DOI: 10.36959/987/224 | Volume 1 | Issue 1

Archives of Sports Medicine

Research Article Open Access

Fractionized Walking at Self-Selected Paces in Women

Henry Williford[1]*, Melvenia Redding[1], Michael Esco[2], Erin Reilly[1], Cornell Foo[1], George Schaefer[1], Deanne Allegro[1] and Brett Nickerson[3]

[1]*Department of Kinesiology, Auburn University Montgomery, USA*

[2]*Department of Kinesiology, The University of Alabama, USA*

[3]*Department of Curriculum and Pedagogy, Texas A&M International University, USA*

Abstract

The purpose of this investigation was to evaluate fractionized self-selected walking in women with one continuous 30 min (1-30) bout compared to three 10 min (3-10) bouts. Participants were19women (age 35.58 ± 14.17 yrs, 72.93 ± 35.07 kg, height 165.02 ± 2.28 cm and fat % 33.20 ± 9.94, Vo_{2max} 30.16 ± 7.11). In a cross-over design subjects walked on an indoor track at self-selected exercise paces for either 1-30 min continuous bout or 3-10 min bouts, spread over the day. Walking distance was measured on a calibrated track, and HR monitored with a Garmin HR monitor. Kcals were determined based on a laboratory open circuit spirometry evaluation of VO_{2max} to determine caloric expenditure. Paired T-tests evaluated statistical significance between conditions 1-30 and 3-10. The total distance walked in the 1-30 trial was significantly less (1-30 = 2834.97 ± 277.93 m vs. 3-10 = 2996.76 ± 324.03 m) (p = 0.001). HR values were 122.94 ± 15.35 (bpm) for 1-30 and 125.73 ± 17.38 for the 3-10 min bouts (p = 0.094). Mean predicted kcals for the 1-30 bout were significantly less (1-30 = 142.02 ± 49.66 vs. 3-10 = 153.05 ± 42.75 kcals) than those expended with the 3-10 bouts (p = 0.019).

Conclusions: There were significantly higher values in total walking distance and energy cost for the 3-10 min bouts as compared to the 1-30 min bouts. This investigation found that when walking at self-selected speed, shorter bouts multiple times per day can be as effective as, and potentially more intense, than walking for 30 continuous min. While there were statistically significant differences between conditions, from a practical standpoint, these differences were not great. Both fractionized and continuous walking met the criteria for moderate physical activity in women and provides different exercise options.

Keywords

Physical activity, Exercise prescription, Aerobic evaluation, Walking, Short bouts of exercise

Introduction

Walking is the most popular form of physical activity and often used to meet physical activity guidelines. Six in 10 adults report that they walk at least 10 minutes per week [1]. Walking is a low cost, low injury mode of physical activity [2]. When performed at moderate intensity, walking can provide numerous health related benefits, including a reduced risk of death from cardiovascular disease and other chronic health conditions [3]. Specific health benefits of walking and physical fitness in women are related to a decreased risk of coronary heart disease [4-6], diabetes [7], hypertension [8,9], breast cancer [10], osteoporosis [11], dementia [12], and all-cause mortality [13-15].

Breaking up the recommended continuous 30 min of exercise over the course of a day is a form of fractionized exercise/physical activity. The American College of Sports Medicine (ACSM) decision to endorse fractionized exercise was first established in 1995. The decision was based on research that supported fractionized, accumulated bouts, or short bouts of exercise spread over time [16-19]. Subsequent to the early studies there has been considerable debate on the effectiveness of multiple

***Corresponding author:** Henry N Williford, Ed.D, FACSM, ACSM EP-C, Department of Kinesiology, Auburn University Montgomery, PO Box 244023, Montgomery, AL 36124, USA, Tel: +334-244-3548, Fax: +334-244-3198, E-mail: hwillifo@aum.edu

Received: January 15, 2017: **Accepted:** March 18, 2017: **Published online:** March 20, 2017

Citation: Williford H, Redding M, Esco M, et al. (2017) Fractionized Walking at Self-Selected Paces in Women. Arch Sports Med 1(1):15-19

bouts of physical activity compared to one continuous bout [18]. Serwe (2011) reported that some studies have found similar health benefit gains with multiple bouts vs. one continuous bout, others have reported superior health benefit gains with fractionized exercise, and others have reported superior benefits with continuous exercise. Differences in research design, volume and intensity of physical activity, plus numerous other factors may account for the lack of consensus [20].

The ACSM and the Centers for Disease Control and Prevention (CDC) established minimal physical activity recommendations in an effort to promote health enhancing physical activity. The guidelines recommend that adults perform a minimum of moderate intensity aerobic physical activity 30 minutes a day, 5 days a week. The recommended time/duration of physical activity may be performed continuously (i.e., one session) or intermittently and can be accumulated over the course of a day in one or more sessions of physical activity that total at least 10 min per session [19].

When starting a walking program individuals typically walk at a self-selected pace. One question that needs further study is, if an individual decides to walk at a self-selected pace for 3-10 min bouts using fractionized walking, would the distance covered and energy expenditure be consistent with walking continuously for one 30 min bout? The current study sought to answer that question by using a cross-over design with women walking at self-selected paces and comparing fractionized walking with continuous walking to see if there were differences in the total distance covered and energy cost. The current study is unique by the fact that the total time was kept consistent, the pace was self-selected, and the women walked on a track rather than a treadmill. Exercise intensity on a treadmill may be different than walking on an indoor or outdoor surface [21].

Materials and Methods

A quasi-experimental cross-over design was selected to evaluate differences between exercise conditions for the following variables: total distance walked in meters (TD), average heart rate (AHR), and total energy expenditure (kcals). Nineteen women age 35.6 ± 14.2 yrs. (Mean ± SD) volunteered to participate in the study. The study was approved by the University Institutional Review Board for Human Subject Research.

Women were recruited from the community to participate in the study. On the first visit the prospective participant reported to the Human Performance Lab for an initial evaluation of a health history questionnaire and an informed consent form was completed. Individuals with orthopedic limitations, taking medications or the inability to complete the study were eliminated. The second visit consisted of metabolic and body composition evaluations. All participants were instructed to not eat, exercise, or consume caffeine for at least 3 hours prior to the laboratory exercise testing.

Weight was measured using a calibrated digital scale (Tanita BWB-800 A, Tanita Corp, Tokyo, Japan). Height was measured with a wall-mounted stadiometer (SECA; Seca Instruments Ltd, Hamburg, Germany). Body composition was determined by a multi-frequency bioelectrical impedance analysis body composition analyzer (GE InBody 720, Biospace Co., Ltd, and Korea). The InBody's analysis included a prediction lean mass and body fat percentage. The 8-electrode InBody 720 system measured body composition across the entire body and 5 segments (arms, legs, and trunk) by passing multiple frequencies at 5, 50, 250, and 500 kHz from the 8-polar contact points. The scanning time for the InBody 720 was approximately 2 minutes per subject. Test-retest procedures were performed on a separate group of active women (n = 20), which demonstrated that the InBody 720 device provided good reliability for measuring percent fat (interclass correlation coefficient (ICC) = 0.99, SEM = 0.16).

To evaluate fitness levels and to determine the relationship between HR and energy expenditure, a graded exercise test (GXT) (modified Bruce protocol) was performed on a treadmill (Trackmaster, Full Vision, Inc., Carrollton, TX). Open circuit spirometry was used to measure VO_{2max} and provide caloric expenditure data. Subjects breathed through a low-resistance valve with nose occluded while pulmonary ventilation and expired fractions of oxygen and carbon dioxide were measured. Expired gas fractions were analyzed with a metabolic cart (Parvo Medics True One® 2400 metabolic cart, Sandy, UT, USA). Each GXT began with a three min. warm up and involved the progression of work rate with incline until VO_{2max} was reached.

Heart rate was evaluated and recorded throughout the test. The test was discontinued and VO_{2max} recorded if two of the following criteria were evidenced: a plateau in oxygen consumption (± 2 ml kg^{-1} min^{-1}) despite an increased work load, respiratory exchange ratio of > 1.15, heart rate within 10 beats of age-predicted maximum (220-age), or volitional fatigue [22]. The participant's HR was monitored and recorded for 5 minutes during the recovery period; HR was measured with a Garmin Forerunner 220 HR monitor.

The third visit took place the week after the metabolic testing. For the third visit subjects reported to the wellness facility to start their walking trials. They were instructed to not eat, consume caffeine, or exercise for three hours prior to reporting to the facility. Before walking, each participant was read a script indicating that they were to walk at their normal steady physical activity walking pace for ei-

ther 1-30 or 3-10 bouts. They were to walk at their chosen pace, refrain from using a cell phone during the walk, and to not engage in conversation or purposely walk with others on the exercise track. A cross-over design was used to determine the order of trials (1-30 vs. 3-10). The track was circular and one lap equaled 179.07 meters. The track distance was evaluated with a calibrated wheel and distances were marked at regular intervals. Average heart rate and total distance covered during the trials was recorded. Total energy expenditure was determined based on the relationship between HR and VO_2 determined during the metabolic treadmill testing.

The 3-10 min walks took place throughout the day with a break of at least a full hour rest between bouts. During the break women were allowed to perform their normal daily activities, but were instructed to not exercise or eat a large meal or consume caffeine between bouts. They were to return to the wellness center two more times during the day to complete the walking assignment.

To evaluate reliability, 10 women volunteered to be part of a reliability sample. On separate days they repeated the 1-30 and 3-10 min walking bouts. The walking environmental conditions and instructions were identical to the initial trials.

All data were analyzed with SPSS version 23 (Somers, NY, USA). Means and SD values for each descriptive variable are reported in Table 1. To evaluate differences between walking conditions, participant's total distance (m), HR, and total energy cost (kcals) were analyzed using two tailed Paired-Samples t-Tests ($P < 0.05$) (Table 2). Reliability statistics were computed for total distance walked and HR values for both walking conditions. As suggested by Hopkins [23], reliability was evaluated by comparing the means and standard deviations, typical error, and interclass correlation coefficients for HR and total distance walked.

Results

Table 1 shows the descriptive data of the women. Their percent mean percent body fat was 33.2 % and their $VO_{2\ max}$ was 30.16 ml kg^{-1} min^{-1}. Based on sex and age related norms from the Cooper Institute, Dallas, TX [24], their percent body fat value was in the very poor category, and maximal aerobic power in the poor category. While their fitness levels and body fat were considered poor, they represented the population they were selected from. The sample was from a city in the southeast United States. In that particular state 67% of the population is either overweight or obese, only 42% of the population meets the moderate intensity aerobic physical activity guidelines, and 35.7% reported that in the last month they participated in no physical activity [25].

Table 1: Descriptive statistics of women walkers (N = 19).

Descriptive variables	Mean ± SD
Age (yrs)	35.58 ± 14.17
Weight (kg)	72.93 ± 35.07
Height (cm)	165.02 ± 2.28
Body Fat (%)	33.20 ± 9.94
Maximal HR bpm	182.37 ± 15.13
Resting HR bpm	78.80 ± 12.25
Treadmill VO_{2max} (ml kg^{-1} min^{-1})	30.16 ± 7.11

Table 2 shows the statistical analysis of the differences in the 1-30 vs. 3-10 walking conditions. There were significant differences in the distance walked and energy cost. The mean distance walked in one 30 min bout was 2834.97 ± 277.93 m as compared to 2996.76 ± 324.03 m for 3-10 min bouts ($p = 0.001$). The mean caloric expenditure of 142.02 ± 49.66 kcals, was significantly less than 153.05 ± 42.75 kcals for 3-10 bouts ($p = 0.019$). HR values were similar, 122.94 ± 15.35 for 1-30 and 125.73 ± 17.38 for the 3-10 min bouts ($p = 0.094$).

The reliability statistics evaluated 10 subjects who repeated all of walking bouts. The results for the 10 subjects who performed the reliability trials were: 3-10 total distance (TD) = 3011.10 ± 431.80 m vs. TD = 3021.10 ± 436.80 m. The mean difference between trials was 10.00 ± 12.90 m, ICC = 1.0, typical error = 9.13 m). 1-30 TD = 2848.50 ± 356.20 m vs. repeated trial = 2857.30 ± 351.00 m, mean difference = 8.80 ± 28.60 m, ICC = 1.0, typical error = 20.24 m. The reliability statistics for HR were: 3-10 HR = 125.30 ± 12.20 bpm vs. 128.20 ± 10.60 bpm. The mean difference was 2.90 ± 1.90 bpm, ICC = 0.99, typical error = 1.35 bpm. For the 1-30 bout HR = 124.00 ± 11.30 bpm vs. 127.30 ± 10.60 bpm. The mean difference was 3.300 ± 1.80 bpm, ICC = 0.99, typical error = 1.29 bpm.

Discussion

Table 2 shows the results comparing fractionized and continuous walking at self-selected paces using the recommended ACSM (30 min) duration. The total distance walked was significantly greater for the 3-10 condition. Fractionized walking resulted in a greater total distance (161.78 m) and expended a greater number of kcals (11.03 kcals).

Table 2: Fractionized walking vs continuous walking distance, HR distance, and kcals, (Two tailed paired T-test results).

Variable	1-30 min	3-10 Min	Mean difference	t	P value
Total distance (m)	2834.97 ± 277.93	2996.76 ± 324.03	161.78 ± 127.90	5.513	0.001
Mean heart rate (bpm)	122.94 ± 15.35	125.73 ± 17.38	2.79 ± 6.87	1.77	0.940
Total energy expenditure (kcals)	142.02 = 49.66	153.05 = 42.75	11.03 ± 18.56	2.59	0.019

There are a number of variables to consider when developing an exercise prescription. Manipulating frequency, intensity, and duration allows for many different exercise options. The results of the present study found that walking at multiple times over the course of a day may be a viable option as compared to one longer walk per day. If the individual does not have a 30 min block of time to walk, they can elect to select other options.

During the current investigation participants self-selected their exercise intensity. No information was provided to the participants regarding pace selection other than walk at your normal exercise pace. The women walked at exercise intensities that would be classified as moderate intensity exercise (1-30 = 68% and 3-10 = 69% HR_{max}). The walking intensity was consistent with another study that evaluated a similar sample of women [26]. The researchers reported a walking intensity of 55-69% of HR_{max}. This intensity was classified as moderate intensity exercise. Walking is primarily considered a moderate intensity exercise, and self-selection of a moderate intensity pace is the norm [27]. It should be noted that our subjects were walking at the upper end of moderate intensity.

For reliability purposes 10 of the women repeated the walking conditions. The reliability statistics as suggested by Hopkins (2000) were computed [23]. The repeated performance total distance for 3-10 was 10.0 ± 12.9m greater for the second trial. The ICC = 1.0 and the typical error was 9.13 m. The typical error is the within-subject deviation or the standard error of measurement, and represents the subject's variation value from measurement to measurement. For the 1-30 repeated bout the second trial was 8.8 ± 28.6 m greater, and ICC = 1.0, typical error = 20.24. There was slightly more variability for the 1-30 condition. However, the differences were minimal and both conditions were highly reliable. The reliability statistics for HR bpm 3-10 indicated a HR of 2.9 ± 1.9 greater for the second trial with ICC = 0.99, and typical error = 1.35. For the 1-30 the mean HR bpm was 3.30 ± 1.8 greater for the second trial. The ICC = 0.99, and typical error = 1.29. Reliability statistics produced good reliability for both total distance and exercise HR for both 1-30 and 3-10.

The mean energy expenditure for 1-30 min, (142.02 ± 49.66 kcals) was significantly less than the 3-10 bouts (153.05 ± 42.74 kcals). Peterson & Palmer (2004) conducted a similar study in men evaluating the energy cost of 1-30 and 3-10 min bouts [28]. They found no difference in energy cost of 1-30 and 3-10 min conditions (3-10 = 278.5 ± 46.6 kcals, l-30 = 273.6 ± 45.7 kcals). However, their study design was different in the fact that their subjects walked on a treadmill at a controlled intensity of 70% of VO_{2max} for both 1-30 and 1-10 bouts. One explanation for the greater caloric expenditure in the Peterson study may be related to the fact that their walkers were males who were significantly heavier (19.5 kg) and had lower percent fat (22.2%). The cardiovascular fitness levels were similar in both studies (Peterson VO_{2max} = 30.8 ± 3.3 vs. 30.2 ± 7.1 for the current study).

Increasing caloric expenditure by walking has been shown to have a positive effect on body composition [29]. Grediagin, et al. studied two groups of women assigned to either a high intensity or low intensity exercise group. One group exercised at 80% VO_{2max} while the other group exercised at 50% VO_{2max} [29]. Both groups exercised 4 days per week for 12 weeks expending a total of 300 kcals per session. At the end of the study body composition results showed that both groups equally lost weight, with the high intensity increasing fat free mass [29]. The authors concluded that if the goal is to decrease fat mass and increase fat-free mass with limited time constraints, individuals can exercise safely at a high intensity in order to expend as much energy as possible during the allotted time. Their study showed that a high intensity walking exercise program that has high total energy expenditure may be an effective strategy for losing body fat and increasing FFM in women.

Adherence is another consideration when selecting an exercise program. The design of the current study did not allow for evaluating exercise adherence. All of the subjects completed both conditions so adherence was not a concern. In controlled training studies where subjects exercise for several weeks or months, exercise adherence is an important factor to consider. Only a few studies have evaluated adherence rates. In studies where walking intensity and exercise adherence have been evaluated the results are mixed. There is no consensus that increasing walking speed will decrease adherence to a walking program [20,30-32].

Individual selection of either multiple short or longer bouts of exercise may be related to a number of factors. The women in this study through a follow-up interview suggested that time, motivation, social or cultural factors, sweating, showering, hair, or makeup were considerations when making decisions regarding their preferred choice of exercise.

Unfortunately we did not measure RPE responses during the walking conditions. Even though the HR responses were similar, it was suggested that one 30 min walk could be more fatiguing to someone with low fitness.RPE would have provided information regarding perceived effort or fatigue. With elderly or less fit populations a 30 min continuous walk could be potentially fatiguing.

Conclusion

The current study suggests that women who walk at free living, self-selected exercise intensities can obtain similar results with either fractionized exercise or one continuous bout. This finding is encouraging for individuals who feel they do not have a continuous 30 min time period avail-

able for walking. We found a significantly greater energy cost and distance with the 3-10 bouts, but from a practical standpoint the differences were fairly small and by adding a few extra minutes to the 30 min walk you could basically obtain the same energy cost. For our subjects both fractionized and continuous walking conditions were appropriate to meet the recommended guidelines for moderate physical exercise training. The decision to select one method over the other may be an individual decision based on personal preference to accumulate 30 min of exercise during the day.

References

1. Berrigan D, Carroll DD, Fulton JE, et al. (2012) Vital Signs: Walking Among Adults - United States, 2005 and 2010. Morbidity and Mortality Weekly Report 61: 595-601.
2. Lee IM, Buchner DM (2008) The importance of walking to public health. Med Sci Sports Exerc 40: S512-S518.
3. Silva AA, Lima DA, Vieira GF, et al. (2015) Assessment of intensity effort of middle-aged adults practicing regular walking. Braz J Phys Ther 19: 491-497.
4. Schnohr P, Scharling H, Jensen J (2007) Intensity versus duration of walking, impact on mortality: the Copenhagen City Heart Study. Eur J Cardiovasc Pre Rehabil 14: 72-78.
5. Manson JE, Greenland P, LaCroix AZ, et al. (2002) Walking compared with vigorous exercise for prevention of vigorous exercise for prevention of cardiovascular events in women. N Engl J Med 347: 716-725.
6. Murphy M, Neville A, Neville C, et al. (2002) Accumulating brisk walking for fitness, cardiovascular risk, and psychological health. Med Sci Spts Exerc 34: 1468-1474.
7. MansonJE, Rimm EB, Stampfer MJ, et al. (1991) Physical activity and incidence of non-insulin-dependent diabetes mellitus in women. Lancet 338: 774-778.
8. Bhammar DM, Angadi SS, Gaesser GA (2012) Effects of fractionized and continuous exercise on 24-h ambulatory blood pressure. Med Sci Sports Exerc 44: 2270-2276.
9. Blair SN, Goodyear NN, Gibbons, et al. (1984) Physical fitness and incidence of hypertension in healthy normotensive men and women. JAMA 252: 487-490.
10. McTierman A, Kooperberg C, White E, et al. (2003) Recreational physical activity and the risk of breast cancer in postmenopausal women: The Women's Health Initiative Cohort Study. JAMA 290: 1331-1336.
11. Pestatello LS, Murphy DM, Anderson D, et al. (2002) Daily physical movement and bone mineral density among mixed racial cohort of women. Med Sci Sports Exerc 34: 1966-1970.
12. Liu R, Sui X, Laditka JN, et al. (2012) Cardio respiratory fitness as a predictor of dementia mortality in men and women. Med Sci Sports Exerc 44: 253-259.
13. Blair SN, Kohl HW 3rd, Paffenbarger RS Jr, et al. (1989) Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA 262: 2395-2401.
14. Lollgen H, Böckenhoff A, Knapp G (2009) Physical activity and all-cause mortality: An updated meta-analysis with different intensity categories. Int J Sports Med 30: 213-224.
15. Williams PT, Thompson PD (2013) The relationship of walking intensity to total and cause-specific mortality. Results from the National Walkers' Health Study. PloS One 19: e81098.
16. DeBusk RF, Stenestrand U, Sheehan M, et al. (1990) Training effects of long versus short bouts of exercise in healthy subjects. Am J Cardiol 65: 1010-1013.
17. Ebisu T (1985) Splitting the distance of endurance running on cardiovascular endurance and blood lipids. Jpn J Phys Educ 30: 37-43.
18. Hardman AE (2001) Issues of fractionation of exercise (short vs long bouts). Med Sci Sports Exerc 33: S421-S427.
19. Pate RR, Pratt M, Blair SN, et al. (1995) Physical activity and public health: A recommendation from the centers for disease control and prevention and the American College of Sports Medicine. JAMA 273: 402-407.
20. Serwe KM, Swartz AM, Hart TL, et al. (2011) Effectiveness of long and short bout walking on increasing physical activity in women. J Womens Health 20: 247-253.
21. Murtagh EM, Borcham CA, Murphy MH (2002) Speed and exercise intensity of recreational walkers. Prev Med 35: 397-400.
22. Howley E, Bassett DR, Welch HG (1995) Criteria for maximal oxygen uptake: review and commentary. Med Sci Sports Exerc 27: 1292-1301.
23. Hopkins WG (2000) Measures of reliability in sports medicine and science. Sports Med 30: 1-15.
24. Pescatello LS and American College of Sports Medicine (2014) ACSM's Guidelines for Exercise Testing and Prescription. (9th edn), Wolters Kluwer/Lippincott Williams & Wilkins Health, 73-74.
25. Centers for Disease Control and Prevention (2014) State Indicator Report on Physical Activity. U.S. Department of Health and Human Services, Atlanta, USA.
26. Murtagh EM, Boreham CA, Nevill A, et al. (2005) The effects of 60 minutes of brisk walking per week, accumulated in two different patterns, on cardiovascular risk. Prev Med 41: 92-97.
27. Braham R, Rosenberg M, Begley B (2012) Can we teach moderate intensity activity? Adult perception of moderate intensity walking. J Sci Med Sport 15: 322-326.
28. Peterson M, Palmer D, Laubach LL (2004) Comparison of caloric expenditure in intermittent and continuous walking bouts. J Strength Cond Res 18: 373-376.
29. Grediagin A, Cody M, Rupp J, et al. (1995) Exercise intensity does not affect body composition change in untrained, moderately over fat women. J Am Diet Assoc 95: 661-665.
30. Donnelly JE, Jacobsen D, Heelan KS, et al. (2000) The effects of 18 months of intermittent vs continuous exercise on aerobic capacity, body weight and composition, and metabolic fitness in previously sedentary, moderately obese females. Int J Obes Rel Metab Disord 24: 566-572.
31. Jakicic J, Wing R, Butler B, et al. (1995) Prescribing exercise in multiple short bouts versus one continuous bout: effects on adherence, cardiorespiratory fitness, and weight loss in overweight women. Int J Obes Relat Metab Disord 19: 893-901.
32. Woolf-May K, Kearney E, Owen A, et al. (1999) The efficacy of accumulated short bouts versus single daily bouts of brisk walking in improving aerobic fitness and blood lipid profiles. Health Educ Res 14: 803-815.