure

Questionnaire estimated physical activity

Physical activity was assessed with the use of the long self – administered version of the International Physical Activity Questionnaire (Craig et al. 2003). This long version (31 items) was designed to collect detailed information within the domains of household and yard work activities, occupational activity, self-powered transport, and leisure-time physical activity as well as sedentary activity. The data collected were summed in order to estimate the total time spent in vigorous physical activity, moderate intensity physical activity and walking. The total weekly PA was estimated as a continuous variable by weighting the reported minutes per week within each activity category by a MET energy expenditure estimate assigned to each category of activity. MET levels were obtained from the 2000 Compendium of physical activities to include walking (3.3 MET), moderate-intensity activities (4 MET) and vigorous-intensity activities (8 MET). Cut points were also used in order to create a categorical variable according to which PA can be characterized as high, moredate and low (IPAQ Scoring protocol, 2005).

Pedometer estimated physical activity

The pedometer used in this study was the Yamax model SW- 200, Yamax Corporation, Tokyo, Japan. This brand detects steps taken acceptably under both controlled conditions (Crouter, Schneider, Karabulut, & Bassett, 2003; Schneider, Crouter, Lukajic & Bassett, 2003; Le

Masurier, & Tudor-Locke, 2003) and free-living conditions (Schneider et al. 2003). Additionally as an electronic pedometer it has greater accuracy than old-fashioned mechanical pedometers (Basset, Ainsworth, Leffett, Mathien, Main, Hunter, & Duncan, 1996). Participants were instructed how to use the pedometer for the following 7 days (remove the pedometer only while bathing, showering, or swimming) starting the morning of following day of the meeting. When 7 24-hour days had elapsed the participants were asked to record their 7 days-end steps taken on the provided log and also report it by phone to the researcher. On the 8th day a meeting with the researcher was scheduled in order for the participants to complete the IPAQ – long form questionnaire, return the pedometer kit and collect data related to height and weight to compute body mass index (BMI) as kg/m^2.

Analysis of data

All statistical analyses were performed using SPSS (Statistical Packege for the Social Sciences for Windows, 14.0, 2006, SPSS Inc., Chicago IL). Descriptive data are presented as frequencies, means and standard deviations. Cross-tabs analysis was used in order to assess the effect of gender of the level of physical activity (categorical score). Two way analysis of variance was used in order to determine the effect of gender (2) x level of physical activity (3) on the dependent variable "number of steps/day". Post hoc analysis was performed using the LSD test. Pearson correlation coefficient was calculated for the variables of total physical activity (MET min/week) score, moderate physical activity (MET min/week) score, walking (MET min/week) score and steps/day. The level of significance was set at p = .05.

Results

Physical characteristics and physical activity data in MET values of the participants according to gender and PA level are presented in Table 1.

Table 1

Physical characteristics and physical activity levels of the male and female participants according to their level of physical activity

M (SD)		***Low PA***	***Moderate PA***	***High PA***	***Total***
Women	(N)	41	38	71	150
	PA –MET score	924 (482)	2.318 (483)	6.562 (3.155)	4.830 (3.490)
	Age (years)	47.9 (7.2)	45.6 (8.4)	43.9 (6.2)	45.8
	BMI	22,73	22,28	22,33	22,38
Men	(N)	31	21	98	150
	PA –MET score	856 (562)	1.981(536)	9.654 (7.653)	5490 (4.313)
	Age (years)	44.2 (5.1)	42.7 (3.3)	45.8 (7.5)	44.5 (8.3)
	BMI	26,5 (4,6)	26,11 (3,3)	25,91 (3,2)	26,06 (3,05)

Gender effects on physical activity –self report measure

Categorical MET Score

According to the results of cross-tabs analysis, chi-square was not statistically significant (x^2=1.30, p>.05) and physical activity level was independent to the factor gender. No differences were reported between the number of male and female participants that were assigned to the 3 different levels of PA according to IPAQ categorical score.

Continuous MET Score

According to the results of the analysis of variance no significant effect for the factor gender ($F_{(1,298)}$ = 1,762, p = .185), was revealed for the total MET score (Table 1). Additionally MANOVA revealed a significant effect for the factor "gender" only on physical activity of high intensity ($F_{(1,298)}$ = 4,793, p = .029) where men had significantly higher scores than women. No gender effects were reported for physical activity of moderate intensity ($F_{(2,298)}$ = 3,064, p = .081), and on walking ($F_{(2,298)}$ = 2,165, p = .142) (Table 2).

Table 2

Physical activity (MET min/week) of high moderate intensity and walking for men and women participated in the study

	High Intensity PA* M (SD)	Moderate Intensity PA	Walking	Total Score
Women	1.825 (2.418)	1.616 (1.477)	1.389 (1.314)	4.831 (4.993)
Men	2.553 (3.272)	1.315 (1.493)	1.622 (1.426)	5.491 (3.490)

*PA = physical activity

Number of steps

According the results of two- way ANOVA no significant interaction was revealed for the factors "gender" and "level of physical activity" ($F_{(2,294)}$ = ,234, p > .792) on the number of steps/day taken. A significant main effect was reported only for the factor "level of physical activity" ($F_{(2,294)}$ = 53,168, p = .000) but not for the factor "gender" ($F_{(1,294)}$ = 1,801, p = .181). Post hoc LSD test revealed significant differences between all three levels of the factor "level of physical activity (p<001), (Table 3).

Table 3

Number of steps per day according to the gender and level of physical activity (PA) set by IPAQ for all the participants in this study

	Low Physical Activity	Moderate Physical Activity	High PA	Total
Women (n)	41	38	71	150
	5183 (1092)	6430 (2302)	8844 (2456)**	7783 (2692)
Men (n)	31	21	98	150
	5309 (2379)	7206(2523)	9324 (3267)*,**	7906 (3339)
Total	72	59	169	300
	5256 (1929)	6867 (2853)*	9061(2853)*,**	7845 (3029)

*= differences with low physical activity group

** = difference with moderate physical activity group

Additionally according to Pearson correlation (r) the number of steps/day was significantly correlated with total physical activity score (r = .50, p = .01) Correlations for men and women between number of steps and total physical activity score, high intensity physical activity, moderate intensity physical activity and walking are presented in Table 4.

Table 4

Correlation of steps per day and physical activity assessed with IPAQ-long form for all the participants in this study

	Steps per day	Walking PA	Moderate Intensity PA	Vigorous PA
Walking PA	.40*			
Moderate Intensity PA	.27*	.27*		
Vigorous PA	.41*	.26*	.34*	
Total PA score	.50*	.59*	.66*	.87*

*p <.01

Discussion

According to the results of this study the majority of the participants (76%) were physically active enough since following the categorical scoring system of the IPAQ long form they were assigned to the moderate and the high PA groups. Additionally the adult men and women in this study, who were moderately and highly physically active again according to IPAQ categorical scoring system, performed significantly more steps per day when compared to adults who were assigned in the low physical level. Further more significant differences in the number of steps/day were also recorded between adults who were moderately and those who were highly active.

In further detail, in relation to gender, male participants who were assigned as highly active performed significantly more steps/day than the other two male groups (low PA and moderate PA) and the moderately active males performed more steps/day than the low activity group. As for female participants, significant differences were reported between the low physical activity group and the highly active women and between the moderately active group without though reporting significant differences between women who were assigned in the low and moderate activity group.

All the above results support the use of the IPAQ long form as a self report instrument used by adults, in assessing PA level. By interpreting these results a rather positive conclusion can be formed concerning the overall PA level of the participants since only 24% had a low PA level that is likely to translate into unfavorable health outcomes whereas the converse would be true for participants in the moderate and high level of PA" (Bouchard, et al. 2006).

This finding of health ensuring physical activity level for the majority of the Greek adults is unfortunately being contradicted by those of recent studies performed in Greece and in other European countries according to which a smaller percentage of Greek adults is active enough to ensure health related benefits (Makavelou, Michalopoulou, Makavelou, Ifantidou, Kourtesis, & Zetou, 2005; Varo, Martinez-Gonzalez, de Irala-Estevez, Kearney, Gibner, & Martinez, 2003). According to the recently published Euro barometer Report (2010), 67% of the Greek responders replayed "never" to the question "How often do you exercise or play sport".

Additionally the number of daily steps that were recorded for the two groups of participants in the high PA and the moderate PA groups that are supposed according to IPAQ scoring protocol to meet the 30 min ($^{-1}$day) recommendations for health enhancing PA, are lower from what has been suggested by the literature (Tudor-Locke, & Bassett, 2004). In more detail if the participants' compliance with pedometer determined recommendations, in this study, was to be based upon the number of steps they performed daily, the results would differ significantly

from the ones that became available with the use of IPAQ long form. Using the cut points in daily step counts suggested by Tudor-Locke, & Bassett (2004), both participants in low and the moderate PA groups would be characterized as " inactive" since their mean daily step counts were within the 5000-7499 range, (5309 and 6867 steps/day respectively). Previous studies have presented contradicting results according to which, adults in Australia who achieve current PA guidelines also achieve 10.000 steps/day (Mc Cormak, Giles-Cort, & Milligan, 2006) and on the other hand self report adherence estimates in a representative sample in US adults, were much higher that those measured by accelerometer, (Troiano, Berrigan, Dodd, Masse, Tilert, & McDowell, 2008).

The use of PA recommendations may be closer to the findings of this study if we consider that 8,000 steps day(-1) might be a more valid screening tool as a proxy for classifying those meeting public health physical activity recommendations of 30 min·day(-1) of moderate activity as suggested by previous studies (Macfarlane, Chan, Chan, Ho, & Lee, 2008; Tudor-Locke, Ainsworth, Thomson, & Matthews, 2002). Additionally, the use of IPAQ long form, a self-report instrument that categorizes participants' PA by level of exertion (light, moderate, vigorous) and a direct method (pedometer), results in increased differences between the mean percent of the higher category levels of intensity (Prince, Adamo, Hamel, Hardt, Gober, & Trambley, 2008).

In conclusion, due to limited convergent validity between the two instruments (Macfarlane, Lee, Ho, Chan, & Chan, 2006) these measures are measuring different levels of habitual PA and care is needed when comparing their results in particular since both instruments address PA recommendations that are being used in lifestyle PA interventions in different population and in determining relationships between PA and health outcomes (Kahn, Ramsey, Brownson, Howze, Powell, Stone, Rajab, & Corso, 2002; Prince et al. 2008).

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