American Journal of Public Health Research, 2020, Vol. 8, No. 1, 7-13
Available online at http://pubs.sciepub.com/ajphr/8/1/2
Published by Science and Education Publishing
DOI:10.12691/ajphr-8-1-2

The Physical Activity Level is Low in Young Adults: A Pilot Study from Turkey

Nilüfer Acar Tek*, Hande Mortaş, Sabriye Arslan, Tuğba Tatar, Süleyman Köse

Gazi University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Turkey
*Corresponding author: acarnil@hotmail.com

Received December 01, 2019; Revised January 04, 2020; Accepted January 14, 2020

Abstract **Objectives:** To determine the physical activity levels of young adults using the pedometer (pedometer step count-PSC), International Physical Activity-Short Form (IPAQ-SF), and physical activity diary (PAD) methods, and to compare these methods with one another. **Methods:** This study was conducted in 551 individuals aged between 18 and 30 years. A questionnaire that includes socio-demographic characteristics, physical activity habits, and anthropometric measurements of the individuals was administrated. Three instruments were used: PSC, PAD, and IPAQ-SF. **Results:** The three different physical activity evaluation instruments were shown positive correlation ($p < 0.01$). According to BMI, 13.2% of individuals were underweight; 12.9% were overweight; and 73.9% had healthy weight. There was no significant difference in physical activity level between BMI groups (underweight, normal weight and overweight) according to all evaluation methods. The majority of the individuals were active according to PSC (50.1%) and IPAQ-SF (59.7%). However, 61.2% of the individuals were sedentary according to the PAD. In addition, 48.5% of the individuals met the target of 10000 steps/d and 38.9% of them met the target of being active (PAL ≥1.7) while 13.4% of them met the target of 30 min/d moderate-to vigorous-intensity physical activity. **Conclusions:** The percentage of individuals met daily physical activity goal is low in young adults according to the different evaluation methods. Therefore, it is necessary to determine whether any of the changes brought about by the transition to university life are also physical inactivity.

Keywords: *physical activity, step count, pedometer, young adults, health*

Cite This Article: Nilüfer Acar Tek, Hande Mortaş, Sabriye Arslan, Tuğba Tatar, and Süleyman Köse, "The Physical Activity Level is Low in Young Adults: A Pilot Study from Turkey." *American Journal of Public Health Research*, vol. 8, no. 1 (2020): 7-13. doi: 10.12691/ajphr-8-1-2.

1. Introduction

Dietary habits and physical activity levels of societies change in the direction of positive energy balance, which brings with it health risks on a global scale as a result of the effect of globalization and urbanization [1]. The World Health Organization (WHO) defined physical inactivity as the fourth leading risk factor causing an increase in global mortality rates [2]. Increasing physical activity is the main recommendation to minimize the prevalence of noncommunicable diseases and to improve the general health of the worldwide population. An adequate level of physical activity affects health in a positive way and reduces the disease burden as well. According to Turkey's Burden of Disease Study, 300850 DALY (disability-adjusted life years) due to ischemic heart disease can be prevented when physical activity habits are sufficient [3].

Physical activity guidelines focused on developing suggestions by taking into consideration the parameters of frequency, duration, and intensity. Within the guidelines released by WHO, it was recommended that moderately intense aerobic physical activities, for individuals aged between 18 and 64 years, be performed in such a way that these activities last for at least 150 min per week, or that highly intense aerobic physical activities be performed in such a way that they last for 75 min per week [2]. It is important that a single bout of aerobic physical activity last for at least 10 min. According to the guidelines published in Japan, it is recommended that a 60-min walk be performed daily so as to attain beneficial health effects [4]. Guides for pedometer and accelerometer use have also been developed. For instance, in Australia, the target of 10000 steps per day was specified to increase daily physical activity, and to that end, a national program was implemented [5].

Within the scope of a program implemented in the USA, 8500 steps per day were suggested for adults [6]. In the United Kingdom, 7000–10000 steps daily were regarded as moderately active, whereas >11000 steps/day were regarded as quite active; however, in Japan, it was reported that approximately 8000–10000 steps were required to be taken daily so as to improve health [4]. On the other hand, in the expert committee report of the WHO/Food and Agriculture Organization of the United Nations (FAO)/ United Nations University (UNU), it is stated that the incidence of 'obesity, diabetes, cardiovascular diseases, and some types of cancer' is

lower in active individuals whose physical activity levels (PAL) are at the level of 1.7 when compared with less active and sedentary individuals. Encouraging an active lifestyle (PAL = 1.7) in line with this suggestion will promote the protection and improvement of health [7].

In Turkey, within the 'Physical Activity Guidelines for Turkey', endurance activities in which larger muscle groups are used for 150 min a week are recommended to be performed with a moderate intensity so as to gain and sustain health in adult individual [8]. In addition, pedometers are provided by the Ministry of Health of Turkey (MoHT) for family physicians to distribute to overweight and obese (class I) adults so as to increase physical activity and prevent obesity. Within the scope of this program, individuals are expected to meet the suggestion of 10000 steps per day [9].

Emphasis on physical activity is increasing more and more in national guidelines to minimize the prevalence of obesity and to improve the general health as stated above. Consequently, when physical activity suggestions are developed priority is usually given to individuals who are in the more risky group in terms of physical inactivity. On the other hand, there are studies showing that physical inactivity is high even in younger age groups [10,11,12]. Therefore, it is reported that the age range including a significant process change such as transition from high school to university should not be ignored in the evaluation of physical activity [12]. Moreover, when considered that physical activity levels do not differ according to BMI in young individuals [13], it is also necessary to evaluate physical activity levels in individuals with normal BMI and to develop suggestions. There exists no report in this field in Turkey. This research was carried out for the purpose of determining the physical activity levels of university students using pedometer, which is an objective method, the IPAQ-SF, and PAD, as well as to compare these methods with one another.

2. Materials and Methods

2.1. Participants and Procedures

The participants were selected out of the university students who had been informed about the study through verbal and written announcements performed in Gazi University. The study was conducted between March and June 2015. The inclusion criteria were as follows: (1) to be healthy in appearance (having no problem performing the physical activities that are undertaken daily on foot); (2) to be a volunteer to participate in the study; and (3) to be in the age range of 18–30 years. The study was conducted in 551 individuals (male: 85; female: 466).

The study protocol involved 7 consecutive days. At the beginning of the study period, a questionnaire consisting of questions about the socio-demographic characteristics and physical activity habits was administered by the researchers, and the participants' anthropometric measurements (height, body weight) were taken. The participants were instructed to wear the pedometer for 7 consecutive days. Separately, the participants were also instructed as to how to keep their 24-h PAD throughout the 3 consecutive days (2 weekdays and 1 weekend day) within those 7 days, during which they would be wearing their pedometers. At the end of the 7-day evaluation, the IPAQ-SF was administered to the participants.

The study was approved by Gazi University Ethics Commission. All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

2.2. Instruments

Family physicians are provided with the TNV 3D Pedometer PM2000 by the MoHT in order for them to distribute them to overweight and obese (class I) adult individuals to be followed up so as to promote physical activity. In this study, pedometers of the same model were used. As for the individuals who cycled or swam, 150 steps were added to the daily pedometer step count (PSC) for each minute they performed these activities [14]. Participants could remove the pedometers only during swimming and showering [15].

According to the classification of Tudor-Locke et al. (2001), the mean daily PSCs were classified as sedentary: <5000 steps/d; low active: 5000–7499 steps/d; somewhat active: 7500–9999 steps/d; active: 10000–12499 steps/d; and highly active: ≥12500 steps/d [15].

In order to compare the evaluation instruments, the mean daily PSCs were divided into tertiles in accordance with the 25^{th} and 75^{th} percentiles (<25^{th} percentile: sedentary-low active (<7509 steps/d); 25^{th}–75^{th} percentile: active (7509–12515 steps/d); >75^{th} percentile: highly active (12515 steps/d).

The levels and durations of physical activity were evaluated using the IPAQ-SF, of which a Turkish validity and reliability study had been performed [16]. The total scores were calculated as MET/wk [17]. The durations (min/d) of walking, moderate-intensity physical activity (MPA), and vigorous-intensity physical activity (VPA) of the individuals for a week were obtained, and the daily averages were calculated. Separately, the total time periods spent by the individuals on moderate- to vigorous-intensity physical activities (MVPA) were computed by summing of the time spent per day on moderate- and vigorous-intensity activities and by dividing them by seven (excluding walking).

Participants were classified into three categories as sedentary-low active (<600 MET-min/wk), active (600-3000 MET-min/wk), and highly active (>3000 MET-min/wk) according to the total MET-min/wk values [18].

The participants recorded their physical activity throughout the three consecutive days (2 weekdays and 1 weekend day) within the 7 days during which they wore pedometers [18,19].

Within the scope of the diary, the time spent sleeping as well as resting (lying down), and the durations of light-, moderate-, and vigorous-intensity activity types were all recorded in 15-min intervals. After each recorded physical activity was multiplied by the physical activity ratio according to their types, the PAL for each day was calculated, and the mean daily PAL values were obtained [7].

The participants were classified as having a sedentary or low-active lifestyle: 1.40–1.69; active or moderately active lifestyle: 1.70–1.99; vigorous or vigorously active lifestyle: 2.00–2.40 according to their PAL values [7].

All analyses were performed using the statistical package program SPSS 15.0. Because age, height, body weight, BMI, and IPAQ-SF results (min/d) to which logarithmic transformation was applied showed a normal distribution, these parameters were compared between gender groups using a Student's *t*-test. Marital status, chronic diseases, the use of cigarettes and alcohol, the status of performing physical activity regularly, pedometer data, and PAL classification groups were given according to gender in the form of a crosstab. Whether or not there was any difference in terms of these frequencies between the groups was determined using chi-square or Fisher's exact tests, depending on the situation.

Because IPAQ-SF (min/d), PAD (PAL), and PSC (steps/d) values were normally distributed, the correlation coefficients (r_p) and the statistical significances were calculated using the Pearson's test. The compliance between different evaluation tools for physical activity in making the distinction by evaluating the individuals as sedentary-low active, active, or highly active was evaluated using the kappa test.

The status of three evaluation instruments in meeting the recommendations was presented using percentages. The differences in percentages of participants who met the recommendations were compared using the McNemar's test. In order for the participants to be considered as active, the following values were set as cutoffs: PAL: 1.7 [7], MVPA: 30 min/d [7,20], and pedometer steps count: 10000 steps/d [21,22,23]. The level of statistical significance was set at 5%.

3. Results

3.1. Participant Characteristics

The participant characteristics were presented in Table 1 and Table 2. According to the IPAQ-SF evaluation, durations of vigorous and moderate physical activities in males (11.1±17.43 and 12.6±21.34 min/d, respectively) were longer than those in females, whereas the durations of light-intensity activities, such as walking (light) (min/d), were found to be longer in females (52.8±47.55 min/d). According to the classification of the PSC by Tudor-Locke et al. [15], a higher proportion of males than females were evaluated as "highly active". Similarly, the results of the PSC classification according to tertiles showed that a higher proportion of females than males were evaluated as "sedentary-low active" and "active", whereas a higher proportion of males than females were evaluated as "highly active" ($p < 0.05$). Furthermore, the mean PSC of the all participants was 10378, whereas the mean PSCs of males and females were 11982 and 10085, respectively (data not shown, $p < 0.05$). In the classification of PAD, it was demonstrated that males were active at a higher rate than females, and females were sedentary at a higher rate than females. The mean PAL value of males was 1.72, whereas this value was found to be 1.61 in females (data not shown, $p < 0.05$).

Table 1. Descriptive characteristics of the participants

Variables	Males (n = 85)	Females (n = 466)	Total (n = 551)
Age	22.1±2.57[a]	20.7±1.86	20.9±2.05
Height (cm)	178.1±5.67[a]	163.6±6.14	165.8±8.03
Weight (kg)	75.0±11.14[a]	57.0±8.68	59.8±11.18
BMI (kg/m^2)	23.6±3.24[a]	21.3±3.07	21.7±3.20
BMI category, n (%)			
Underweight	4 (4.7)[a]	69 (14.8)	73 (13.2)
Normal	56 (65.9)[a]	351 (75.3)	407 (73.9)
Overweight	25 (29.4)[a]	46(9.9)	71 (12.9)
Marital status (single %)	90.6[a]	98.3	97.1
Chronic disease (yes %)	4.7[a]	15.2	13.6
Smoking (yes %)	15.3[a]	4.3	6.0
Alcohol (yes %)	12.9[a]	5.4	6.5
Regular Physical Activity (yes %)	48.2[a]	23.6	27.4
IPAQ-SF			
Vigorous PA (min/d)	11.1±17.43[a]	1.3±5.45	2.8±9.18
Moderate PA (min/d)	12.6±21.34[a]	8.3±18.87	8.9±19.31
Walking (Light) PA (min/d)	44.3±32.23[a]	52.8±47.55	51.4±45.59
Total Physical Activity (MET/wk)	2215.4±1961.1[a]	1553.3±1359.6	1655.4±1485.8
Pedometer* (%)			
Sedentary (<5000 steps)	7.1[a]	8.4	8.2
Low active (5000–7499 steps)	9.4[a]	18.0	16.7
Somewhat active (7500–9999 steps)	23.5[a]	27.3	26.7
Active (10000–12499 steps)	22.4[a]	23.4	23.2
Highly active (≥12500 steps)	37.6[a]	23.0	25.2
Pedometer** (%)			
Sedentary-low active (<7509 steps/d)	16.5[a]	26.6	25.0
Active (7509–12515 steps/d)	45.9[a]	50.9	50.1
Highly active (12515 steps/d)	37.6[a]	22.5	24.9
Physical Activity Diary (PAD %)			
Sedentary-low active (1.40–1.69)	55.3[a]	62.2	61.2
Active (1.70–1.99)	32.9[a]	33.7	33.6
Highly active (2.00–2.40)	11.8[a]	4.1	5.3

a. $P < .05$ (male compared with female) BMI: Body Mass Index; IPAQ-SF: International Physical Activity-Short Form; PA: Physical activity
*Tudor-Locke et al. (2001) classification (15); **Percentile classification.

There was no significant difference in physical activity level between BMI groups (underweight, normal weight and overweight) according to PAD (PAL value), PSC, and IPAQ (MET/wk). According to IPAQ, PAD and PSC, 28.3%, 61.2% and 23.8% of individuals with normal BMI were sedentary, respectively. However, there was not a significant difference among groups of evaluation methods (data not shown).

3.2. Comparison of the IPAQ-SF, pedometer steps count, and physical activity diary

The correlations of the evaluation instruments including IPAQ-SF, PSC, and PAD (PAL) were given in Table 2. The three instruments were determined to have a significantly positive association with one another ($p < 0.05$; Table 2).

Table 2. Correlations between the IPAQ-SF, PAD, and pedometer

Dependent Variable	Independent Variable	r	p
IPAQ-SF (MET/wk)	PAD (PAL)	.549	.00
IPAQ-SF (MET/wk)	Pedometer	.466	.00
PAD (PAL)	Pedometer	.482	.00

IPAQ-SF: International Physical Activity-Short Form; PAD: Physical Activity Diary; PAL: Physical activity level.

3.3. Physical Activity Classification

The majority of the participants (61.2%) were found to be "sedentary-low active" according to the PAD, whereas the majority of them (59.7%) were determined to be "active" according to the PSC (50.1%) and IPAQ-SF (Figure 1). According to the kappa statistical results, the agreement between the IPAQ-SF, PAD, and PSC was significant ($p < 0.01$, Figure 1), and the agreement rates were found to be as follows: 55.7% between the IPAQ-SF and PSC, 53.9% between the IPAQ-SF and PAD, and 40.5% between the PAD and PSC.

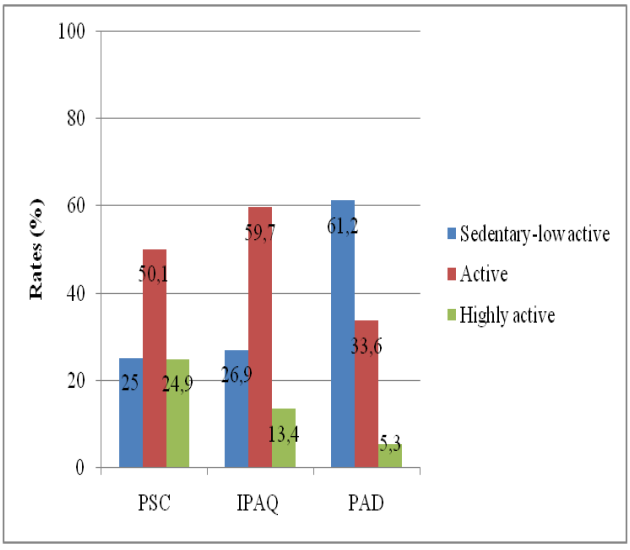

Figure 1. Classification of physical activity by the International Physical Activity Questionnaire Short Form (IPAQ-SF), Pedometer Step Count (PSC), and Physical Activity Diary (PAD). IPAQ-SF: kappa statistic = 0.262 ($P = 0.00$, 55.7% agreement compared with PSC); kappa statistic = 0.266 ($P = 0.00$, 53.9% agreement compared with PAD). PAD: kappa statistic = 0.106 ($P = 0.00$, 40.5% agreement compared with PSC)

3.4. Meeting the Physical Activity Recommendations

Whereas 48.5% of individuals met the target of 10000 steps/d and 38.9% of them met the target of being active (PAL ≥1.7), 13.4% of them were found to have met the target of 30 min MVPA/d according to the IPAQ-SF (Figure 2). The proportions of the individuals who met the physical activity recommendations were found to be significantly different from one another according to the pairwise comparisons ($p < 0.05$).

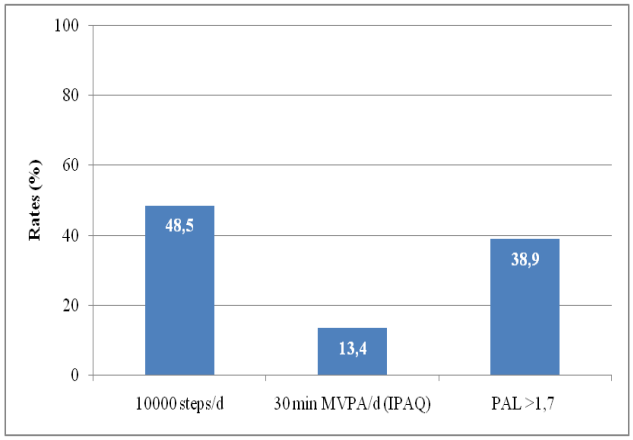

Figure 2. Percentage of participants reaching the step count of 10000 steps/day, 30 minutes of moderate-intensity to vigorous-intensity physical activity per day according to International Physical Activity Questionnaire Short Form (IPAQ-SF), and the standard of 1.7 Physical activity level (PAL) of "active" group according to physical activity diary (PAD)

4. Discussion

According to the classification of PAD, it was determined that males were active at a higher level than females, while a higher proportion of females were sedentary. Separately, according to the Turkey Nutrition Health Survey results, it was found that 41.6% of the males in 19-30 year age group had an active or moderately active lifestyle, whereas 19.7% of them had a high active lifestyle; on the other hand, the majority of the females had a sedentary or moderately active lifestyle [24]. Similarly in this study, while the proportion of individuals evaluated as "highly active" was higher in males than in females according to the classification of the daily PSC, the proportion of "sedentary" and "low active" individuals was higher in females than in males.

In the IPAQ-SF evaluation, it was also observed that the mean vigorous and moderate physical activity (min/d) was higher in males than in females. The mean walking activity (min/d) in females, however, was higher. Similarly, in our country, in a study conducted on 455 university students by Öl çüc ü et al. physical activity levels were determined to be higher in male than in female students [25]. Also, in a study conducted by Savcı et al. the total and moderate physical activity scores of males, as well as their vigorous physical activity and walking activity scores, were found to be significantly higher than those of females [26]. Also, in this study, the total physical activity (MET/wk) averages of the males were

found to be higher than those of the females. In a study conducted on 333 university students in Romania, the male students were determined to be more active than the females [27]. It is thought that the reasons for these results could be that the types of activities and their intensities preferred by females and males were different, and that females had confronted some environmental and social obstacles in performing regular physical activity. According to WHO, several environmental factors, such as violence and crimes in open areas, the intensity of traffic jams, the low quality of weather conditions, and the pollution in walking areas, parks, and sports areas also prevent individuals from being more active [2].

In some of the studies conducted in the USA, it was determined that the physical activity levels specified through the number of steps and the use of a questionnaire found to be significantly and positively associated with one another [28, 29]. All the three evaluation instruments were determined to be significantly and positively associated with each other ($p < 0.01$) in the present study. In a review that evaluated the mean steps per day and the physical activity levels determined on the basis of self-report, the median correlation was ascertained to be $r = 0.33$ [30]. The low sensitivity of questionnaires to walking activity may result in differences between methods. While there is the condition of a 10-min walk at a minimum to evaluate walking activity in the IPAQ-SF, recording all of the walking activities on the pedometer may lead to differences between the two methods. In a study conducted by Basset et al., the walking record self-reported via PAD was determined to be lower than the value determined by the pedometer [31]. In a study conducted on menopausal women, a weak accordance was ascertained between the IPAQ-SF and the pedometer and the IPAQ-SF made a higher prediction than the pedometer [32]. The fact that the ages of the participants in the study were older than the ages of those who participated in our study may also have caused this difference [33].

According to classification of the PSC (percentile), PAD (PAL), and IPAQ-SF (MET/wk) values, a higher proportion of individuals were determined to be sedentary (61.2%) according to the PAD. On the other hand, according to the IPAQ-SF (59.7%) and the PSC (50.1%), the proportion of individuals classified as active was higher. Separately, the number of individuals in the highly active group according to the pedometer evaluation was, though statistically not significant, higher than the number of individuals in the highly active group according to the IPAQ-SF and PAD classifications. While the total walking activity performed throughout the day is recorded through the use of a pedometer, only the walking activity performed in sessions of 10 min and above is recorded on the IPAQ-SF. Thus, a lower sensitivity of the IPAQ-SF in terms of walking activity may lead to this outcome. In another previously conducted study, however, it was determined that the self-report methods in which the IPAQ-SF was included had led to a higher rate of prediction when compared with the objective methods [34].

In this study, according to IPAQ, PAD and PSC, 28.3%, 61.2% and 23.8% of individuals with normal BMI were sedentary, respectively. Similarly, in another study conducted with 894 individuals aged 18-25 years, physical inactivity prevalence was found 41.4% [10]. In the other countries such as Singapore, Malaysia, Taiwan, Hong Kong and South Korea, physical inactivity prevalence was found 7.2%, 8.0%, 13.5%, 16.8% and 28.5% in similar aged students, respectively [11]. Despite the fact that physical activity is expected to be higher in the young age range, the reversed results prompt researchers to question the reason for this. The rate of physical activity was found to be decrease from high school years to college years (66.2% declines to 44% in first two months in university) in a cohort study [12]. Therefore, it is necessary to determine whether any of the changes brought about by the transition to university life are also physical inactivity.

Another objective of this study was to determine whether or not the individuals had met the physical activity recommendations found in the guidelines. In a study conducted on university students in the Czech Republic, it was ascertained that only 9% of individuals had attained the target of 10000 steps/d [34]. Again, in another study conducted on university students in Austria, 45% of males and 51% of females were determined to have attained the target of 10000 steps/day [35]. The mean steps per day of the students in our study can be said to be higher than that of the general population. On the other hand, the usual physical activity level is advised to be ≥1.7 PAL so as to reduce the risk of obesity, cardiovascular diseases, diabetes, and some cancer types [7]. In this study, while the proportion of individuals who attained the 1.7 PAL value targeted was 38.9%, the proportion of individuals who attained the targeted value in terms of the mean steps per day was 48.5%, and the proportion of individuals who attained the target minimum of 30 min MVPA was 13.4%. In a previously conducted study, it was stated that approximately 3000 steps provided 30 min of moderate intensity activity [36]. This outcome may have been caused by the fact that there were self-reported errors through the IPAQ-SF and PAD in this study. Separately, while the MVPA category in the IPAQ-SF does not involve walking activity other than brisk walking, the pedometer records all of the steps taken throughout the day without distinguishing the intensity. Moreover, in this study, some corrections were made to the pedometer values for such activities as swimming and cycling, which are among the activities evaluated within the scope of MVPA. Because of this, this difference may occur due to the more extensive activity recording that is performed using the pedometer. Similarly, using the PAD method, the number of individuals who attained the target physical activity level may have been higher than the number found by the IPAQ-SF, because the PAD involved both the types of walking at all intensities and the other activities in the MVPA group. Furthermore, in a study conducted with respect to different evaluation questionnaires on physical activity, it was emphasized that there were great differences in the study results regarding the validity and reliability of the IPAQ-SF among different countries, due to which further studies needed to be conducted on the validity and reliability of IPAQ-SF [37]. Even though the pedometer fails to distinguish the type and the intensity of a physical activity, it still provides valuable and objective data for the evaluation of the status of physical activity of populations.

Due to the fact that the males in our study were reluctant to join and continue with the studies, the small

number of males included was a limitation of our study. Owing to the fact that the population consists of young adults, the results may not be generalized to middle-aged or adults or those of advanced age. Aside from all of these factors, the wide and homogeneous nature of the sample studied, as well as the usage of different physical activity level evaluation instruments together, are the powerful aspects of the study.

In conclusion, our study is important in terms of being the first study in Turkey in which all of an internationally valid and reliable questionnaire, a pedometer device, which is an objective evaluation method, and a physical activity diary were used. Also, this study highlights an important finding for the health of college students. Since physical inactivity is high in this age group, young adults should be taken into consideration when policy is being developed. The fact that males were more active than females suggests that females in particular should be supported in terms of physical activity. In this study, the fact that an objective method –the pedometer– as well as two subjective methods –the physical activity diary and IPAQ-SF– where shown to be in significant agreement with one another also suggests that these tools can replace each other. However, due to the fact that the error margin of self-report methods is higher, it may be important to benefit from objective methods as well, while determining physical activity levels. Apart from this, while physical activity is being evaluated through the use of a questionnaire method, explaining the types of activities to the participants in detail and allowing them to answer the questions through a face-to-face interview method may minimize the margin of error. Separately, while the method of PAD is being applied, allowing individuals to keep the recording at short time intervals (10-15-min periods) will provide more accurate results. The ages, genders, socio-economic status, and health conditions of the individuals may necessitate applying a different method to determine physical activity levels. Further studies are required, in which physical activity levels will be investigated through various evaluation methods of physical activity level in different socio-economic, demographic, and cultural groups.

Acknowledgement and/or Disclaimers

The authors declare that they have no conflict of interest and no funding.

Statement of Competing Interests

The authors declare that they have no any competing interests.

List of Abbreviations

BMI = Body mass index; DALY = disability-adjusted life years; FAO = Food and Agriculture Organization; IPAQ-SF = international physical activity-short form; MoHT = Ministry of Health of Turkey; MPA = moderate-intensity physical activity; MVPA = moderate- to vigorous-intensity physical activities; PAD = physical activity diary; PAL = physical activity level; PSC = pedometer step count; SPSS = Statistical Package for the Social Sciences; UNU = United Nations University; WHO = World Health Organization; VPA = vigorous-intensity physical activity.

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