137 - FACTORS RELATED TO THE ACCURACY OF PEDOMETERS IN ADULTS WALKING AT THEIR USUAL SPEED.

FRANCYELLE DOS SANTOS SOARES[1,2]
RAFAEL CASTANHO[1]
MARIANA PUHL[1]
FENG HSIU HSIEH[1]
FÁBIO PITTA[2]
1 - Universidade Estadual do Oeste do Paraná (UNIOESTE), Cascavel/PR/Brasil.
2 - Universidade Estadual de Londrina (UEL), Londrina/PR/Brasil.
franfisio@hotmail.com

INTRODUCTION

Quantifying the physical activity performed during daily life in a valid and accurate way has gained growing interest and relevance, since the relation between inactivity and high rates of morbidity and mortality has already been established (13). A pedometer is an economically accessible movement sensor, capable of quantifying the number of steps taken by an individual in a determined period (28). Considering that physical activities which implicate in walking are very frequent in real life (20), pedometers are useful not only for evaluation (14) but also as an incentive to the usual practice of physical activity (2).

There are several available publications in the literature about pedometers (15,26,27). Nevertheless, there are still aspects not fully defined, e.g., the influence factors such as the user's body mass index (BMI) and the kind of trajectory in which the subject walks (flat ground, stairs, inclined ramp, curves). In daily life, individuals with different body characteristics walk in non-horizontal trajectories, such as upward and downward ramps and stairs, not to mention that they frequently do not walk in a straight line (especially in indoor environments). For these reasons, it is important to determine how much these factors affect the accuracy of pedometers. Therefore, the objective of this study was to evaluate the influence of the side of equipment placement (right or left waist), of anthropometric characteristics and of different walking trajectories on the accuracy of a pedometer.

METHODS

Sample

For this cross-sectional study, 100 subjects from a convenience sample were included. The individuals were apparently healthy, of both genders, from 18 up to 59 years old, employees or students of an University Hospital without gait alterations due to orthopedic, vascular or neurologic problem. The study was approved by the Research Ethics Committee under the resolution number 199/06. For each participant the following was recorded: age (years), gender, height (m) and weight (Kg) measured in a previously calibrated anthropometric mechanical scale (Welmy Ind. e Com. Ltda, Brazil), as well as the dominant lower limb. Calculation of the body mass index (BMI) was performed according to the formula: weight (Kg) divided by square height (m2). According to the BMI classification adopted by the World Health Organization (29), subjects were divided in three subgroups: eutrophic (EG: 18.5 to 24.9 Kg/m²; n=40), overweight (OWG: 25 to 29.9 Kg/m²; n=30) or obese (OBG: higher or equal 30 Kg/m²; n=30).

Protocol

After obtaining the anthropometric data, one pedometer Yamax DigiWalker SW-701 (Yamax Inc.,Tokio, Japan) was put at the waistline of the volunteer (right hemiclavicular line). Among the different types of available pedometers, this was chosen for being more accurate when compared to others of similar mechanism (19). The researcher assured that the equipment was firmly attached to the belt or clothing and in a vertical position in relation to the body. According to the inclination of the surface and the walking trajectory, the pre-determined routes for the tests were: straight line on the level (SLL), walking in curves (or “zigzag”) on the level (WCL), ascending ramp (AR), descending ramp (DR), upstairs (US) and downstairs (DS). Each trajectory had its own lane, and for each test, the subject was conducted to the beginning of the lane and the pedometer was then set to zero.

In all the lanes the subject walked in straight line, except for the “zigzag” lane. At the latter, the subject took about three steps forward and to the left, then three steps forward and to the right and so on, making soft successive bends to both sides, developing a non-straight pattern which was similar among all the individuals. In all trajectories, the subject took 50 steps at his usual walking speed, accompanied by the researcher. Immediately at the end of the 50 steps, counted by the researcher and by the volunteer, the number of steps detected by the pedometer was recorded. If there was no agreement between the volunteer and researcher counting, the test was repeated. The order of the tests was random. The steps were 17 cm high and 33 cm depth, whereas the ramp had approximately 8% of inclination.

Statistical analysis

The groups comparison concerning their characteristics (age, height, weight, BMI) was performed by One-way ANOVA, whereas for the gender comparison the Chi-square test was used. The accuracy of the pedometers was studied according to the percentage of steps correctly detected by the equipment in relation to the steps counted by the researcher [(steps recorded by the pedometer / steps counted by the researcher) x 100] (7), and this was the variable used for the analyses between the groups and trajectories (26). The acceptable error in this kind of protocol is 5%, and therefore the acceptable values for accuracy werre between 95% and 105% (25). Consequently, results below 95% indicate underestimation and results above 105% indicate overestimation of the detection of actual steps taken.

The effects of BMI and the trajectories on the accuracy were studied by the One-way ANOVA, followed by the Tukey post-test when appropriate. For the analysis of the effects of BMI, non-repeated measures were used whereas for the effects of the trajectories, repeated measures were used. The normality of data distribution was shown by the Kolmogorov-Smirnov test.The correlation between age, height, weight and BMI with the pedometer accuracy was performed by the Pearson correlation coefficient.

The statistical power of the study (0.92) was calculated as follows: the difference between the average of steps detected in the obese and eutrophic groups in all the trajectories, divided by the standard deviation of the whole sample, taking into consideration the statistical significance of 5% (4). For the statistical analysis, the softwares Epiinfo 3.3.2TM (Atlanta, GA, EUA) and GraphPad Prism 3.0 (San Diego, CA, EUA) were used. Data were described as average, standard deviation and 95% confidence interval. The statistical significance level was set as 5%.

RESULTS

Characteristics

The characteristics of the subjects are shown in table 1. There was no statistically significant difference among the groups concerning age and height. Despite the number of women was higher than that of men, this was proportional in all groups, and therefore there were no differences in gender proportion among them. As expected, the body mass index (and the body weight) showed statistically significant differences among the groups, since this was their classification criterion. The majority of the individuals (96%) reported dominance of the right lower limb.

Table 1. Characteristics of all participants and of each group classified according to the body mass index (BMI)

	All (n-100)	EG (n=40)	OWG (n=30)	OB(n=30)	p
Age (years)	....	31 ± 10	36 ± 11	36 ± 11	0.096
Weight (Kg)	73 ± 15	60 ± 8	74 ± 9	89 ± 10	< 0.0001
Height (cm)	165 ± 9	166 ± 9	165 ± 10	164 ± 9	0.609
BMI ($Kg.m^{-2}$)	27 ± 5	22 ± 2	27 ± 2	33 ± 3	< 0.0001
Gender (F/M)	67/33	26/14	18/12	23/7	0.367 (χ^2 = 2.01)

Data are presented as mean ± standardl. χ2= Chi-square for the gender comparison among the groups

Analysis of the factors related to the accuracy of the pedometer

Both the BMI and the type of trajectory affected significantly the accuracy of the pedometer. Regarding the BMI, the obese group showed significant underestimation when compared to the eutrophic and overweight groups, with an average error of 13% in relation to the actual step counting when all trajectories are considered jointly. Regarding the different types of trajectories, the accuracy of the pedometer was similar except for walking in curves (or "zigzag"), which presented statistically significant underestimation in relation to the other trajectories ($p<0.001$ versus all the others). Walking in downward trajectories (ramp and stairs) yielded the best accuracy in step detection, followed by walking in straight line on the level, walking in upward trajectories (ramp and stairs) and walking in curves (table 2).

Table 2. Percentage of correct step detection by the pedometer, shown as mean ± standard deviation, in different trajectories and groups divided according to BMI.

Groups	Trajectories						
	SLL	WCL	AR	DR	US	DS	All trajectories
EG	98 ± 9	93 ± 16	100 ± 6	101 ± 4	98 ±7	100 ± 5	98 ± 6
OWG	100 ± 11	93 ± 15	99 ± 8	102 ± 4	100 ± 6	99 ± 7	99 ± 6
OBG	89 ± 22 *	80 ± 27 *	85 ± 30 *	92 ± 17*	85 ± 27 *	92 ± 16 *	87 ± 19 *
All subjects	96 ± 15†	90 ± 20	95 ± 17†	98 ± 10†	95 ±17†	97 ± 11†	

* $p<0.05$ versus eutrophic and versus overweight; † $p< 0.05$ versus all the other trajectories.

Although only modestly, the factor which showed higher correlation with the pedometer accuracy considering all trajectories jointly was the BMI, showing an inverse correlation ($r = -0.41$; $p<0.0001$) (table 3). Table 3 also shows that other negative and weak correlations were observed,but the BMI was the only anthropometric characteristic to correlate significantly with each kind of trajectory.

Table 3. Correlation between the pedometer percentage of correct step detection (accuracy) and other factors in each trajectory

Characteristics	All trajectories	SLL	WCL	AR	DR	US	DS
Age (years)	-0,22[a]	0,02	-0,23[a]	-0,21[a]	-0,17	-0,20	-0,30[b]
Heigh (m)	0,17	0,06	0,22[a]	0,18	0,10	0,08	0,16
Body mass(Kg)	-0,26[b]	- 0,20[a]	-0,16	- 0,25[a]	-0,29[b]	-0,22[a]	-0,22[a]
BMI (Kg/m^2)	-0,41[d]	-0,26[b]	-0,32[b]	-0,41[d]	-0,40[d]	-0,31[b]	-0,33[c]

Statistically significant correlations (Pearson's): a $p<0.05$; b $p<0.01$; c $p<0.001$; d $p<0.0001$.

DISCUSSION

The present study showed that BMI correlates negatively with the equipment's accuracy, affecting it in a significant way. Furthermore, the walking trajectory reduces significantly the accuracy of the measurement only when curves are frequently performed.

The three groups, divided according to the BMI, were homogeneous in terms of gender and age. Concerning gender, Kerrigan et al. (09) have demonstrated that, despite the fact that there are differences between men and women in the biomechanics of the hip, knees and ankles, individuals of both genders present similar walking speed. In addition, Leicht & Crowther (11) showed that there are no significant differences in the accuracy of step detection by pedometers when men and women walk along paved ground, with average errors of 2.3% e 2.9%, respectively. Therefore, although the present sample had predominance of females, all groups had similar proportion of men and women, indicating that gender was not an influencing factor in the present results. Concerning age, it was chosen a wide age range which was representative of the adult population, although it did not include elderly, i.e., individuals over 59 years old. There are reports in the literature which demonstrate that, in healthy elderly, there is step underestimation of 10 % (12) and 13% (6) when these individuals walk at their usual speed. Therefore, the inclusion of elderly individuals in the present study would bring a confounding factor that would make the interpretation of results very difficult.

The influence of the BMI on the accuracy of pedometers is not a novel finding. Crouter et al.(5), evaluating overweight and obese individuals all together, also identified that the Yamax SW701 significantly underestimates step counting in these subjects. Melanson et al.(12) studied subjects walking at their usual speed and also identified underestimation in obese individuals, with an average percentage of error similar to the present study (11% and 13%, respectively). Tyo et al.(24) showed in a recent study that the same pedometer, when used in obese adults, generates twice as much error than in eutrophic and that this

equipment should not be used to correlate walking volume and adiposity. Swartz et al.(22) did not find statistically significant differences among groups divided according to their body composition, although there were less obese individuals in that study (n=17) than in the present one (n=30). The contribution of the present study for the current literature lies on the fact that three different categories of BMI were compared, being possible to demonstrate that the accuracy of the pedometer is not significantly affected in eutrophic and overweight individuals, but just in obese. The obese group had a proportion of steps not detected which outnumbered the accepted level in the clinical practice, reinforcing the current message that pedometers with spring mechanisms are not adequate equipment for an accurate assessment in this group of individuals.

Two factors might explain the influence of the BMI on the accuracy of step detection by pedometers: incorrect positioning of the equipment and variations of the gait pattern. Crouter et al. (5) verified the accuracy of two kinds of pedometers when used in individuals with BMI above 25 Kg/m2 and concluded that the spring pedometers were less accurate equipment's angle of inclination in relation to the trunk increased. Therefore, the fact that the pedometer does not stay in a strictly vertical position in individuals with high BMI (and consequently large abdominal circumference) is one of the explanations for the underestimation, since spring pedometers depend on the hip vertical acceleration which achieves a force threshold of 0.35g (26) in order to detect steps accurately. The same study demonstrated that, in obese, spring pedometers generate underestimation in a wide range of walking speeds (3.2 to 5.6 Km/h), indicating that walking speed is not a significant factor in the explanation of the step detection inaccuracy in this group.

Concerning the gait patterns of obese individuals, Browning et al. (3) have demonstrated that obesity significantly increases the energy expenditure during walking in both genders. In order to minimize this fact and make the gait as efficient as possible, obese subjects use some unconscious adaptations to decrease the component of internal work of the gait (muscular contraction). Some of these adjustments were studied by Lai et al (10) who made a tridimensional analysis of the gait in obese adults and proved that they increase the abduction angle of the lower limb in the balance phase, keep the lower limbs in a more extended position during all phases and keep a more straight posture. The inverted pendulum movement is then favored, leading to less muscle contraction and consequently less energy spent in walking. This gait variation, with more pronounced lateral movement, might be another factor contributing to the inaccuracy of spring pedometers in these subjects.

Besides the evaluation at a straight line, pedometer accuracy has already been assessed in stairs, although with different methodology than the present study (fewer steps; another model of pedometer known as less accurate; smaller number of participants; sample including elderly and patients who had undergone lower limbs surgery) (21). Recently, Horvath et al.(8) evaluated 20 subjects using pedometers Yamax taking 70 steps upstairs and downstairs at their usual speed and found average values of 96% and 98% of correct detection, respectively, which are values almost identical to the ones in the present study (95% and 97% respectively). Ayabe et al.(1), also using Yamax pedometers, showed that this equipment was accurate in trajectories upstairs and downstairs (95% and 105%, respectively), when the cadence was between 80 and 120 steps per minute. Both aforementioned studies showed that the accuracy in the downward trajectory was higher than in the upward, corroborating data from the present study. Teh & Aziz (23) demonstrated that the cadence chosen by the majority of adult subjects when walking in staircases is between 95±14 steps/minute on the way up e 106±14 steps/minute on the way down, therefore including the cadence tested by Ayabe et al.(1). Walking downstairs has a higher cadence since there is direct help from the gravity when taking the steps. Walking faster downward implicates in walking more vigorously and with higher vertical impact (18). Therefore, the self-determined higher speed in downward trajectories (ramps and stairs) explains the somewhat better accuracy in comparison to upward trajectories.

The results showed that walking in “zigzag” presented statistic difference in comparison to all the other trajectories, as well as it presented error larger than 5% in relation to the real. This means that walking in curvilinear trajectory generates inaccuracy when using the pedometer. We hypothesized that this can be explained due to variations in the balance phase and weight transference during the gait, with less hip vertical movement (that does not achieve the force threshold) and, possibly, slower speed. It is important to emphasize that the pedometer is accurate in the majority of daily situations. However, populations which remain in very restrict environments (e.g: indoors), and therefore perform constant direction changes with curves, are likely to have their number of steps underestimated. In this situation, it is suggested that devices with lower threshold are used (e.g. accelerometers).

The lack of knowledge of the speed in which each subject walked in the different trajectories might be a limiting factor to the interpretation of this study's results. However, as described in the methodology, the subject was instructed to walk in his or her usual speed. Therefore, we believe that this limitation is counteracted by the fact that the usual walking speed of subjects between 18 and 59 years old (age range similar to the present sample) is known: 4.8 Km/h, i.e., compatible with a speed that generates adequate accuracy in eutrophic individuals (12). Another potential limitation of this study was the absence of an objective method that allowed to assure the number of steps developed by each individual. However, the mandatory agreement between the number of steps counted by the subject and by the researcher suggests that the possibility of counting errors is unlikely.

In summary, it was concluded that the accuracy of step detection by the Yamax DigiWalker SW701 pedometer in healthy adults walking at their usual speed is affected by the BMI and the trajectory. The BMI showed negative relation to the equipment accuracy, and this fact restricts the use of pedometers in obese, but not in overweight subjects. Finally, it was demonstrated that walking in curvilinear trajectory decreases the pedometer accuracy in all subjects, regardless of the BMI.

REFERENCES

1. Ayabe M, Aoki J, Ishii K, Takayama K and Tanaka H. Pedometer accuracy during stair climbing and bench stepping exercises. J Sports Sci & Med 2008; 7: 249-54.

2.Bravata DM, Smith-Splanger C, Sundaram V, et al. Using pedometers to increase physical activity and improve health: a systematic review. JAMA 2007; 298 (19): 2296-304.

3.Browning RC, Baker EA, Herron JA, Kram R. Effects of obesity and sex on the energetic cost and preferred speed of walking. J Appl Physiol 2006; 100: 390-8.

4.Cohen J. Statistical Power Analysis for the Behavioral Sciences, 3rd ed. New York (NY): Academic Press; 1988, 75-83 p.

5.Crouter SE, Schneider PL and Basset Jr DR. Spring-levered versus piezo-eletric pedometer accuracy in overweight and obese adults. Med Sci Sports Exerc 2005; 37 (10): 1673-9.

6.Cyarto EV, Myers AM and Tudor-Locke C. Pedometer accuracy in nursing home and community-dwelling older adults. Med Sci Sports Exerc 2004; 36 (2): 205-9.

7.Foster RC, Lanningham-Foster LM, Manohar C, et al. Precision and accuracy of an ankle-worn accelerometer-based pedometer in step counting and energy expenditure. Prev Med 2005; 41: 778-83.

8.Horvath S, Taylor DG, Marsh JP and Kriellaars DJ. The effect of pedometer position and normal gait asymmetry on step count accuracy. Appl Physiol Nutr Metab 2007; 32: 409 -15.

9.Kerrigan C, Todd MK and Croce UD. Gender differences in joint biomechanics during walking: normative study in young adults. Am J Phys Med Rehabil 1998; 77: 2-7. .

10.Lai PPK, Leung AKL, Li ANM, Zhang M. Three dimensional gait analysis of obese adults. Clin Biomechanics 2008; 23 (sup 1): S2 – S6

11.Leicht AS & Crowther RG. Pedometer accuracy during walking over different surfaces. Med Sci Sports Exerc 2007; 39 (10): 1847-50.

12.Melanson EL, Knoll JR, Bell ML, et al. Commercially available pedometers: considerations for accurate step counting. Prev Med 2004; 39: 361-68.

13.Pate RR, Pratt M, Blair SN, et al. Physical activity and public health : a recommendation from the centers for disease control and prevention and the American College of Sports Medicine. JAMA 1995; 273 (5): 402-7.

14.Pitta F, Troosters T, Probst VS, Spruit MA, Decramer M and Gosselink R. Quantifying physical activity in daily life with questionnaires and motion sensors in COPD. Eur Respir J 2006; 27:1040-55.

15.Richardson CR, Newton TL, Abraham JJ, Sen A, Jimbo M, Swartz AM. A Meta-analysis of pedometer-based walking interventions and weight loss. Ann Fam Med 2008;6:69-77.

16.Rowlands AV, Stone MR and Eston RG. Influence of speed and step frequency during walking and running on motion sensor output. Med Sci Sports Exerc 2007; 39 (4): 716-27.

17.Sadeghi H, Allard P, Prince F, Labelle H. Symmetry and limb dominance in able-bodied gait: a review. Gait and Posture 2000; 12:34-45.

18.Scharff-Olson M, Williford HN, Blessing DL, Moses R and Wang T. Vertical impact forces during step aerobics: exercise rate and experience. Percept Mot Skills 1997; 84:267-74.

19.Schneider PL, Crouter SE and Basset Jr DR. Pedometer measures of free-living physical activity: comparison of 13 models. Med Sci Sports Exerc 2004; 36 (2): 331-5.

20.Schutz Y, Weinssier RL and Hunter GR. Assessment of free-living physical activity in humans: an overview of currently available and proposed new measures. Obes Res 2001; 9 (6): 368-79.

21.Shepherd EF, Toloza Eileen, McClung CD and Schmalzried TP. Step activity monitor: increased accuracy in quantifying ambulatory activity. J Orthop Res 1999; 17 (5): 703-8.

22.Swartz AM, Basset Jr DR, Moore JB, Thompson DL and Strath SJ. Effects of body mass index on the accuracy of an electronic pedometer. Int J Sports Med 2003; 24: 588-92.

23.Teh KC & Aziz AR. Heart rate, oxygen uptake, and energy cost of ascending and descending the stairs. Med Sci Sports Exerc 2002; 34 (4): 695-9. .

24.Tyo BM, Fitzburg EC, Basset Jr DR, John D, Feito Y e Thompson DL. Effects of body mass index and step rate on pedometer error in a free-living environment. Med Sci Sports Exerc 2011; 43 (2): 350-356

25.Tudor-Locke C, Sisson SB, Lee SM, Craig CL, Plotnikoff RC, Bauman A. Evaluation of quality of commercial pedometers. Can J Public Health 2006; 97: S10-6.

26.Tudor-Locke C, Williams JE, Reis JP and Pluto D. Utility of pedometers for assessing physical activity: convergent validity. Sports Med 2002; 32 (12): 795-808.

27.Tudor-Locke C, Williams JE, Reis JP and Pluto D. Utility of pedometers for assessing physical activity: construct validity. Sports Med 2004; 34 (05): 281-91.

28.Welk GJ, Differding JA, Thompson RW, Blair SN, Dziura J and Hart P. The utility of the Digiwalker step counter to assess daily physical activity patterns. Med Sci Sports Exerc 2000; 32 (9): S481-8.

29.World Health Organization (WHO). Obesity: Preventing and managing the global epidemic. Report of a WHO consultation on obesity. Geneva: The Organization; 2000.

Colegiado do Curso de Fisioterapia da UNIOESTE
Rua Universitária,1619. Jardim Universitário.
CEP: 85819110 -Cascavel- PR.
E-mail: franfisio@hotmail.com

FACTORS RELATED TO THE ACCURACY OF PEDOMETERS IN ADULTS WALKING AT THEIR USUAL SPEED.

ABSTRACT

Introduction: A pedometer is an economically accessible movement sensor, capable of quantifying the number of steps taken by an individual. They are useful not only for evaluation but also as an incentive to the usual practice of physical activity. There are several available publications about pedometers nevertheless, there are still aspects not fully defined, e.g., the influence factors such as the user's body mass index (BMI) and the kind of trajectory in which the subject walks (flat ground, stairs, inclined ramp, curves). Objectives: To study the influence of different trajectories and body mass index (BMI) on the accuracy of step detection by a pedometer. Methods: One-hundred healthy subjects from both genders, 18 to 59 years, were divided in three groups according to their BMI: eutrophic (EU; n=40); overweight (OW; n=30) and obese (OB; n=30). While wearing one pedometer Yamax Digiwalker SW-701 placed at the right side of the waist, the subject walked 50 steps at usual speed in six different trajectories: straight line and walking in curves (or "zigzag") on the level, ascending and descending ramps, upstairs and downstairs. Results: As for the BMI, OB showed significant underestimation compared to EU and OW ($p<0.05$ for both). Accuracy was similar and acceptable (error <5%) in the different trajectories except for the "zigzag", which showed lower number of steps detected in comparison to the others ($p<0.05$). Although modestly, the factor which showed higher correlation with the accuracy in all trajectories was the BMI ($r = -0.41$; $p<0.0001$). Conclusions: The accuracy of the Yamax Digiwalker SW-701 pedometer in obese subjects walking at their usual speed is low and negatively related to the BMI. Furthermore, walking in curvilinear trajectory decreases the pedometer accuracy in all subjects, regardless of the BMI.

KEYWORDS: pedometer, body mass index, trajectory.

FACTEURS RELATIFS A LA PRECISION DES PODOMETRES SUR DES ADULTES MARCHANT A LEUR VITESSE USUELLE.

RÉSUMÉ

Introduction: le podomètre est un détecteur de mouvements capable de mesurer le nombre de pas effectués. Il est d'une grande utilité tant pour l'évaluation que pour l'encouragement à la pratique d'activités physiques. Il existe diverses publications disponibles relatives aux podomètres, néanmoins certains de leurs aspects demeurent mal définis. Objectifs: évaluer l'influence du trajet et de l'indice de masse corporelle (IMC) sur la précision de la détection du nombre de pas d'un podomètre. Méthodologie: cent individus sains des deux sexes, de 18 à 59 ans, ont été répartis en trois groupes selon leur IMC: groupe au poids normal (GE ; n=40), groupe en sur-poids (GS ; n=30) et groupe obèse (GO ; n=30). En utilisant un podomètre placé à la ceinture (ligne semi-claviculaire droite), l'individu marchait 50 pas à sa vitesse usuelle, la quantité de pas détectés par le podomètre étant enregistrée par le chercheur. Le test fut réalisé sur 6 trajets: terrain plat en ligne droite, terrain plat en lacets, rampe ascendante et descendante, escalier ascendant et descendant. Résultats : pour l'IMC, le GO démontra une sous-estimation significative comparé au GE et au GS ($p < 0,5$ pour ces deux derniers). La précision fut similaire et acceptable (taux d'erreur < 5 %) sur les différents trajets à l'exception des trajets en lacets qui procurèrent moins de nombres de pas détectés en comparaison de tous les autres ($p < 0,05$). Bien que modérément, le facteur qui a le mieux répondu aux exigences de la précision sur tous les trajets fut l'IMC ($r = -0,41$; $p < 0,0001$). Conclusions: la précision du podomètre Yamax Digiwalker SW-701 sur les obèses marchant à leur vitesse usuelle est basse et inversement proportionnelle à l'IMC. De surcroît, la marche impliquant des déplacements latéraux compromet la précision du podomètre, indépendamment de l'IMC.

MOTS-CLÉS : podomètre, indice de masse corporelle, trajet.

FACTORES RELACIONADOS CON LA PRECISIÓN DE LOS PODÓMETROS EN ADULTOS AL CAMINAR EN SU VELOCIDAD NORMAL.

RESUMEN

Introducción: El podómetro es un sensor de movimiento capaz de cuantificar el número de pasos. Es muy útil para evaluación y también para promover la práctica de actividades físicas. Hay muchas publicaciones disponibles sobre los podómetros, todavía hay algunos aspectos no definidos en su totalidad, tales como: influencia del índice de masa corporal (IMC) de los usuarios y la trayectoria sobre su precisión. Objetivos: evaluar la influencia de la trayectoria y de lo IMC en la precisión de un podómetro. Métodos: Cien sujetos sanos, hombres y mujeres, 18-59 años, fueron divididos en tres grupos según el IMC: grupo de peso normal (GE, n=40), grupo sobrepeso (GS, n=30) y grupo obeso (GO, n=30). Utilizando un podómetro Yamax Digiwalker SW-701 colocado en la cintura (línea media clavicular derecha), el individuo caminó 50 pasos con velocidad habitual y entonces la cantidad de pasos detectados por el podómetro fue registrada por el investigador. La prueba se realizó en seis diferentes caminos: superficie plana en línea recta y en curva (o "zig-zag"), rampa de ascenso y descenso, escalera de ascenso y descenso. Resultados: Referente al IMC, GO mostró subestimación significativa en comparación con GE y GS ($p <0,05$ para ambos). La precisión fue similar y aceptable (error <5%) en los diferentes caminos, excepto en las curvas, lo que generó un menor número de pasos identificados en relación con todos los otros grupos ($p <0,05$). Aunque moderado, el factor que mejor se correlacionó con la precisión en todas las rutas fue el IMC ($r = -0,41$, $p <0,0001$). Conclusiones: La precisión del podómetro Yamax SW-701 Digiwalker en obesos al caminaren en su velocidad habitual es baja e inversamente relacionada con el IMC. Además, caminar en zig-zag compromete la precisión del contador de pasos, independientemente del IMC.

PALABRAS CLAVE: Podómetro, índice de masa corporal, trayectoria

FATORES RELACIONADOS À ACURÁCIA DE PEDÔMETROS EM ADULTOS CAMINHANDO EM SUA VELOCIDADE USUAL.

RESUMO

Introdução: O pedômetro é um sensor de movimento capaz de quantificar o número de passos efetuados por um indivíduo. É de grande utilidade tanto para avaliação como para incentivo à prática de atividades físicas. Existem diversas publicações disponíveis acerca de pedômetros, porém ainda existem alguns aspectos não totalmente definidos, como: influência do índice de massa corpórea (IMC) do usuário e do percurso no qual este caminha sobre sua acurácia. Objetivos: Avaliar a influência do trajeto de caminhada e do IMC sobre a acurácia na detecção do número de passos por um pedômetro. Metodologia: Cem indivíduos saudáveis, de ambos os sexos, 18-59 anos, foram divididos em três grupos de acordo com o IMC: grupo eutrófico (GE; n=40); grupo sobrepeso (GS; n=30) e grupo obeso (GO; n=30). Utilizando um pedômetro Yamax Digiwalker SW-701 posicionado na cintura (linha hemiclavicular direita), o indivíduo caminhava 50 passos com velocidade usual e então a quantidade de passos detectados pelos pedômetros era registrada pelo pesquisador. O teste foi realizado em seis diferentes trajetos: terreno plano em linha reta, terreno plano em curvas ou “zigue-zague”, rampa ascendente e descendente, escada ascendente e descendente. Resultados: Quanto ao IMC, o GO demonstrou subestimação significativa quando comparado ao GE e GS ($p<0,05$ para ambos). A acurácia foi similar e aceitável (erro < 5%) nos diferentes trajetos exceto no deslocamento em curvas, que gerou menor número de passos detectados em relação a todos os demais ($p<0,05$). Embora moderadamente, o fator que melhor se correlacionou com a acurácia em todos os trajetos foi o IMC ($r = -0,41$; $p<0,0001$). Conclusões: A acurácia do pedômetro Yamax Digiwalker SW-701 em obesos caminhando em sua velocidade usual é baixa e inversamente relacionada ao IMC. Além disso, a caminhada envolvendo deslocamentos em curva compromete a acurácia do pedômetro, independentemente do IMC.

PALAVRAS-CHAVE: pedômetro, índice de massa corpórea, trajeto.