Scientific Research and Essays Vol. 6(25), pp. 5457-5461, 30 October, 2011
Available online at http://www.academicjournals.org/SRE
DOI: 10.5897/SRE11.649
ISSN 1992-2248 ©2011 Academic Journals

Full Length Research Paper

Impacts of pedometer determined physical activity on biochemical risk factors of the cardiovascular system

Majid Jalili, Farzad Nazem* and Ali Heydarianpur

Physical Education and Sport Science Department – Bu-Ali Sina University, Hamedan – Iran.

Accepted 15 August, 2011

Physical activity (PA) volume is an important element in maintaining health and functional ability in the population and has a useful effect on lipid profile. Walking is a preferred choice and as a current movement pattern in PA and several social jobs. The aim of this present study was to evaluate the effects of daily number of steps on the blood lipid profile in middle age men. Daily steps volumes were measured in the healthy men (n = 108) by the pedometer. Subjects voluntarily selected as an active group (AG) and sedentary group (SG). In addition, total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) were measured. The averages of daily steps in the AG (12632±3957 steps/day) were significantly higher than SG (5347±1631step/day) (*P<0.001*). TG and TC concentrations in the AG group were significantly lower than SG group (P<0.05). TC/HDL-C and LDL-C/HDL-C ratios in AG group were significantly lower than SG group (P<0.05), whereas, HDL-C and LDL-C concentrations were not significantly different in the two groups (P>0.05). It seems that the middle aged sedentary populations were at least 12,500 steps/day accordant with PA, and morning exercise programs as a threshold of anti–risk factor can improve the cardiovascular system efficiency.

Key words: physical activity, biochemical risk factor, steps per day, pedometer.

INTRODUCTION

Lack of physical activity (PA) is a hypo-kinetic phenomenon in the modern lifestyle (Catherine et al., 2004; Bernard et al., 2007). Also it is associated with several disadvantages such as overweight, obesity, cardiovascular disease, diabetes, and some cancers (Graham et al., 2007). Increase in blood lipids concentration is the threatening factor in cardiovascular system function (Nancy et al., 2004). Studies shows that moderate PA reduces the risk of cardiovascular disease and it has positive effect on blood lipids and lipoproteins in middle age (Sugiura et al., 2002; Dancy et al., 2008; Furukawa et al., 2003).

Walking is a preferred-choice (Tully et al., 2005), safe and moderately intensive form of exercise and PA (Furukawa et al., 2003). Studies have indicated that increasing the number of daily steps can improve the serum lipids profile, reduce blood pressure, and increase fitness (Sugiura et al., 2002; Tully et al., 2005).

Recent scientific sources recommend a goal of 10,000 steps/day as an improving index of health outcomes, especially in adults and older (Furukawa et al., 2003; Iwane et al., 2000).

Pedometer is a movement sensor that can accurately measure the movement of the individual, making possible the measurement of total steps in different situations such as working, housekeeping, leisure time, and recreation (Tudor-Locke and Bassett, 2004; Lubans et al., 2009; Schofield et al., 2009). Assessment of PA is important for researchers (Iwane et al., 2000; Tudor-Locke, 2002; Swartz et al., 2003). Therefore, number of daily steps can serve as an easy, valuable, quantitative scale for assessment of PA volume.

Recently, public field exercise, especially morning

*Corresponding author. E-mail: farzadnazem1336@gmail.com. Tel: 0989181117911. Fax: 0988118273236.

Abbreviations: PA, Physical activity; **AG**, active group; **SG**, sedentary group; **TC**, total cholesterol; **TG**, triglyceride; **LDL-C**, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol.

exercise, has been developed in Iran and is used to promote health within the society, particularly in the middle-aged population. Most of the studies have been done on sick populations and often the study samples were women. Therefore, the purpose of this research was to evaluate the effect of the mean of daily steps on the blood lipids profile in healthy middle-aged men. In other words, to understand how morning exercises along with other routine activities reduce the level of plasma lipids in middle-aged men.

MATERIALS AND METHODS

This study had a cross-sectional design. In this study, 108 healthy men between the ages of 40 and 65 years voluntarily participated. Participants consisted of an active group (AG) and a sedentary group (SG). The participants did not have any orthopedic limitations for walking and had no history of disease and did not use any medicine regularly. The AG (n = 50) had regular physical activity (that is, morning exercise program) since 2 years ago. The SG (n=58) did not have any regular physical activity or exercise. The health status and regular exercise habits questionnaire, as well as daily invoice of energy consumption, were used to homogenize the participants (American College of Sports Medicine, 2004). The University of Medical Sciences of Hamedan, Iran Ethic Committee approved this study protocol. All subjects gave written consent to participate to the study after the protocol was fully explained to them.

Each subject wore a Digi-Walker pedometer model SW-200 (New Lifestyles Inc., Lees Summit, MO) throughout the day, except for sleeping and bathing for three (3) consecutive weeks. The pedometers were positioned on the waist, in-line with the right mid-thigh (Tudor-Locke, 2002). Each morning, the pedometer was reset to zero, and each evening, the subject recorded the steps accumulated during the day. Subjects were asked to follow their typical work and/ or leisure routines during the weeks of investigation. Also, the AG was asked to record the number of steps taken during diary morning exercise.

Digital scales (SECA, model no. 770, Germany) were used to measure weight to the nearest 0.1 kg. Height was measured using a wall-mounted stadiometer (Seca Corporation, Columbia, MD) to the nearest 0.1 cm. Body mass index (BMI) was assessed as body mass (kg) divided by stature (m^2). Body density was converted to body fat percentage (%BF) using the Siri equation. Standing waist circumference (WC) (the narrowest part of the torso between the rib cage and the iliac crest, after a normal expiration) and, hip circumference (HC) (greatest gluteal protuberance while the subject stood with the feet together) were measured in duplicate using a Gulick fiberglass measuring tape with a tension handle (Creative Health Products, Inc., Plymouth, MI), and mean values were used in calculations (Siri, 1961). Also waist/hip ratio (WHR) risk factor was measured. DUCKE questionnaire was used to determine the daily energy expenditure.

This questionnaire consisted of 12 questions about the routine physical activity pattern of the participants (American College of Sports Medicine, 2004).

Venous blood samples of 5cc were taken following a 12 h period of fasting, and were collected in tubes treated with EDTA or serum clot activator. The serum was recovered following centrifugation at 3,000 rpm for 15 min and then stored at 4°C. All analyses were completed within 48 h. TC in the serum was assessed by the cholesterol oxidase method (Cholesterol E-test Wako, Wako Co., Osaka, Japan). HDL-C in the serum was assayed by the phosphotungstic acid-magnesium chloride precipitation method (HDL cholesterol E-test Wako, Wako Co., Osaka, Japan). TG in the serum was assayed by the glycerol-3-phosphate oxidase method (Triglyceride E-test Wako, Wako Co., Osaka, Japan). LDL-C was calculated by applying the Friedewald equation. The TC: HDLC and LDL-C: HDL-C ratios were adopted according to the atherogenetic index.

Independent sample t test was utilized to compare the study variables. Pearson product moment correlations were used to examine the relationship between average steps per day and plasmatic variables. All analyses were performed using SPSS/16 for Windows, and α level was set at 0.05.

RESULTS

Demographic characteristics were shown in Table 1. There is no significant difference between this variables, except for, the waist hip ratio (WHR) (P<0.01) and daily energy expenditure (P<0.001). Figure 1 shows the number of daily steps. The daily step average of the AG (12632±3957 steps/day) is significantly more than that of the SG (55347±1631 steps/day) (P<0.001). However, there is no significant difference between the daily steps number (not including the AG steps taken during morning exercise) of the AG (6510±2985) and the SG (5347±1631) (P>0.05).

The values of blood lipids profile are shown in Table 2. TG, TC TC/HDLC and LDL-C: HDL-C in the AG were significantly lesser than the SG (P<0.05). But HDL-C and LDL-C did not differ in two groups (P>0.05). A significant correlation was found between average steps per day and TG (-0.424, P<0.05); TC (-0.389, P<0.05); TC/HDL-C (-0.469; P<0.01); HDL-C/LDL-C (-0.390; P<0.05); and daily oxygen consumption (0.853; P<0.001) and BMI (-0.721; P<0.001). However there was no significant correlation between steps/day and HDL-C and LDL-C (p>0.05) (Table 3).

DISCUSSION

Although the cross-sectional nature of this study does not allow causal relationships to be determined, we found that middle aged men who walked more had more normal levels of blood lipids/or lower biochemical risk factors of the cardiovascular system (that is, TG, TC, TC:HDLC-C, and LDL-C:HDL-C ratios).

The Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) have recommended that every adult accumulate at least 30 min of moderate-intensity physical activity on most days of the week (Schneider, 2004; Pate et al., 1995). Another popular recommendation is the accumulation of 10,000 steps per day on most days of the week. According to Tudor-Locke and Bassett (2004) and LeMasurier et al. (2003) the amount of physical activity achieved by walking 10,000 steps per day is in agreement with the recommendations of the CDC and the ACSM (Bravata, 2007).

In the present study, the AG has lower level of TG. This

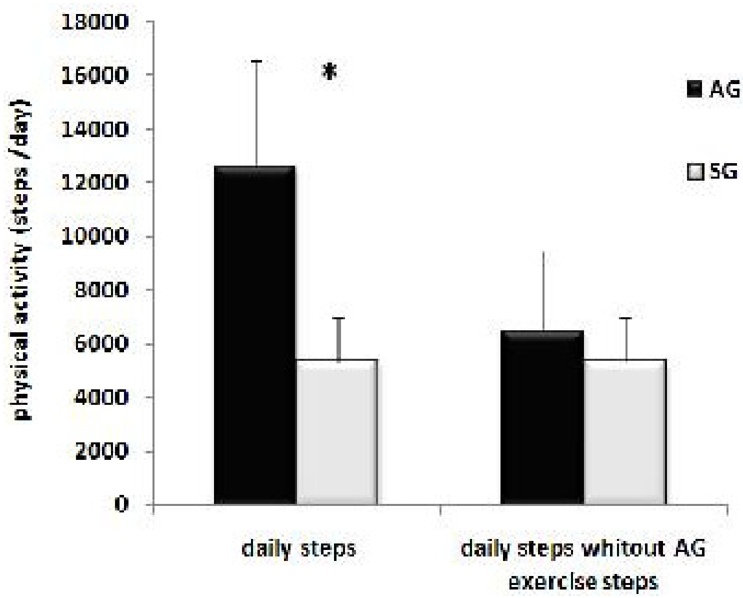

Figure 1. Comparison between the daily steps of AG and SG in middle-aged men. Where, AG = active group; SG = sedentary group. *p<0.001.

Table 1. Participant characteristics (mean ± SD).

Characteristics	AG[a] (n =50)	SG[a] (n=58)	p
Age (years)	51.67±7/73	49.07±7.34	0.38
Height (cm)	171±4.95	170.57±6.28	0.71
Weight (kg)	81.2±1.1	80.93±8.33	0.94
BMI[a] (kg/m2)	27.6±3.1	27.81±2.8	0.85
BF (%)	23/33±5/19	23/4±2/51	0.76
WC[a] (cm)	93.79±8.3	96.47±5.73	0.33
HC[a] (cm)	101.18±6.39	99.33±5.26	0.41
WHR[a] *	0.93±0.05	0.97±0.03	0.004
Vo_2[a] (ml/kg/min)**	27.62±1.93	18.83±1.62	0.001
MET**	7.890.55	5.37±0.46	0.0001

[a]AG, active group; SG, sedentary group; BMI, body mass index; BF%'; body fat percent, WC, waist circumference; HC, hip circumference; WHR, waist to hip ratio; Vo_2, daily oxygen expenditure. *P<0.01; **P<0.001.

finding is in agreement with the studies of Dancy et al. (2008) and Kobayashi et al. (2006), but such a difference was not observed in the research of Forukava et al. (2003) and Schneider (2004). Strong evidence has been presented for lower levels of TG in active people (Dancy et al., 2008). Studies have been shown that Individuals who participate in aerobic training often have a lower level of TG in comparison with sedentary people. The amount of TG difference between active and sedentary groups has been reported from 18 to 77mg/dl in at least half of cross-sectional studies (Wynne et al., 1980; Schwartz et al., 1992). In this survey, TC concentration was also lower in the AG. However, Furukawa et al. (2003), Kobayashi et al. (2006), and Schneider et al. (2004) did not find the same result. Several reasons including age, sex, nutritional habits, and the amount and duration of PA can be suggested for these inconsistent results. Nonetheless, on the reduction of TC fewer has been reported and amount of reduction was from low to moderate (Wynne et al., 1980; Hornbuckle et al., 2005). Also, the TC: HDL-C and LDL-C: HDL-C ratios were less in the AG. This change was supported by Sugiura et al.

Table 2. Participants' blood lipids profile (mean ± SD).

Variable	AG[a] (n =50)	SG[a] (n=58)	P
TG (mg/dl) *	114.92±33.52	168.4±48.47	0.003
TC (mg/dl) *	171.92±22.37	201.67±33.42	0.014
HDL-C (mg/dl)	39±8.12	35.6±7.19	0.26
LDL-C (mg/dl)	114.25±18.63	132.33±28.02	0.067
LDL-C/ HDL-C *	4.56±1.02	5.72±0.84	0.004
TC:HDL-C *	3.11±0.62	3.77±0.67	0.016

[a]AG, active group; SG, sedentary group. *P<0.05.

Table 3. Correlation between steps/day and blood lipids, VO_2, and BMI (n=108).

Variable	r	P-value
TG (mg/dl) *	-0/424	0/027
TC (mg/dl) *	-0/389	0/045
HDL-C (mg/dl)	0/202	0/313
LDL-C (mg/dl)	-0/388	0/084
TC/ HDL-C *	-0/469	0/014
LDL-C/ HDL-C *	-0/390	0/044
Vo_2 (ml/kg/min)**	0/853	0/000
BMI (kg/m2)	-0/721	0/000

*Correlation is significant at the 0.05 level (two tailed). **Correlation is significant at the 0.001 level (two tailed).

(2002) and Crouse et al. (1997). In this study, the level of HDL-C was higher in the AG than in the SG, but this difference wasn't significant. This finding was paralleled by Kobayashi et al. (2006) but differed from Schneider et al. (2004), Furukawa et al. (2003) and Sugiura et al. (2002). Lack of a significant difference in HDL-C concentration may be explained by the absence of data on preliminary HLDL-C concentration (Savage et al., 1986; Woolf et al., 2008). Studies show that, people with a low preliminary level of HDL-C (<35mg/dl) are more resistant to the changes resulting from exercise (Savage et al., 1986). Therefore, exercise may increase this variable in people with a normal or higher preliminary level of HDL-C before initiating PA (Woolf et al., 2008). In addition, increase in HDL-C level after aerobic exercise requires reaching a duration and volume threshold of PA (Albright et al., 2006; Kokkinos et al 1995). In the present study, LDL-C concentration in the AG was lower than the SG. However, this difference (18mg/dl, equal to 13.8%) was not significant (*P>0.05*). This result is in agreement with Sugiura et al. (2002), Furukawa et al. (2003), and Schneider (2008). Reduction in LDL-C concentration after exercising has rarely been reported and is often synchronized with considerable body weight loss (Albright et al., 2006; Kokkinos et al 1995) (Table 2).

Scientific observations indicated that persons who have an active lifestyle, decrease their cardiovascular risk/or blood lipids profiles, in comparison with persons who have a sedentary lifestyle (Hornbuckle et al., 2005). Most of the cross-sectional and longitudinal designs indicate little difference in the TC and LDL-C levels in active and inactive people (Kobayashi et al., 2006). However, there is strong evidence for change in TG and HDL-C concentrations (Hornbuckle et al., 2005). Also, evidences shows that TG and HDL-C levels are more sensitive than TC and LDL-C levels to regular exercise and PA (Woolf et al., 2008). It seems that exercise and PA volume (that is, calorie consumption) is a pervasive stimulus which can affect the blood lipids, especially the TG and HDL-C (Wynne et al., 1980).

Figure 1 shows that, the average of the daily steps taken by the AG is significantly higher than that of the SG, (P<0.001). But when the number of steps taken in the morning exercise program by the AG was subtracted from the total number of their steps, and the result compared with the SG daily steps, no significant difference in daily steps were found in the two groups (P>0.05). Therefore, we concluded that the morning exercising of the AG is the main factor in their significant increase of daily steps in comparison with the SG. Therefore, active lifestyle (regular Participation in morning exercise) of the AG my lead to have better blood lipid profiles.

We can point to a number of reasons for the heterogeneity in the results, including nutritional habits, weight control methods, intensity and duration of PA, age, sex, genetics, BMI, weight, body composition, and the primary levels of blood lipids profile at the start of PA programs (Albright et al., 2006; Kokkinos et al., 1995). Additionally, cross-sectional studies did not clearly show the effects on the blood lipids profile, of unexpected variables or personal characteristics beyond exercise. Also, there is a possibility that the interventional factor of energy intake from diet (that is, quality and quantity of nutrition) has an important role in moderating some blood lipids variables.

Conclusions

Permanent PA in terms of increasing the daily steps for at least two years improves the lipids profile in middle-aged men. It seems that public exercise programs (that is, morning exercising) and similar daily activities play an important role in maintaining physiologic heath status. Therefore, it is suggested that inactive, healthy middle-aged men can improve the health level of their cardiovascular system by walking at least 12,500 steps/day.

ACKNOWLEDGMENTS

The authors are grateful to Bu-Ali Sina University of Hamedan, Iran for supporting this research by providing equipment. Special thanks go to all persons who participated in this study.

REFERENCES

Albright C, Dixie L, Thompson (2006). The Effectiveness of Walking in Preventing Cardiovascular Disease in Women: A Review of the Current Literature. J. Women's Health. 15(3).

American College of Sports Medicine (2004). ACSM's Health-related Physical Fitness Assessment Manual. 2nd Ed Philadelphia7 Lippincott, Williams and Wilkins.

Bernard CK, Anita WP, Jerome CL, Elaine CL (2007). Daily step goal of 10,000 steps: A literature review. Clin. Invest. Med., 30 (3): 146-151.

Bravata DM, Spangler CS, SundaramV (2007). Using Pedometers to Increase Physical Activity and Improve Health. A Systematic Review. JAMA, 298(19): 2296-2304.

Catherine B, Daniel AJ, Tudor-Locke C (2004). Health benefits of a pedometer-based physical activity intervention in sedentary workers. Prev. Med., 39: 1215-1222.

Crouse S, Obrien B, Grandjean P, Crouse S, Obrien B, Grandjean P, , Robert C. Lowe J, James R, John S (1997). Effects of exercise training and a single session of exercise on lipids and apolipoproteins in hypercholesterolemic men. J. Appl. Physiol., 83: 2019-2028.

Dancy C, Lohsoonthorn V, Williams MA (2008). Risk of dyslipidemia in relation to level of physical activity among thai professional and office workers. Southeast Asian J. Trop. Med. Public Health., 39(5): 932-941.

Furukawa F, Kazuma K, Kawa M, Miyashita M, Niiro K, Kusukawa R, et al (2003). Effects of an Off-Site Walking Program on Energy Expenditure, Serum Lipids, and Glucose Metabolism in Middle-Aged Women. Biol. Res. Nurs., 4(3): 181-192.

Graham I, Atar D, Johnsen KB, Boysen G, Burell G, Cifkova R (2007). Review European guidelines on cardiovascular disease prevention in clinical practice: Executive summary. Atherosclerosis, 194: 1-45.

Hornbuckle LM, Bassett DR Jr, Thompson DL (2005). Pedometer-determined walking and body composition variables in African-American women. Med. Sci. Sports Exerc., 37: 1069-1074.

Iwane M, Arita M, Tomimoto S, Satani O, Matsumoto M, Miyashita K, Nishio I (2000). Walking 10,000 Steps/Day or More Reduces Blood Pressure and Sympathetic Nerve Activity in Mild Essential Hypertension. Hypertens Res., 23(6): 573-580.

Kobayashi J, Murase Y, Asano A, Nohara A, Kawashiri MA, Inazu A, Yamagishi M, Mabuchi H (2006). Effect of walking with a pedometer on serum lipid and adiponectin levels in Japanese middle-aged men. Journal of Atherosclerosis and Thrombosis. 13(4): 197-201.

Kokkinos P, Holland J, Pittaras A, Narayan P, Dotson CO, Papademetriou V (1995). Cardiorespiratory fitness and coronary heart disease risk factor association in women. J. Am. Coll. Cardiol., 26: 358.364.

LeMasurier GC, Sidman CL, Corbin CB (2003). Accumulating 10,000 steps: Does this meet current physical activity guidelines? Res. Q Exerc Sport., 74: 389-394.

Lubans DR, Morgan PJ, Tudor-Locke C (2009). A systematic review of studies using pedometers to promote physical activity among youth. Prev. Med., 48: 307-315.

Nancy L, Cynthia A, Mary J (2004). Review: Measuring Physical Activity to Promote an Active Lifestyle. J. Am. Diet Assoc., 104: 1398-1409.

Pate RR, Pratt M, Blair SN Haskell WL, Macera CA, Bouchard C, Buchner D, Ettinger W, Heath GW, King AC (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.

Savage M, Petratis M, Thompson WH, Berg K, Smith JL, Sady SP (1986). Exercise training effects on serum lipids of prepubescent boys and adult men". Med. Sci. sports Exerc., 18: 197-204.

Schneider PL (2004). Accuracy of pedometers and their use in a 10,000 steps per day intervention study. The University of Tennessee. 188 pages; AAT 3148307.

Schofield G, Schofield L, Hinckson EA, Mummery WK (2009). Daily step counts and selected coronary heart disease risk factors in adolescent girls. J. Sci. Med. Sport., 12: 148-155.

Schwartz RS, Cain KC, Shuman WP, Larson V, Stratton JR, Beard JC, Kahn SE, Cerqueira MD, Abrass IB (1992). Effect of intensive endurance training on lipoprotein profiles in young and older men. Metabolism, 41: 649-654.

Siri WE (1961). Body composition from fluid spaces and density: analysis of methods. In: Techniques for Measuring Body Composition, J. Brozek and A. Henschel (Eds.). Washington, DC: Nation. Acad. Sci., pp. 223-244.

Sugiura H, Kajima K, Mirbod SM, Iwata H, Matsuoka T (2002). Effects of long-term moderate exercise and increase in number of daily steps on serum lipids in women: randomized controlled trial. BMC Women's Health. 2:3.

Swartz AM, Strath SJ, Bassett DR, Moore M, Redwine BA, Groe¨r M, Thompson DL (2003). Increasing daily walking improves glucose tolerance in overweight women. Prev. Med., 37: 356-362.

Tudor-Locke C (2002). Taking Steps Toward Increased Physical Activity: Using Pedometers to Measure and Motivate. President's Council on Physical Fitness & Sports. Res. Digest., 3(17): 1-8.

Tudor-Locke C, Bassett JR (2004). How Many Steps/Day Are Enough? Preliminary Pedometer Indices for Public Health. Review. Sports Med., 34(1): 1-8.

Tully MA, Cupples ME, Chan WS, McGlade K, Young IS (2005). Brisk walking, fitness, and cardiovascular risk: A randomized controlled trial in primary care. Prev. Med., 41: 622- 628.

Woolf K, Reese CE, Mason MP, Neaird LC, Tudor-Locke C, Vaughan LA (2008). Physical Activity Is Associated with Risk Factors for Chronic Disease across Adult Women's Life Cycle. J. Am. Diet. Assoc., 108(6): 948-959.

Wynne T, Bassett-Frey M, Laubach L, Glueck C (1980). Effect of a controlled exercise program on serum lipoprotein level in women on oral contraceptives. Metabolism, 29: 1267-1271.