ORIGINAL ARTICLE

Correlation between average number of steps per day and the six-minute walk test in asymptomatic adults and elderly

Correlação entre a média do número de passos diário e o teste de caminhada de seis minutos em adultos e idosos assintomáticos

Correlación entre el promedio del número de pasos diarios y el test de marcha de seis minutos en adultos y adultos mayores asintomáticos

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ABSTRACT | The objective of this study was to evaluate the correlations between the habitual physical activity levels (HPAL) measured by accelerometry, the distance walked during the 6-minute walk test (6MWD) and the score obtained from a HPAL questionnaire. Thirty-three adults (23 women, 64±7 years old) were evaluated. Participants answered the International Physical Activity Questionnaire (IPAQ) and underwent two 6MWT. The average number of steps per day (SPD) for five days was examined by an uniaxial accelerometer. Correlations between the studied variables were evaluated and two multiple regression models were developed to compare the influence of the variables in the SPD. In the first model, the 6MWD and the total IPAQ store as were considered as independent variables. In the second model, the 6MWD and demographic and anthropometric variables were included (for example, age, height, weight and gender).The SPD had a significant relationship ($p<0.05$) with 6MWD ($r=0.51$) and the total IPAQ score ($r=0.47$). After regression analysis, only 6MWD was selected as a determinant of 26.5% of the total variability of SPD. We can conclude that the 6MWT was only moderately correlated with the HPAL. However, in relation to gender, 6MWD was able to explain 36.6% of the total variability of SPD.

Keywords | walking; exercise; adult; aged.

RESUMO | O objetivo deste estudo foi avaliar as correlações existentes entre o Nível de Atividade Física Habitual (NAFH) mensurado por acelerometria, a distância percorrida no Teste de Caminhada de Seis Minutos (DTC6) e o escore obtido por meio de um questionário de NAFH. Trinta e três adultos (23 mulheres; 64±7 anos) foram avaliados. Os participantes responderam ao Questionário Internacional de Atividade Física (IPAQ) e foram submetidos a dois Testes de Caminhada de Seis Minutos (TC6). A média do número de passos diários (NPM) de cinco dias foi analisada por um acelerômetro uniaxial. As correlações entre as variáveis estudadas foram avaliadas e dois modelos de regressão múltipla foram desenvolvidos para comparar a influência das variáveis estudadas no NPM. No primeiro modelo, foram considerados a DTC6 e o escore total do IPAQ como variáveis independentes. No segundo modelo, a DTC6 e variáveis demográficas e antropométricas foram incluídas (por exemplo, idade, estatura, peso e gênero). O NPM correlacionou-se significativamente ($p<0,05$) com a DTC6 ($r=0,51$) e com o escore total do IPAQ ($r=0,47$).

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Após análise de regressão, apenas a DTC6 foi selecionada como determinante de 26,5% da variabilidade total do NPM. Podemos concluir que o TC6 correlacionou-se apenas moderadamente com o NAFH. Entretanto, associado ao sexo, a DTC6 foi capaz de explicar 36,6% da variabilidade total do NPM.

Descritores | caminhada; exercício; adulto; idoso.

RESUMEN | El objetivo de este estudio fue evaluar las correlaciones existentes entre el Nivel de Actividad Física Habitual (NAFH) medido por acelerometría, la distancia recorrida en el test de marcha de 6-min (DTM6) y el score obtenido en el cuestionario NAFH. Treinta y tres adultos (23 mujeres; 64±7 años) fueron evaluados. Los participantes respondieron el cuestionario IPAQ y fueron sometidos a dos TM6. La media del número de pasos diarios (NPM) de cinco días fue analizada por un acelerómetro uniaxial. Las correlaciones entre las variables estudiadas fueron evaluadas y dos modelos de regresión múltiple fueron desenvueltos para comparar la influencia de las variables estudiadas en el NPM. En el primero, fueron considerados la DTM6 y el score total de IPAQ como variables independientes. En el segundo, la DTM6 y variables demográficas y antropométricas fueron incluidas (ej. edad, estatura, peso y género). El NPM se correlacionó significativamente (p<0,05) con la DTM6 (r=0,51) y con el score total do IPAQ (r=0,47). Después del análisis de regresión, solo la DTM6 fue seleccionada como determinante del 26,5% de la variabilidad total de NPM. Podemos concluir que el TM6 se correlacionó solo moderadamente con el NAFH. Por lo tanto, en asociación con el sexo, la DTM6 fue capaz de explicar 36,6% de la variabilidad total del NPM.

Palabras clave | marcha; ejercicio; adulto; adulto mayor.

INTRODUCTION

The habitual physical activity level (HPAL) is defined as the total number of volunteer movements produced by the skeletal muscles, above rest levels throughout the days[1]. The increasing interest to quantify physical activity in any population is based on the narrow relationship between these people and health, morbidity and mortality[2]. So, the HPAL evaluation is important to understand the reason for the use of specific physical activities in the population, to study the results of interventions made by means of physical exercise and to design strategies of prevention and health promotion[3]. HPAL can be assessed by methods, such as: direct observation, movement sensors (pedometers or accelerometers), self-report diaries and questionnaires[2,3].

The questionnaires have been extensively used due to their applicability in large population samples, to their low cost and because they are an instrument that collects detailed information on the type of activity and its context[3]. However, these instruments have known limitations, such as the reliability of the answers given by the assessed subjects. So, in some studies, other methods that objectively evaluate HPAL have been used to investigate the validity of these questionnaires. One of these instruments is the International Physical Activity Questionnaire (IPAQ)[4], which is considered as a reliable and reproducible tool, that is validated for studies in Brazil[5,6].

The movement sensors are instruments that register the body movement in real time[2,3], used by researchers due to its potential to objectively measure physical activity[7]. The pedometers are instruments that count the steps taken by the subject. On the other hand, accelerometers are able to quantify physical activity with more advanced sensors, which produce measures by calculating the acceleration and deceleration of body movements[2,3]. However, these instruments have disadvantages due to their high cost, the need for the volunteer to use them for a prolonged period and the difficulty to use them in large populations[2,3]. A few studies examined how the daily physical activity is related to measures of exercise functional ability, commonly used in clinical practice. In this sense, recent literature points out to a consistent correlation between the 6MWT and the HPAL, monitored by movement sensors in patients[8-13]. The 6MWT is a field test which consists of instructing the patient to walk the longest possible distance during six minutes. Its main advantages are the low cost, applicability and operational simplicity[14-16]. The existence of correlation between the HPAL assessed by movement sensors and the 6MWT was demonstrated in studies performed in patients with chronic obstructive pulmonary disease (COPD)[8-12] and in others who were at the post-stroke period[13]. In the study by Pitta et al.[8], the 6MWT was selected as a predictive factor regardless of quantity and intensity of the habitual physical activity of these patients. Hill et al.[10] points out that this type of correlation suggests that exercise functional ability tests provide information concerning the daily physical activity performed by the patient.

Even though the association between the 6MWT and the HPAL has been observed in patients, little is known about this relationship in the adult and elderly asymptomatic population. We raise the hypothesis that the 6MWT is correlated with the HPAL in this population.

The objective of this study was to verify the correlation and the weight of the association between the HPAL measured by movement sensor with the 6MWT and the results of the IPAQ.

METHODOLOGY

Thirty-three asymptomatic subjects of both genders, aged ≥40 years old, selected by convenience in the city of Santos/SP, were included in the research. All subjects were submitted to health screening, being asked about the presence of arterial hypertension, dyslipidemia, diabetes mellitus, smoking or sedentary lifestyle. The ones considered as asymptomatic were those without heart or pulmonary disease, with controlled blood pressure, glucose or lipidemia and without evidence of cardiovascular, pulmonary, neurological, musculoskeletal or metabolic impairment that could prevent the performance of physical exercises. Hypertensive volunteers with controlled blood pressure were not excluded from the study, as well as diabetic, dyslipidemic or sedentary volunteers in good health conditions. The Physical Activity Readiness Questionnaire (PAR-Q)[17] was used, which allows to prevent the inclusion of subjects with heart or osteoarticular conditions, chest pain or tendency to faint.

The project was submitted to and approved by the Human Research Ethics Committee at *Universidade Federal de São Paulo*, and all of the volunteers signed the informed consent form.

After health screening, the subjects answered the IPAQ. Anthropometric measurements were taken, and the instructions for the 6MWT were given. Two 6MWT were performed on the same day, with a 30 minute interval between them. At the end of these procedures, the subjects received the movement sensor and were told to start using it on the day after the test. Volunteers came back to return the movement sensor on the seventh monitoring day.

The long version of IPAQ[4] was used by means of personal interview, which assesses the time spent in activities of different intensities (vigorous, moderate and mild) in four domains: job-related, transportation, housework and recreation, sport and leisure-time activities. Total score was calculated and expressed in minutes per week. Subjects were told to answer the questions based on the week prior to the application of the instrument.

The 6MWT was performed according to the recommendations of the American Thoracic Society (ATS)[15]. Volunteers were instructed to walk the longest possible distance in six minutes, without trotting or running, in a 30 m corridor limited by two traffic cones, with marks every 3 meters on the way. A standardized verbal encouragement was given every minute. Some items were analyzed before and after the tests: dyspnea, lower extremity fatigue (Borg-CR10 scale)[18], heart rate (Polar Electro Oy – S810, Finland), and blood pressure. The estimated maximum rate was calculated as 220 – age. The final distance of the second test, registered in meters, was used in comparative analyses. The equation to predict walking distances for the Brazilian population was used[19].

The dependent variable was the HPAL, objectively monitored by a uniaxial accelerometer (Power Walker PW-610, YAMAXX, Japan). The equipment is small (48.8x70.7x14.4 mm) and light (34 g). The number of steps was the emphasized variable. Subjects were told to wear the equipment inside their pockets or on their waist during the whole time, except for taking showers and sleeping, for a period of seven days. The device was adjusted according to body weight and mean step length for each subject (measured in 10 m of walking at usual speed). The average number of steps per day (SPD) was calculated in five days of monitoring, including one day on the weekend[20]. Subjects who had SPD≤5,000 were classified as having a sedentary lifestyle[21].

The statistical analysis was performed with the software SigmaStat 2.03 (SPSS, Inc., Chicago, IL, USA) and SPSS 15 (SPSS, Chicago, IL, USA). Data were presented as mean±standard deviation, except when indicated. The normality of variables was assessed with the Kolmogorov-Smirnov test. Correlations between the analyzed variables were assessed by the Pearson's or Spearman's correlation coefficients. Two multiple regression models were developed to compare the influence of the 6MWt and the IPAQ on SPD. In the first model, only the 6MWT and the total IPAQ score were considered as independent variables. In the second model, the 6MWT and demographic and anthropometric variables were included (for instance, age, height, weight and gender). The probability of error α was estimated in 5%.

RESULTS

Thirty-three asymptomatic subjects were assessed (23 women), aged ≥40 years old (Table 1). Two volunteers were former smokers and none of them reported smoking currently. Nine subjects presented normal body mass index (BMI) values, eleven were overweight and thirteen were obese. Seventeen volunteers reported hypertension controlled by medicines and sixteen presented dyslipidemia.

The average number of SPD in the analyzed sample obtained by movement sensor was 10,112±3,761 steps/day. Two volunteers were classified as having a sedentary lifestyle by the SPD, and nineteen presented insufficient SPD to acquire health benefits (≤10,000 steps/day). The mean of the 6MWT in the second test was 552±91 m, which corresponded to 106±14% of the predicted value, which is within the expected for the Brazilian population.

The SPD were correlated with the domains of job-related physical activity (r=0.453; p=0.008), of recreation, sport and leisure-time activities (r=0.518; p=0.002) and with the total IPAQ score (r=0.473; p=0.005); with dyspnea (r=-0.360; p=0.039) and with lower extremity fatigue (r=0.459; p=0.007) at the end of the 6MWT. There was significant correlation between the SPD and the 6MWT (Figure 1). The linear regression analysis comparing the 6MWT to the total IPAQ scores selected only the 6MWT as being determinant of 26.5% of the total variability of SPD. In this model, SPD can be calculated as follows: SPD=-1632, 507+(21, 250, 6MWT); R^2=0.265.

Among the assessed demographic and anthropometric variables, only gender was determinant for SPD. Women performed an average of 2912 less steps then men. The multiple regression model, including the 6MWT and gender, explained 26.6% of the total variability of SPD (Table 2).

DISCUSSION

With this study, it was observed the 6MWT was moderately correlated to the HPAL measured by movement sensors, and the multiple regression model included the 6MWT and gender explaining 36.6% of the total variability of SPD.

As to IPAQ, SPD were correlated to the domains of job-related activity (r=0.453; p=0.008), recreation, sport and leisure-time activities (r=0.518; p=0.002) and with total score (r=0.473; p=0.005) of this questionnaire. However, the linear regression analysis comparing the 6MWT and the total IPAQ score selected only the 6MWT as being determinant for the total variability of the SPD. Our results corroborated other studies that suggest that the correlation between this questionnaire and the movement sensors is not consistent. De Cocker, Bourdeaudhuij e Cardon[22] found a moderate correlation (r=0.37) between total IPAQ score and counting the steps with a pedometer, as well as other authors who, in different populations, observed a weak to moderate correlation

Table 1. Sample characterization

Variable	Male (n=10)	Female (n=33)	Total
Age (years)	65±7	65±8	64±7
Body mass (kg)	79±3	71±8	73±10
Height (cm)	174±8	156±8	160±11
BMI (kg/m²)	26+2	29±4	28±3
6MWT (m)	615±8	530±79	552±91
6MWT (predicted%)	109±15	105±13	106±14
MaxHR (predicted %)	78±11	78±11	78±11
SPD (steps/day)	8966±3098	13169±3443	10112±3761

BMI: Body Mass Index; 6MWT: Six-Minute Walk Test. MaxHR: Maximum heart rate at the end of the walking test; SPD: Average of steps per day.

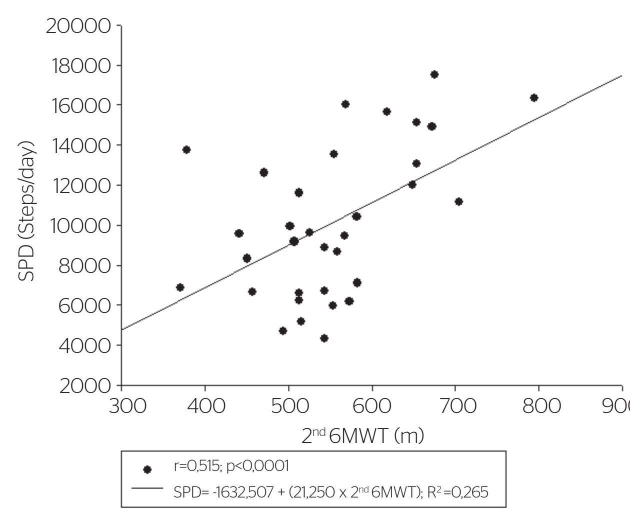

Figure 1. Significant correlation bewteen the average number of steps per day (SPD) and the distance walked in the second six-minute walk test (2nd 6MWT)

Table 2. Results of the multiple linear regression analysis to predict the average of steps per day

	Coefficient	Standard-error	ΔR^2	R^2	p-value
Constant	948,311	3560,305			
6MWT (m)	15,144	6,617	0,265	0,265	0,029
Gender*	2912,826	1333,769	0,101	0,366	0,037

*Gender factor (men=1; women=0); 6MWT: Six-minute walk test. Average number of steps per day (SPD) can be calculated by the equation: SPD (stepd/day)=948,311+(15,144x6MWT)+(2912,826xgender) between the IPAQ and movement sensors[20,23,24]. Despite their advantages, questionnaires present limitations, such as: level of understanding of the participant; ability to remember the activities; size and complexity of the questionnaire; individual characteristics of volunteers (for instance, age, sociocultural level); and the possibility of an incorrect estimate as to time and intensity of activities from the subject[2,3]. According to Steele et al.[9], one of the possible reasons for the modest association between these instruments is that movement sensors can precisely quantify small movements in daily activities, which can pass unnoticed during self-report[9].

In our study, the 6MWT was correlated to the HPAL. So, the ability to walk a longer distance in a determinate period of time partly explains the mean quantity of steps in daily life. The 6MWT, because of its controlled duration, makes it possible to obtain a stable aerobic state after two or three minutes, thus representing the highest walking speed that can be sustained for long periods[16]. This fact can partly explain the good correlation that the test can present with the performance of daily physical activity. The ability to walk longer distances is associated with the better general health status of the patients with chronic diseases and elderly asymptomatic subjects[25].

Similar comparisons have been made in studies involving patients with COPD. Steele et al.9 used a triaxial accelerometer to measure the HPAL in 47 patients (44 men) with COPD. The authors observed a significant correlation between the 6MWT and accelerometry ($r=0.74$; $p<0.001$). According to the authors, "the narrow association between the movement sensor activity and the 6MWT supports the statement that the 6MWT is parallel to the level of activity regularly presented by the patients in their daily lives"[9].

Pitta et al.[8] used a sophisticated motor sensor (Dynaport Activity Monitor; McRoberts BV) in 50 patients with COPD. The equipment was able to identify the time spent walking, cycling, standing, sitting and lying down, as well as the intensity of the movement while walking. A strong correlation between walking time and the 6MWT ($r=0.76$; $p=0.0001$), but the 6MWT was the main determining factor of the walking time per day, after the multiple regression analysis ($R^2=0.56$; $p<0.0001$). In this same study, the 6MWT was able to identify the patients during daily activities, and the patients who walked less than 400 m in the 6MWT were considered as extremely inactive in their daily lives.

Hernandez et al.11 studied the correlations between the exercise functional ability assessed by the 6MWT and the HPAL in 40 Brazilian patients with COPD paired with 30 healthy elderly participants. A moderate correlation was found between accelerometry (walking time per day and movement intensity) and the 6MWT. In the group of healthy elderly, only the movement intensity was correlated with the 6MWT. These authors point out that the relationship was less narrow ($r=0.42$) than in other studies, which was explained by the higher level of physical activity of this sample of patients in comparison to the aforementioned studies. Bertici et al.[12] also found a moderate correlation between pedometry and the 6MWT in patients with COPD.

Hill et al.[10] compared how much the 6MWT performance is associated with the mean daily energy expenditure assessed by a movement sensor, with the objective of knowing the exercise ability tests can provide information on daily physical activity. Also, a significant correlation ($r-0.40$; $p=0.046$) was found between the 6MWT and the HPAL, and the association is higher when using the product of the 6MWT by the body moss, and this calculation represents the work performed during walking. These authors found a weaker correlation than the ones described in previous studies, suggesting that weaker associations are found when the health impairment of the patients is more modest (6MWT>400 m)[10]. Likewise, in our study a moderate correlation was found ($r=0.51$) in subjects who walked in average 552±91 m, which is different from the consistent correlation observed in some of the studies in patients with respiratory disease[8,9].

Also in the work by Hill et al.[10], the Incremental Shuttle Walk Test (ISWT) was studied. It was identified that patients who walked more than 450 m in the ISWT performed enough physical activity to bring health benefits into their daily lives. In this sense, functional ability tests can be a screening tool to identify sedentary or active patients[10]. The ability to identify which subjects are more physically inactive allows a better approach in the implementation of physical activity prpograms[10]. Our sample was not sufficient to develop a ROC curve and establish a 6MWT able to diagnose physical inactivity with proper sensitivity and specificity in asymptomatic adults and elderly. The definition of this index in future studies could provide subsides in order for the 6MWT to be applied as a simpler and less expensive strategy than movement sensors, and more reliable than questionnaires in clinical contexts and in epidemiological studies to identify physical inactivity.

Aiming to determine how much the 6MWT can predict the daily walking activity, Fulk et al.[14] compared the register of a movement sensor with the 6MWT and other clinical measurements in a group of patients who suffered a stroke. Only the 6MWT was a strong predictor of the average number of steps per day. The multiple regression equation was determined, being the 6MWT able to explain 46% of the variability of the number steps per day. The authors suggested that the 6MWT is important to guide interventions and provide a view on the daily waking of these patients, at home or outside.

Data related to this comparison in healthy subjects are rare in literature. In the study by Pitta et al.[8], 26 healthy subjects were assessed (17 men). After the multiple regression analysis, the 6MWT did not present a determining correlation with daily walking time, explaining only 7% of the total variability of this variable. The different results found in the study by these authors in comparison to this study can be explained by the different characteristics of our sample, comprised of nonsmokers and more women. Besides, the assessment instrument used in the study by Pitta et al.[8] was different than the one used in our study, as well as the protocol used to perform the 6MWT.

Even though it is an efficient instrument to measure the HPAL, the movement sensor is limited, unable to distinguish activities in inclined planes and to monitor activities performed with the upper limbs, which do not involve horizontal dislocation or actions inside water[3,9]. Another limitation of our study was the convenience sample, which resulted in more women considering the difficulty to recruit male, elderly and asymptomatic participants.

CONCLUSION

We can conclude that the 6MWT was moderately correlated with the HPAL. However, in relation to gender, the 6MWT was able to properly explain the total variability of the SPD.

REFERENCES

1. Steele BG, Belza B, Cain K, Warms C, Coppersmith J, Howard J. Bodies inmotion: monitoring daily activity and exercise with motion sensors in people with chronic pulmonary disease. J Rehabil Res Dev. 2003;40(5 Suppl 2):45-58.
2. Pitta F, Troosters T, Probst VS, Spruit, MA, Decramer M, Gosselink R. Quantifying physical activity in daily life with questionnaires and motion sensors in COPD. Eur Respir J. 2006;27(5)):1040-55.
3. Amorim PRS, Gomes TNP. Gasto energético na atividade física: pressupostos, técnicas de medida e aplicabilidade. Rio de Janeiro: Shape; 2003.
4. International Physical Activity Questionnaire [Internet]. 2005 [acesso mai 2009]. Disponível em: www.ipaq.ki.se.
5. Bauman A, Bull F, Chey T, Craig CL, Ainsworth BE, Sallis JF et al. The International Prevalence Study on Physical Activity: results from 20 countries. Int J Behav Nutr Phys Act. 2009;31;6(1):21.
6. Barros MVG, Nahas MV. Reprodutibilidade (teste-reteste) do Questionário Internacional de Atividades Físicas (QIAF-Versão 6): um estudo-piloto com adultos no Brasil. Rev Bras Ciênc Mov. 2000;8(1):23-6.
7. Tudor-Locke C, Williams JE, Reis JP, Pluto D. Utility of Pedometers for assessing Construct Validity. Sports Med. 2004;34(5):281-91.
8. Pitta F, Troosters T, Spruit MA, Probst VS, Decramer M, Gosselink R. Characteristics of physical activities in daily life in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2005;171(9):972-7.
9. Steele BG, Holt L, Belza B, Ferris S, Lakshminaryan S, Buchner DM. Quantitating physical activity in COPD using a triaxial accelerometer. Chest. 2000;117:1359-67.
10. Hill K, Dolmage TE, Woon L, Coutts D, Goldstein R, Brooks D. Defining the relationship between average daily energy expenditure and field-based walking tests and aerobic reserve in COPD. Chest. 2012;141(2):406-12.
11. Hernandes NA, Teixeira DC, Probst VS, Brunetto AF, Ramos EM, Pitta F. Profile of the level of physical activity in the daily lives of patients with COPD in Brazil. J Bras Pneumol. 2009;35(10):949-56.
12. Bertici N, Fira-Mlădinescu O, Oancea C, Tudorache V. The usefulness ofpedometry in patients with chronic obstructive pulmonary disease. Multidiscip Respir Med. 2013;8(1):7.
13. Fulk GD, Reynolds C, Mondal S, Deutsch JE. Predicting home and community walking activity in people with stroke. Arch Phys Med Rehabil. 2010;91(10):1582-6.
14. Dourado VZ. Equações de referência para o teste de caminhada de seis minutos em indivíduos saudáveis. Arq Bras Cardiol. 2011;96:e128-38.
15. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-7.
16. Casas A, Vilaro J, Rabinovich R, Mayer A, Barberà JA, Rodriguez-Roisin R et al. Encouraged 6-min Walking Test Indicates Maximum Sustainable Exercise in COPD Patients. Chest. 2005;128:55-6.
17. Thomas S, Reading J, Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Can J Sport Sci. Human Kinetics. 1992;17(4):338-345.
18. Borg G. Escala CR10 de Borg. In: Escalas de Borg para dor e esforço percebido. São Paulo: Manole; 2000.
19. Iwama AM, Andrade GN, Shima P, Tanni SE, Godoy I, Dourado VZ. The six-minute walk test and body weight-walk distance product in healthy Brazilian subjects. Braz J Med Biol Res. 2009;42(11):1080-5.
20. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-95.

21. Tudor-Locke C, Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 2004;34(1):1-8.

22. De Cocker KA, De Bourdeaudhuij IM, Cardon GM. What do pedometer counts represent? A comparison between pedometer data and data from four different questionnaires. Public Health Nutr. 2009;12(1):74-81.

23. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski EL. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. Rev Bras Med. Esporte. 2007;13(1):11-6.

24. Benedetti TRB, Mazo GZ, Barros MV. Aplicação do Questionário Internacional de Atividade Física para avaliação do nível de atividades físicas de mulheres idosas: validade concorrente e reprodutibilidade teste/reteste. Rev Bras Ciên Mov. 2004;12(1):25-33.

25. Enright PL, McBurnie A, Bittner V, Tracy RP, McNamara R, Arnold A, Newman AB. The six-min walk test: a quick measure of functional status in elderly adults. Chest. 2003;123(2):387-98.

23. Benedetti TRB, Antunes PC, Rodriguez-Añez CR, Mazo GZ, Petroski EL. Reprodutibilidade e validade do Questionário Internacional de Atividade Física (IPAQ) em homens idosos. Rev Bras Med. Esporte. 2007;13(1):11-6.

24. Benedetti TRB, Mazo GZ, Barros MV. Aplicação do Questionário Internacional de Atividade Física para avaliação do nível de atividades físicas de mulheres idosas: validade concorrente e reprodutibilidade teste/reteste. Rev Bras Ciên Mov. 2004;12(1):25-33.

25. Enright PL, McBurnie A, Bittner V, Tracy RP, McNamara R, Arnold A, Newman AB. The six-min walk test: a quick measure of functional status in elderly adults. Chest. 2003;123(2):387-98.