Journal of Exercise Physiology**online**

**December 2012**
**Volume 15 Number 6**

**JEPonline**

Official Research Journal of the American Society of Exercise Physiologists

ISSN 1097-9751

# Effects of Different Environments on the Number of Steps and Heart Rate of Obese Women Workers

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## ABSTRACT

**Timossi LS, Osiecki ACV, Leite N, Francisco AC, Osiecki, R**. Effects of Different Environments on the Number of Steps and Heart Rate of Obese Women. **JEPonline** 2015;15(6):120-127. The aim of this study is to compare the number of steps, cadence, speed of walk, distance walked, and heart rate of obese women workers during a 30-min walk in two different conditions. The study investigated 15 obese women (45.06 ± 8.42 yrs of age and BMI of 34.94 ± 2.99 $kg \cdot m^{-2}$). Each subject had a session of familiarization and two experimental sessions held at random which consisted of 30 min of walking in a laboratory and outside of a laboratory. During each session of walking the number of steps, cadence, speed, and distance were measured. The data were analyzed using a paired t-test. The alpha level for statistical significance was set at $P<0.05$. The number of steps (3829 ± 400 / 3631 ± 466), cadence (127.6 ± 15 / 121 ± 16), speed (1.39 ± 0.08 / 1.31 ± 0.10), and distance (2508 ± 151 / 2349 ± 193) during 30 min of walking outside were significantly higher in comparison to the same variables during walking in the laboratory ($P<0.05$). However, there was no significant difference ($P>0.05$) in heart rate between the two walking conditions (72.02 ± 7.63 and 72.35 ± 7.47, laboratory vs. outside, respectively). Although walking outside was characterized by a different gait pattern from that of walking inside, the heart rate of the subjects was the same.

**Key Words**: Physical Activity, Walk, Pedometer, Women, Employees

## INTRODUCTION

In the past decades, the prevalence of obesity has substantially increased. This is a major concern since obesity is associated with a higher rate of morbidity and mortality (3,5). With the intent to minimize and/or alter this statistical relationship, it has become common practice to encourage the practice of walking. Obese individuals, in particular, benefit from regular exercise since it results in positive physiological benefits (6). Despite the fact that the benefits of regular exercise have been well described in literature, there is a reversed relationship between obese individuals and their desire (or willingness) to participate in programs of physical activity (2).

Based on these presuppositions, previous studies have examined alternatives to increase motivation for and participation in programs of physical activity by the obese population (7,9). For example, Pal and colleagues (9) reported that the use of pedometers was associated to a significant increase in the level of physical activity by overweight and obese women. The feedback on the count of steps provided by the pedometer has been connected to increased awareness that has apparently helped to change behavior.

Although previous studies have used pedometers in the attempt to motivate individual for the regular practice of exercise, little is known in relation to the count of steps and the physiological demand expressed by heart rate in a session of walk in different environments (i.e., the laboratory vs. the outside). This is particularly important due to the fact that the outside environment (e.g., parks, streets, sidewalks, walking and athletics tracks) provides more opportunities to walk and is often less expensive (8). On the other hand, walking in an indoor environment with the use of a treadmill may be more favorable. This point speaks to presence of many environmental barriers as well as the lack of safety or other conditions that may influence walking outside.

Thus, the purpose of this study was to collect gait pattern and physiologic effort data while walking in a laboratory versus outdoors to aid health professionals involved with the prescription of exercise for obese clients and/or patients.

## METHODS

### Subjects

Fifteen obese women (age, 45.06 ± 8.42 yrs, BMI, 34.94 ± 2.99 kg·m$^{-2}$) recruited from administrative sectors of the Federal University of Paraná served as subjects in this study. All subjects submitted to a medical evaluation, which classified them as being in good health. The criteria for inclusion and exclusion were: (a) BMI =30 kg·m$^{-2}$ but = 39.9 kg·m$^{-2}$; (b) negative responses to the Physical Activity Readiness Questionnaire (PARQ); (c) nonsmokers; (d) no history of diabetes; (e) no cardiovascular disease; (f) no orthopedic restraints; and/or (g) no counter indication to physical exercise.

All the subjects were classified as sedentary for the past 6 months. Before starting the investigation, the subjects read and signed a term of consent as approved by the committee of ethics of the Health Sector from the Federal University of Paraná in compliance to the resolution 196/96 and under the registration: CEP/SD: 1159.084.11.06; CAAE 0082.0.091.000-11.

### Procedures

#### *Evaluation of Body Composition and Step Length*

During the protocol for determining body composition, subjects could not eat or undergo hydration. Body weight was measured in street clothing without shoes using a calibrated electronic scale. Height was measured using a portable stadiometer. Two separate measurements were conducted for both the weight and the height measures. The average of the two values was used in statistical analysis. Body mass index was calculated as weight (kg)/height ($m^2$). Percentage of body fat content (%) and (Kg) was predicted by bioimpedance (Maltron BF- 906).

The step length was calculated by the distance between two points of contact on the soil made by the same lower limb and was normalized dividing the height of the subject by the step length in meters.

***Session of Familiarization***

Following the measurement of body composition, each subject was familiarized with the treadmill for a period of 10 min. During this session, the previous experience on a treadmill by the individual was not taken into consideration and all the subjects were asked to perform the familiarization procedure. Similarly, the subjects were taken to an outside athletic track in order to perform the familiarization process with the track and the experimental procedures.

***Walk in the Laboratory and Outside***

Following a minimum interval of 72 hrs and a maximum of 96 hrs following familiarization, the subjects were submitted to two experimental sessions of 30 min of treadmill walking in the rhythm of their choice and walking on the track; each session was on a different day. The sequence for the sessions was counterbalanced. Both experimental sessions of 30 min were held individually in order to avoid any sort of group dynamics or social interaction that may have influence the results. The 30 min walk on the treadmill started at a velocity of 1.11 $m \cdot s^{-1}$ with “0” grade. The subjects were allowed to adjust their speed to an adequate rhythm of their choice for 30 min of exercise. The speed meter was hidden from the subject under evaluation as proposed by Pintar et al. (6).

The 30 min walk on the outside was held on an athletic track of tartan, 400 m long, in the facilities of the Federal University of Paraná. The velocity of the walk was determined by a global positioning system (GPS, Garmin Forerunner, model 305), which is an excellent method of measuring speed in outside settings. The collection of data took place during the autumn with an average temperature of 20°C. All subjects were instructed to walk at their own pace and rhythm for both sessions.

***Heart Rate and Number of Steps***

The subjects’ HR was monitored during walking in the laboratory and outdoors with the use of a Polar monitoring system (Polar Electro™ FT-40, Finland). Heart rate was recorded continuously. At the end of the 30-min exercise period, an average for each session was calculated.

The number of steps was measured with the aid of an electronic pedometer (Yamax Digi-Walker SW-700) attached to the subjects’ clothes, next to the waist. The average of steps in each session of 30 min of exercise was recorded. The pedometer has an absolute error general average of 3% (12). Two studies have compared 13 models of pedometers and reported that the Digi-Walker Yamax as one of the most accurate for research purposes (13,14).

**Statistical Analyses**

The data were presented as average ± standard deviation (SD). The normality of the data was verified through the Kolmogorov-Smirnov test. The comparison between the number of steps, cadence, walk speed, distance walked, and heart rate of the subjects in the laboratory and outdoors were statistically compared using the t-test for paired samples and the adoption of a $P<0.05$ level of significance. All data were analyzed by means of SPSS 20.0 for Windows (SPSS, Inc., Chicago, USA).

## RESULTS

The descriptive data for the 15 obese subjects are presented in (Table 1). The number of steps, cadence ($m \cdot min^{-1}$), and distance (m) walked by the subjects during the 30-min walk in two different environments (laboratory and outside) are shown in (refer to Figure 1).

**Table 1. Descriptive Data of the Sample Obese Women Workers.**

| Variables | Mean ± SD |
|---|---|
| **Age** | 45.06 ± 8.42 |
| **Weight** (kg) | 89.24 ± 9.48 |
| **Height** (m) | 1.59 ± 0.04 |
| **BMI** ($kg \cdot m^{-2}$) | 34.94 ± 2.99 |
| **Body Fat** (%) | 42.83 ± 4.55 |
| **Body fat** (Kg) | 38.63 ± 8.18 |

The number of steps during the 30-min walk overground (3829 ± 400) is significantly higher than that of steps on the treadmill in the laboratory (3631 ± 466) ($P<0.05$) (see Figure 1A). Also, a greater cadence of steps ($m \cdot min^{-1}$) was observed during the exercise outside (127.6 ± 15) when compared to the session of walking in the laboratory on the treadmill (121 ± 16) ($P<0.05$) (refer to Figure 1B). The higher number of steps along with the longer steps range provided for a longer distance during the 30 min of walking overground (2508 ± 151) as compared to the exercise done in the laboratory on the treadmill (2349 ± 193) ($P<0.05$) (refer to Figure 1B).

The walking speed ($m \cdot s^{-1}$) and HR (%HR max) obtained during the session of 30 min walking in two different settings (laboratory and outdoors) is shown in Figure 2. The walking speed was significantly higher in the exercise session held overground (1.39 ± 0.08) as compared to that in the exercise done in the laboratory (1.31 ± 0.10) ($P<0.05$) (refer to Figure 2A). However, the HR percentage during the walk performed overground (72.35 ± 7.47) was similar to that under laboratory condition (72.02 ± 7.63) ($P<0.05$) (Figure 2B).

## DISCUSSION

Using a counterbalanced design, this investigation evaluated the number of steps, cadence, speed, distance walked, and heart rate of obese women during a 30-min walk session in both a laboratory setting and an outdoor setting. The results indicate that the number of steps and the cadence were higher during the outside exercise period compared to the laboratory session. Additionally, the results contributed to a higher speed and, consequently, a longer distance walked outdoors. Interestingly, it was verified that no matter the type of setting, either in a laboratory or overground, values of heart rate remained similar in both conditions.

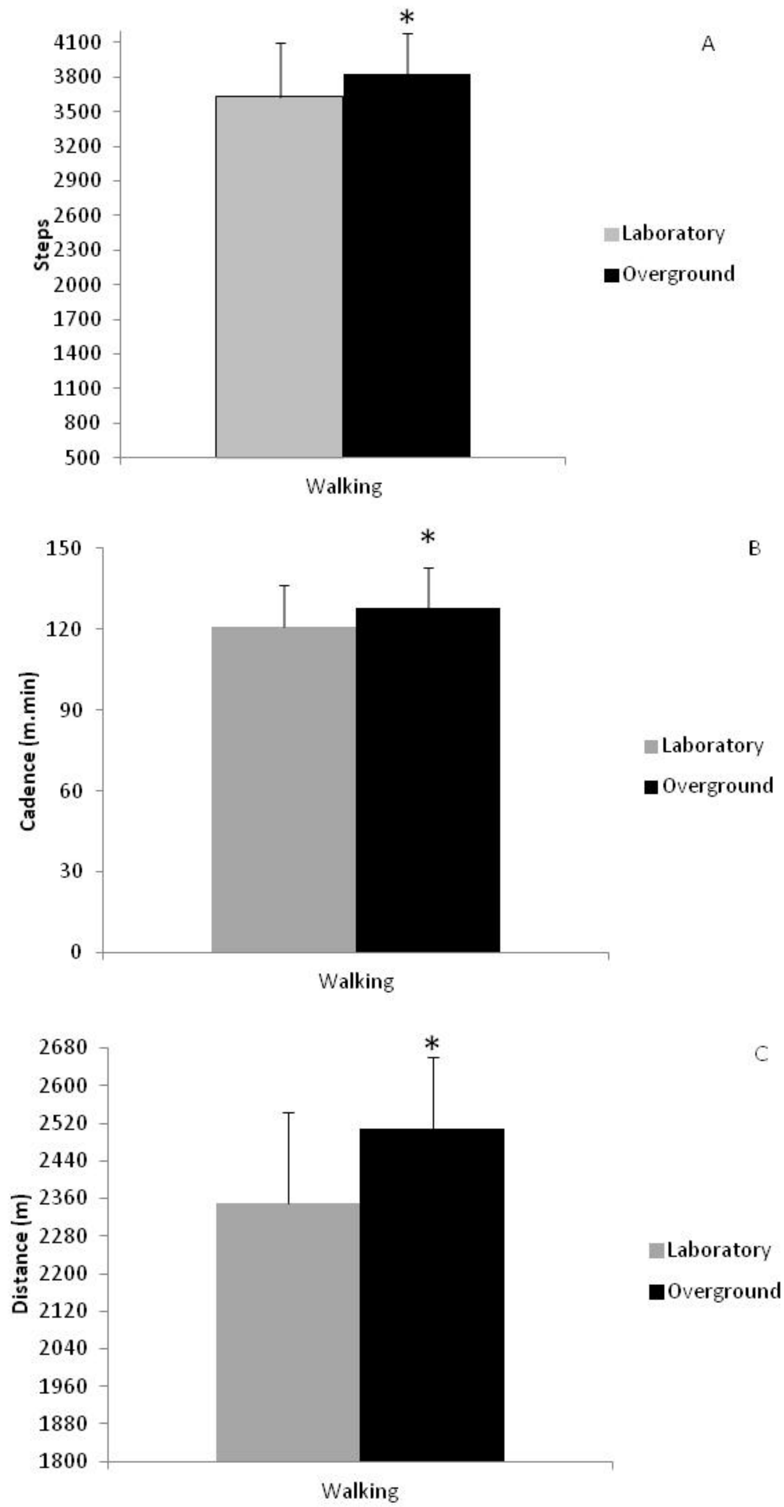


**Figure 1. Number of Steps, Cadence and Distance Walked during a 30 min of walking in Laboratory and Overground.**

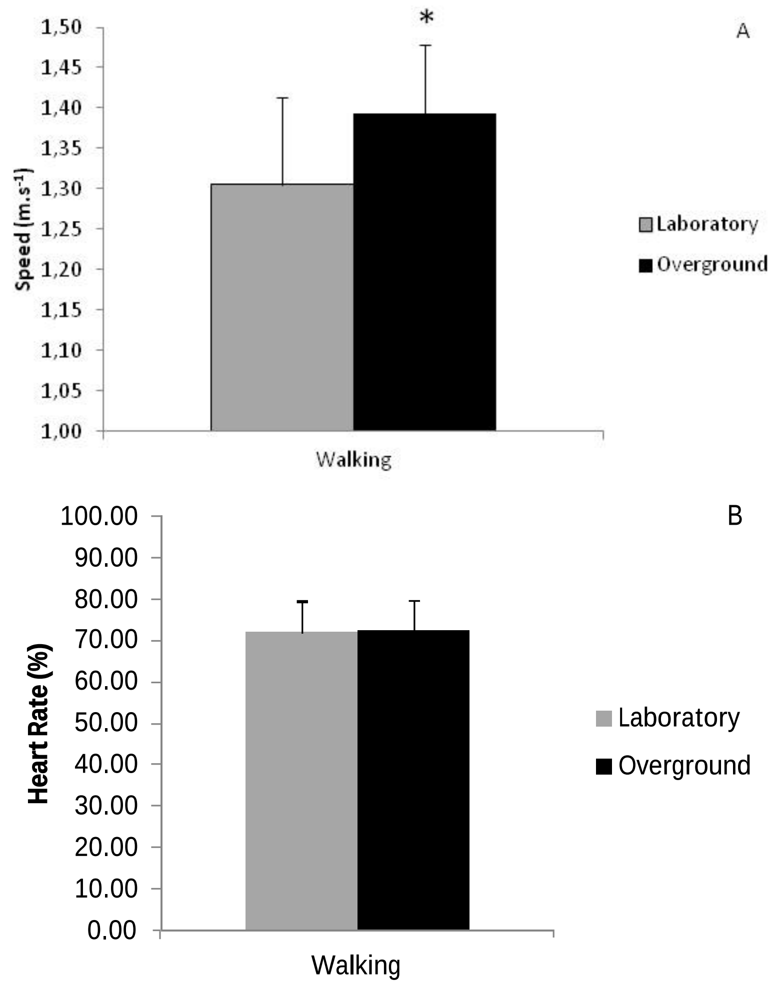


**Figure 2. Velocity and Heart Rate during 30 min Walk in Laboratory and Overground.**

Only a few studies have compared the effects of walking inside versus walking outdoors (4,10). This is probably because walking outdoors is considered a more natural way of exercising. However, the use of a treadmill becomes more likely the choice between the two for those situations in which outdoor exercise is simply not possible. Despite this fact, it must be noted that the present study does point out that walking on a treadmill is different from walking overground. The findings corroborate those from a recent investigation (4), showing that women walk at a significantly higher speed in an overground environment when compared to walking in a laboratory setting.

A possible explanation for the difference in speed found during a walk in a laboratory in relation to that observed in an outdoor environment may be related to the fact that individuals intuitively select, by themselves, the intensity of the exercise that allows for energy saving. In fact, a previous study (1) reported that obese women prefer to exercise at a speed with low energetic demand. Also, it has been reported that walking on a treadmill requires more balance and coordination, which results in higher metabolic demand and consequently a lower walking speed (4).

Nonetheless, it is verified that in spite of the different gait pattern that led to higher speed during the 30 min of walking overground (vs. the laboratory), HR was similar in both exercise conditions. Previous research (10) indicated that walking on a treadmill at a speed similar to that overground required a larger contraction of agonist and antagonist muscles. Thus, the level of demand involved in treadmill walking at the same speed of overground walking is suppose require a greater physiological demand and yet, this was not the case (i.e., HR was the same between the two walks). It is also likely (and possible) that the subjects walked overground at a speed significantly higher because it was more economical to do so, thus allowing for a lower HR than physiologically expected.

## CONCLUSIONS

It can be concluded that the number of steps, cadence, speed, and distance walked, except for the HR of sedentary obese women during a session of 30 min of walking are influenced by the environment in which the activity is performed. These findings allow for theoretical and practical implications. From the theoretical perspective, this investigation provides, first, important information to understand gait patterns and, second, the role of HR of in sedentary obese women in two different environments. On the other hand, from the practical point of view, the results indicate that the laboratory setting and overground mode of exercise must be taken into account by exercise physiology healthcare professionals responsible for planning exercise (walking) programs for obese subjects. Also, it is likely that the findings are applicable to individuals with normal weight or in better body fitness, or by other populations such as subjects with hypertension and diabetes.

## ACKNOWLEDGMENTS

The authors are grateful to Capes and Cnpq for providing financial support research. Authors are also grateful to all the women participants for their excellent cooperation.

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## REFERENCES

1. Browning CR, Baker EA, Herron JA, Kram R. Effects of obesity and sex on the energetic cost end preferred speed of walking. ***J Appl Physiol.*** 2006;100(2):390-398.

2. Buchowski MS, Cohen SS, Matthews CE, Schlundt DG, Signorello LB, Hargreaves MK, Blot WJ. Physical activity and obesity gap between black and white women in the southeastern U.S. ***Am J Prev Med.*** 2010;Aug;39(2):140-147.

3. Church TS, Thomas DM, Tudor-Locke C, Katzmarzyk PT, Earnest CP, Rodarte RQ, et al. Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity. ***PLoS One.*** 2011;6(5):e19657.

4. Dal U, Erdogan T, Resitoglu B, Beydagi H. Determination of preferred walking speed on treadmill may lead to high oxygen cost on treadmill walking. ***Gait Posture.*** 2010;31:366-69.

5. Flegal KM, Carroll MD, Ogden CL, Curtin LR, Prevalence and trends in obesity among US adults, 1999-2008. ***JAMA.*** 2010;303(3):235-241.

6. Ehlen KA, Reiser RF, Browning RC. Energetics and biomechanics of inclined treadmill walking in obese adults. ***Med Sci Sports Exerc.*** 2011;43:1251-1259.

7. Grave RD, Calugi S, Centis E, Ghoch ME, Marchesini G. Cognitive-behavioral strategies to increase the adherence to exercise in the management of obesity. ***J Obes***. 2011:1-11.

8. Lee C, Moudon AV. Physical activity and environment research in the health Field: Implications for urban and transportation planning practice and research. ***Journal of Planning Literature.*** 2004;19:147-181.

9. Pal S, Cheng C, Egger G, Binns C, Donovan R. Using pedometers to increase physical activity in overweight and obese women: A pilot study. ***BMC Public Health.*** 2009;25(9):309.

10. Parvataneni K, Ploeg L, Olney SJ, Brouwer B. Kinematic, kinetic, and metabolic parameters of treadmill versus overground walking in healthy older adults. ***Clin Biomech.*** 2009;24:95-100.

11. Pintar JA, Robertson RJ, Kriska AM, Nagle E, Goss FL. The influence of fitness and body weight on preferred exercise intensity. ***Med Sci Sports Exerc.*** 2006;38(5):981-988.

12. Ryan CG, Grant PM, Tigbe WW, Granat MH: The validity and reliability of a novel activity monitor as a measure of walking. ***Brit J Sports Med.*** 2006;40:779-784.

13. Schnneider PL, Crouter SE, Bassett DR: Pedometer measures of free-living physical activity: comparison of 13 models. ***Med Sci Sports Exerc.*** 2004;36(2):331-335.

14. Schnneider PL, Crouter SE, Lukajic O, Bassett DR Jr: Accuracy and reliability of 10 pedometers for measuring steps over a 400-m walk. ***Med Sci Sports Exerc.*** 2003;35(10):1779-1784.