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ORIGINAL

Different physical activity guidelines and its association with socio-demographic and anthropometric characteristics among working women

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Sema Can[1 ABEF], Erşan Arslan[2 ADEF] Elżbieta Biernat[3 CDE] Monika Piątkowska[4 CE]

[1] Faculty of Sport Sciences, Hitit University, Çorum, Turkey
[2] Physical Education and Sports School, Siirt University, Siirt, Turkey
[3] Department of Tourism, Collegium of World Economy, Warsaw School of Economics, Warsaw, Poland
[4] Department of Organization and History of Sport, Józef Piłsudski University of Physical Education in Warsaw, Poland

abstract

Background Physical activity, supporting health, wellbeing and working ability, is not only vitally important for healthy people, but also necessary for workers, especially women. This study aims to evaluate the relationship between meeting different physical activity guidelines and socio-demographic and anthropometric characteristics in middle-aged females from Turkey.

Material/Methods Physical activity was assessed using the Sense Wear Armband. Logistic regression was used to determine the relationship between socio-demographic and anthropometric criteria and the odds of meeting different physical activity guidelines.

Results All females achieved ≥ 150 min/week of moderate-to-vigorous physical activity. With regard to vigorous physical activity, only 5% of women achieved ≥ 75 min/week. Among all studied socio-demographic and anthropometric characteristics only the waist-to-hip rate and income differentiated odds for meeting the World Health Organization criterion.

Conclusions Different percentages of subjects fulfill the pro-health criteria depending on the norm considered. We do need to identify the best criteria of PA to meet adequate health. It is crucial to take into account time, frequency and intensity of aerobic efforts but also in relation to energy expenditure related to resistance (anaerobic) and flexibility efforts while formulating physical activity guidelines.

Key words physical activity guidelines, objective monitoring, female

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Corresponding author: Assistant professor Sema Can (Ph.D), Hitit University, Faculty of Sport Sciences, Çorum – TURKEY; phone: +90 364 2277923; fax number: +903642277921; e-mail: semacan@yandex.com; semacan@hitit.edu.tr

INTRODUCTION

Regular physical activity (PA) can be beneficial in preventing numerous major chronic diseases, thereby, reducing the risk of all-cause mortality and improving health [1, 2]. Various PA guidelines have been published over the past few decades [3]. In 2000, it was recommended that European adults should do at least 30 min a day of moderate-intensity activity for health according to the Health-Enhancing Physical Activity (HEPA) guidelines [4]. The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) were more precise and emphasized that "all healthy adults need moderate-intensity aerobic activity for a minimum of 30 min on five days a week or vigorous-intensity aerobic activity for a minimum of 20 min on 3 days a week" [5]. The latest American guidelines by the US Department of Health and Human Services (USDHHS) [6], which are in compliance with the World Health Organization (WHO) norms, state that adults should exercise for at least 150 min of moderate-intensity or 75 min of vigorous intensity aerobic activity or an equivalent combination of this intensity in each week [7]. Among more objectively measured PA a volume of 10,000 steps/day is important to produce positive changes in lifestyle (regular PA boosts mental wellness as it can relieve tension, anxiety, depression and anger) and certain aspects of fitness and cardiovascular health [8].

However, this volume of PA may be insufficient to prevent age-related weight gain [8]. The consensus at present is that the prevention of weight gain in both developed and undeveloped countries is associated with the physical activity level (PAL – the ratio of total energy expenditure to 24 hr basal energy expenditure) of about 1.7 [9] to 1.8 [10]. On average a PAL of 1.75 [11], which is equivalent to about 60 to 90 min of daily leisure-time physical activity, is recommended.

Numerous studies have examined whether adults meet a specific guideline [12] but few have compared the compliance with several PA guidelines within the same sample [13]. In addition, levels and patterns of PA may vary as a function of gender, age, educational level, socio-economic status, marital status [3]. The purpose of the present study was to assess the factors that affect PA and to examine the relationship between meeting the guidelines of objectively measured PA: (1) 150 min/week MVPA: a weekly total of ≥ 150 min MVPA in 10-min bouts; (2) 75 min/week VPA: a weekly total of ≥ 75 min vigorous activity in 10-min bouts [7]; (3) PAL 1.75: a weekly average PAL of ≥ 1.75 [11]; (4) 7 × 10,000 steps/week: 7 days with ≥ 10,000 steps/day [8] and socio-demographic and anthropometric characteristics in middle-aged high educated premenopausal sedentary Turkish women.

MATERIALS AND METHODS

120 women with at least a bachelor's degree who work at the Ministry of Health or Hitit University participated in this study. The exclusion criteria of the subjects were (1) subjects who were in the menopausal process (n = 2); (2) subjects who did not have valid Sense Wear Armband data for seven consecutive days (a valid day was considered a day with at least 1368 min of data, after imputation of known activities, which corresponds to 95% of a 24-hour period); (n = 5); (3) subjects who had chronic or acute health conditions and pregnancy, which might affect an ability to engage in PA (n = 2). The

final sample consisted of 111 premenopausal women between 20–49 years old. The acceptance rate of subjects meeting sampling criteria consenting to participate in the study amounted to 92.5%. The descriptive statistics of the socio-demographic and anthropometric characteristics of participants among all age groups are shown in Table 1.

Study protocols were approved by the Research Ethics Committee of Ankara University, Turkey, and were conducted in a manner consistent with the institutional ethical requirements for human experimentation in accordance with the Declaration of Helsinki. All participants were notified of the research procedures, requirements, benefits, and risks before giving informed written consent.

Table 1. Descriptive statistics for the participants

Factors		Females (n = 111)	
		n	%
Age	20–29 years old	36	32.4
	30–39 years old	46	41.4
	40–49 years old	29	26.1
Education level	Bachelor's degree	57	51.4
	Master's degree	27	24.3
	Doctorate degree	27	24.3
Average monthly per capita income	< 2,499 TL	10	9.0
	2,500–3,499 TL	75	67.6
	≥ 3,500 TL	26	23.4
Marital status	Single	47	42.3
	Married	64	57.7
Smoking status	Smokers	38	34.2
	Non-smokers	73	65.8
Car Possession	Yes	50	45.0
	No	61	55.0
Anthropometric measurements (mean±SD)	Height (cm)	159.1 ±11.2	
	Weight (cm)	61.8 ±7.4	
	BMI (kg/m^2)	24.3 ±2.8	
	WHR	0.8 ±0.06	
Physical activity (mean±SD)	Time spent in MVPA (min/day)	81.7 ±23.0	
	Time spent in VPA (min/day)	3.9 ±2.9	
	Steps (number/day)	9.867 ±1.756	
	Physical activity level (PAL)	1.6 ±0.2	

BMI: body mass index; WHR: Waist–Hip ratio; MVPA: moderate-to-vigorous physical activity; VPA: vigorous physical activity. Currency conversion: 1.00 EUR = 3.04 TL (Turkish Lira).

The study was conducted between 2012–2015 (spring and summer months). The data collection was conducted over a week period for each participant beginning with the survey consisting of general sociodemographic questions and anthropometric measurements (Table 1) performed by the same researchers after an overnight fast at a similar time of the day between 8:00 and 12:00 a.m. in order to have similar chronobiological characteristics [14]. The participants were weighed while wearing light clothes and without shoes. The weight was determined within 0.1 kg for each subject using an electronic scale calibrated before each measurement session. The height was determined using a fixed wall-scale measuring device to the nearest 0.1 cm. The body mass index (BMI) was calculated as weight in kg divided by height in meters squared (kg/m^2). The waist-to-hip ratio (WHR) was calculated. Standardized

testing procedures were followed as defined in the ACSM guidelines [15]. All participants were asked not to make any changes to their typical daily work and leisure time routines during the monitoring week. In attempt to avoid a possible Hawthorne effect, subjects knew that they participated in a PA study and were monitored for their activity.

Participants were instructed to wear a SenseWear Pro 3 Armband (BodyMedia, Inc., Pittsburgh, PA, USA) 24 hours a day except during water-based activities, for seven consecutive days [16]. Data from these sensors are combined in a proprietary manner with gender, age, dominant arm, body weight and height, and smoking habits to estimate energy expenditure, PA intensity and the number of steps, using algorithms developed by the manufacturer (Sense Wear Professional software, version 8.0). A valid day was considered a day with at least 1368 min of data, after imputation of known activities, which corresponds to 95% of a 24-hour period in this study. Energy expenditure, METs (metabolic equivalents expressed as kcal/kg/min) values and steps were computed in 1-min intervals according to the manufacturer's algorithms. PAL (average daily METs) and energy expenditure (total kcal per day) were the indicators of the daily expenditure of energy. Physical activity level (PAL, expressed in MET) is an indicator of total energy expenditure, calculated as the average of SenseWear METs over the entire week. Steps/minute was summed to obtain the total number of steps/day. Minute-by-minute time spent in moderate (METs 3–5.9) and vigorous activities (METs ≥ 6) were summed to compute daily and weekly values of time spent in these different intensities [16].

Descriptive statistics (means and standard deviations) were presented for all PA variables. The assumption of normality of PA variables was verified using the Shapiro–Wilk test. Logistic regression examined the associations between socio-demographic and anthropometric criteria and the odds of meeting the different PA guidelines with the significance level set at $p < 0.05$. All analyses were performed using an IBM® SPSS® Statistics software, version 21.

RESULTS

Data analysis revealed that the WHO recommendations of ≥ 150 min MVPA per week were met by 100% of women and thus only this type of activity allowed all participants to meet the guidelines. With regard to VPA, only 3.6% of women achieved ≥ 75 min/week (Table 2). The average time of MVPA in whole group amounted to 571.9 ±161.0 min/week, and VPA 27.4 ±20.4 min/week.

None of the analyzed variables (age, educational level, marital status, smoking status, possessing a car, anthropometric measures and PA) had a statistically significant relationship with achieving the recommended dose of MVPA (Table 2). When considering engaging in ≥ 75 min/week of VPA, this criterion is more often ($Chi^2 = 8.9$; $p < 0.05$) met with average capitation < 2499 Turkish Lira − TL (20.0%) than 2500–3499 TL (2.7%).

Table 2. Prevalence (n [%]) of sufficient PA according to the different guidelines by socio-demographic and anthropometric characteristics (adjusted odds ratios [95% confidence interval])

Factors	WHO 75 min/week VPA		PAL 1.75		7x10,000 steps/week	
	n (%)	OR(95% CI)	n (%)	OR(95% CI)	n (%)	OR(95% CI)
Age						
20–29 years old	2 (5.6)	1	6 (16.7)	1	18 (50.0)	1
30–39 years old	2 (4.3)	0.8 (0.1–5.8)	11 (23.9)	1.57 (0.5–4.8)	21 (45.7)	0.84 (0.35–2.0)
40–49 years old	-	0.2 (0.01–5.1)	5 (17.2)	1.04 (0.3–3.8)	11 (37.9)	0.61 (0.23–1.7)
Education level						
Bachelor's degree	4 (7.0)	1	14 (24.6)	1	27 (47.4)	1
Master's degree	-	0.2 (0.01–4.2)	4 (14.8)	0.53 (0.15–1.8)	11 (40.7)	0.76 (0.3–1.9)
Doctorate degree	-	0.2 (0.01–4.2)	4 (14.8)	0.53 (0.15–1.8)	12 (44.4)	0.89 (0.35–2.3)
Average monthly per capita income						
< 2,499 TL	2 (20.0)	1	4 (40.0)	1	5 (50.0)	1
2,500–3,499 TL	2 (2.7)	0.1 (0.01–0.9)	14 (18.7)	0.34 (0.09–1.4)	39 (52.0)	1.08 (0.3–4.1)
TL ≥ 3,500 TL	-	0.06 (0.01–1.5)	4 (15.4)	0.27 (0.05–1.4)	6 (23.1)	0.3 (0.1–1.4)
Marital status						
Single	2 (4.3)	1	8 (17.0)	1	18 (38.3)	1
Married	2 (3.1)	0.73 (0.1–5.4)	14 (21.9)	1.37 (0.5–3.6)	32 (50.0)	1.61 (0.8–3.5)
Smoking status						
Smokers	2 (5.3)	1	5 (13.2)	1	14 (36.8)	1
Non-smokers	2 (2.7)	0.51 (0.07–3.8)	17 (23.3)	2.0 (0.7–5.9)	36 (49.3)	1.67 (0.8–3.7)
Car Possession						
Yes	2 (4.0)	1	12 (24.0)	1	21 (42.0)	1
No	2 (3.3)	0.8 (0.1–6.0)	10 (16.4)	0.62 (0.24–1.6)	29 (47.5)	1.25 (0.6–2.7)
BMI (kg/m^2)						
< 25	4 (5.9)	1	15 (22.1)	1	32 (47.1)	1
≥ 25	-	0.94 (0.9–1.0)	7 (16.3)	0.69 (0.3–1.9)	18 (41.9)	0.81 (0.4–1.8)
WHR						
< 0.8	4 (5.0)		16 (20.0)	1	30 (37.5)	1
≥ 0.8	-		6 (19.4)	0.96 (0.3-2.7)	20 (64.5)	3.03 (1.3–7.2)
Total	4 (3.6)		22 (19.8)	1	50 (45.0)	

BMI: body mass index; WHR: Waist–Hip ratio; VPA: vigorous physical activity; PAL: physical activity level; Currency conversion: 1.00 EUR = 3.04 TL (Turkish Lira); Bold – statistically significant $p < 0.05$; *MVPA is not included in OR analysis because 100% of the women met the WHO criterion of ≥ 150 min MVPA.

When considering the guidelines for weight maintenance (average PAL of 1.75), a weekly average PAL of ≥ 1.75, 19.8% of women were sufficiently active to avoid excessive weight gain. There were no statistically significant differences considering the analyzed variables.

Despite the high daily average of steps 9867 (±1756), only 45.0% took 10,000 steps/day on seven consecutive days. The average monthly per capita income was statistically related with this criterion. Respondents declaring a lower income (< 2499 TL − 50.0% and 2500–3499 TL − 52.0%) more often (Chi^2 = 6.6; $p < 0.05$) took 10,000 steps/day than those earning ≥ 3500 TL − 23.1%. In addition, women with WHR < 0.8 (37.5%) met these guidelines less often (Chi^2 = 6.59; $p = 0.01$) than those with WHR ≥ 0.8 (64.5%).

Adjusted odds ratios (95% confidence interval) for the studied variables and meeting the different PA guidelines are presented in Table 2. There was no statistically significant relationship related to the achievement a PAL of ≥ 1.75. As for the steps criterion, women with WHR ≥ 0.8 are 3 times more likely to take ≥ 10,000 per day compared to those with WHR < 0.8 (OR: 3.03). Meeting the WHO criterion of ≥ 75 min VPA was ten times more likely (OR:0.1 [0.01–0.89]) with those earning 2500–3499 TL compared to < 2499 TL. Age, educational level, marital status, smoking status, possessing a car, or BMI were not related to meeting the different guidelines.

DISCUSSION

The study supports the hypothesis that the ability to meet different PA guidelines by middle-aged highly educated premenopausal Turkish women with a sedentary lifestyle differs according to the guideline perspective.

The first WHO criterion of 150 min/week MVPA was met by 100% of the respondents and the second one of 75 min/week VPA only by 3.6% of them. It is not, however, an isolated example since other studies also point to the fact that participation rate for VPA as compared to MVPA is generally lower [16]. It is reflected in a similar study on Belgian women [3], although in that case the percentage of subjects performing MVPA was considerably lower (86.5%) and VPA higher (17.8%).

The next recommendation of 7 days with ≥ 10,000 steps/day was realized only by 45% of the women – which in view of the study results of Tudor-Locke et al. [8] and Colley et al. [13] (the percentage of a sufficient number of steps among adults ranged from 13.9% to 34.5%) is quite a high fraction. The total number of steps amounted to 9,867 ±1,756 step/day and is similar to the values average for the European population (9,655 daily number of steps in Belgium [1], 10,617 in Switzerland [17], 9,500 in Finland, 11,272 UK [18] and 10, 941 in Turkey) [19] − values vary because of differences in age, sex and socio-demographic characteristics) [20]. It must be noted, however, that the environmental, cultural or social variables might exist that result in differences among these groups. It is worth observing that some researchers have argued that taking 10,000 step/day is not sufficient to reach health benefits associated with physical activity [8]. Tudor-Locke et al. [8] recommended that despite some inter-individual variation, 100 steps/minute represents a reasonable floor value indicative of moderate intensity walking. Not only is the daily accumulation of PA important, but the intensity of the exercise as well. The present findings show that the measured level of PA (1.61 MET) was moderate according to the PAL classification [21] and only 19.8% of women attained the recommended average PAL of ≥ 1.75. Similarly to our study, the previous study by Scheers et al [3, 16] reported an average PAL of 1.59 MET.

The secondary purpose of this study was to assess the relationship between meeting the pro-health guidelines and socio-demographic and anthropometric characteristics. World-wide previous studies revealed that many factors, such as education, age [22], profession [23] marital status [24] or smoking [3], affect the level of PA. For example, the rate of participation in PA increases proportionally to the level of education [3]. Similarly, lower education is connected with a lower income and results in creating more PA barriers [24]. However, lower-educated individuals were almost four times more likely

to take 10,000 steps/day [3]. In contrast to the education-related results, the rate of engagement in sufficient PA decreased with increasing age [22]. For example, the proportion of the WHO criterion of 75 min VPA per week declined [3]. Younger people, aged 20-34, were four times more likely to meet the advised 150 min of MVPA per week compared to other age groups [3]. Occupation may also determine the fulfillment of pro-health recommendations. Employees with more physically demanding jobs such as postmen, manual workers and technicians showed higher levels of PA [25].

In the current study, among all the analyzed variables, a significant relationship was observed only in the case of WHR and income (and only with regard to some recommendations). Pro-health recommendations suggest that PA should be performed for ten or more consecutive minutes of at least moderate intensity to provide beneficial health and fitness effects [12,13]. BMI and waist and hip circumferences are used as a prediction of cardiovascular disease risk factors in middle-aged adult population [26]. Contrary to BMI (not related to meeting the different guidelines), Turkish women with WHR < 0.8 (37.5%) met the recommended 7*10,000 steps/day three times (OR: 3.03) less often than those with WHR ≥ 0.8 (64.5%). Also, regarding the steps criterion women with WHR ≥ 0.8 are three times more likely to take ≥ 10,000 per day compared to those with WHR < 0.8 (OR: 3.03). Such a relationship was not observed in the case of WHO and PAL norms, which may indicate that walking is a preferred form of activity among the overweight and obese. Biernat [27] has shown that significant differences in average MET-min/week MPA, VPA and walking according to the respondent's BMI.

The economic status of people is an important factor that enhances their active lifestyles. However, it should be noted that the impact of increased affluence on health-oriented behaviors is not clear. On the one hand, it may encourage greater spendings on recreation and sports facilities [28]. On the other hand, it may become a factor reinforcing unhealthy habits: the tendency to excessive, irresponsible consumption and the abandonment of PA (e.g. doing household chores) [25]. The current study results reflect the fact that women with lower incomes undertake VPA more frequently since the criterion of ≥ 75 min/week of VPA was ten times more often (OR:0.1) met by subjects with average income < 2499 TL (20.0%) than by those with 2500–3499 TL (2.7%). This might be connected with the fact that women with lower income are involved in more daily routine activities.

CONCLUSIONS

Different percentages of subjects fulfill the pro-health criteria depending on the norm considered. The MVPA criterion is met by 100% of the respondents and VPA only by 3.6% whereas PAL is 19.8%. There should be more emphasis on VPA in women belonging to this age group. Further research is needed to investigate the different guidelines and recommend PA requirements for public health.

The article is important in its premise that we do need to identify the best criteria of PA to meet adequate health. Beneficial aspects of PA should be analyzed not only from the quantitative perspective (time, frequency and intensity of aerobic efforts) but also in relation to energy expenditure related

to resistance (anaerobic) and flexibility efforts. All those aspects considered together contribute to a healthy and high quality life.

LIMITATIONS

The findings from this article are limited due to the homogenous nature of the selected subjects. Purposeful selection of healthy educated women may limit the effect of income, car possession, average income and other variables.

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