A Preliminary Outcome Evaluation of the Effect of Community Based Walking Program on Risk of Metabolic Syndrome in Overweight Participants

Kornanong Yuenyongchaiwat¹*, Duangnate Pipatsitipong², Panthip Sangprasert³

¹Physiotherapy Department, Faculty of Allied Health Sciences, Thammasat University, Thailand
²Department of Medical Technology, Faculty of Allied Health Sciences, Thammasat University, Thailand
³Faculty of Nursing, Thammasat University, Thailand

*Correspondence: Kornanong Yuenyongchaiwat, Physiotherapy Department, Faculty of Allied Health Sciences, Thammasat University, 99 Moo 18, Paholyothin Road, Klong Luang, Rangsit, Prathumthani, 12120, Thailand, Tel: +66(0)29869213; E-mail: ykornano@tu.ac.th, plekornanong@gmail.com

Received: 06.04.2016; Accepted: 07.05.2016; Published: 17.05.2016

Abstract

Background: The metabolic syndrome has been defined in term of a group of risk factors for cardiovascular disease. Increased physical activity has been recommended to prevent cardiovascular diseases. In addition, most studies explored the effect of physical activity on the Mets in Western countries. A few studies have been conducted in Asia. Therefore, the aim of this study was to evaluate the effect of a 12-week pedometer based community walking intervention on change in risks of metabolic syndrome (defined as clinical diagnosis criteria from the National Cholesterol Education Program Adult Treatment Panel III guidelines), in participants with overweight.

Method and findings: Thirty-five overweight participants who had body mass index ≥ 25 kg m⁻² were participated and were assigned to the 12-week pedometer-based walking program (an accumulated 10,000 steps d⁻¹). Blood pressure, blood samples and anthropometric parameters were measured initially before and after 12-week walking intervention program. The amount of step-counts, 5-day a week was recorded in diary booklet. The study found systolic blood pressure and waist circumference were significantly lower in 30 individuals who had accumulated 10,000 steps d⁻¹ in the intervention group at 12 week follow up (-13.74 mmHg and -2.48 cm, respectively). In addition, reduction in fasting blood glucose (-14.89 mg/dL) were statistically significantly associated with 10,000 steps daily (p < .001). However, triglycerides and high-density lipoprotein cholesterol were not observed.

Conclusion: The accumulation of least 10,000 steps d⁻¹ resulted in decreased the risks of metabolic syndrome such as hypertension, diabetic mellitus in overweight adults.

Keywords: Metabolic syndrome; Physical activity; Walking; Blood pressure; Blood glucose; Pedometer

Introduction

The metabolic syndrome has been defined in term of a group of risk factors for cardiovascular disease and cerebrovascular disease. The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III), the International Diabetes Foundation (IDF), the World Health Organization (WHO), and the European Group for the Study of Insulin Resistance (EGIR) have been proposed as the clinical diagnosis criteria of metabolic syndrome (defined as ≥ 3 of the following: central obesity, elevated blood pressure (BP), low high-density lipoprotein cholesterol (HDL-C), elevated triglycerides (TG), impaired fasting glucose [1]. In addition, many studies has been reported that individuals who have been diagnosed with Mets are a twofold increases in the risk for CVD over the next 5-10 years and a five-fold increase in the risk of type II diabetes mellitus [2]. In addition, the prevalence of Mets has been also become increasing worldwide. The observed prevalence of the Mets in ten European countries and from the USA was 24.3% [3]. Further, the prevalence rate of obesity (defined as BMI ≥ 30 kg m⁻²) in seven European countries was 17% (from 11.6% to 26.3%) [4]. In Thailand, overall a prevalence of being Mets among adults was up to 32.6 % and 35% in Bangkok [5] In a survey in Thailand, a prevalence of being overweight and obesity (body mass index; BMI ≥ 25 kg m⁻²) among adults was up to 23.9% [6]. Moreover, several studies have reported that increasing physical activity or exercising could reduce risk of CVD and the metabolic syndrome. Bankosi et al. [7] reported that people with metabolic syndrome had longer average sedentary time with non-metabolic syndrome. It has been also known that lack physical activity was associated with greater increase of increased BMI, higher waist circumference and percent of body fat [8]. Increasing physical activity is one of the recommendations for the reduction in the risk of metabolic syndrome. The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) propose that accumulations of 30 minutes of moderate intensity physical activity at least 5 days per week or 150 minutes per week increase physical activity in all population groups [9]. Accordingly, walking (i.e., brisk walking) is also generally recommended and equivalent to an alternative moderate
physical activity. It has been reported that an accumulating at least 10,000 steps a day has been revealed to meet the necessary minimum current physical activity required [10,11]. Further, Sisson et al. [12] examined the relationship between daily steps walking and Mets with a cross-sectional study. They found that participants who had diagnosed metabolic syndrome decreased a step walking daily. Moreover, lower waist circumference, higher HDL-C level and lower TG level were observed in adults who took more steps daily. However, little is known regarding the effects of walking with a pedometer on the risk of metabolic syndrome among overweight adults in a community setting. Therefore, the aim of this study was set the community based walking intervention to determine the effects of accumulating 10,000 steps per day with a pedometer on risk of the metabolic syndrome among overweight participants.

Materials and Methods

Participants and design

Thirty-five participants were recruited from the community aged 35-59 with overweight adults (defined as BMI ≥ 25 kg·m⁻²). Written and informed consent were obtained. In addition, the ethics and protocol were approved by the Ethics Committee of Thammasat University. The quasi experimental cohort study was designed to determine whether the effect of using a pedometer on risk of metabolic syndrome (defined as ≥ 3 of the following: elevated clinical diagnosis blood glucose, BP, HDL-C, TG, central obesity). According to the clinical diagnosis criteria by National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III guidelines, the metabolic syndrome is defined as a person having waist circumference (WC) in male > 102 cm (> 40 inches) or female > 88 cm (> 35 inches) plus any 2 or more of the following 4 risk factors: (a) TG ≥ 150 mg/dL; (b) low HDL-C; male < 40 mg/dL, and female < 50 mg/dL; (c) high BP (systolic BP ≥ 130 or diastolic BP ≥ 85 mmHg) or having antihypertensive medicine; and (d) high fasting glucose (≥ 110 mg/dL) or previously diagnosed with type 2 diabetes [1]. Therefore, the metabolic syndrome in the present study was identified by NCEP ATP III guidelines.

Measures and apparatus

Measurements of risk of metabolic syndrome (i.e., central adipose tissue, BP and blood samples) were obtained prior and after the intervention program. Central adipose tissue is defined as a waist circumference. Participants were measured with upright standing position, and the level of umbilicus was taped measurement. Participants were asked to sit quietly a comfortable chair while resting BP readings were obtained. BP was administrated by an Omron M6 Comfort BP monitor (HEM-7211; Omron Healthcare B.V., Kruisweg, Hoofddorp, The Netherlands), which is an automated oscillometric non-invasive BP device. The monitor corresponds to comparisons with intra-aortic values within American National Standard Institute / Association of Medicine Instrumentation standards for accuracy (a mean difference of ± 5 mmHg, and a standard deviation of ± 8 mmHg; the manufacturer recommendations).

Further, the Omron M6 device has been met the validation requirement of the 2010 European Society of Hypertension international protocol revision [13]. The automated BP monitor was set to read and record BP and HR at 5 and 6-minute, with a one-minute interval reading, an averaged BP was calculated. However, in case of the difference between at 5 and 6-minute is greater than 5 mmHg, the BP is recommended to measure [14]. Blood samples had been analyzed of lipids and glucose. All participants were asked to refrain from drinking and food consumption for 8-12 hours. Blood samples were drawn to measure plasma glucose level, HDL-C and TG.

Baseline walking steps per day were measured with the pedometer (Yamax Digi-Walker SW-200; Yamax Tokei Keiki Co., Ltd., Tokyo, Japan). Individuals were asked to wear their sealed pedometer during the working day for 5 days whilst following their normal daily routine and then record the details in their booklet. At the 12-week intervention, the participants were instructed to walk at least 10,000 steps per day and record their steps in their diary.

Statistical analysis

Steps per day were calculated weekly (i.e., only 5 working days per week was averaged). The change in the average number of steps per day over the 12-week intervention program was modeled for each participant. Descriptive data was presented as a percentage (%), mean and standard deviation (SD). Data was verified for normality of distribution (Komogorov Siminov Goodness of Fitness test). Paired t-test was used to determine whether the pedometer decreased significant changes in risk of metabolic syndrome before and after walking intervention programs (Table 1).

Table 1 Demographic data in overweight participants at baseline (n = 30).

<table>
<thead>
<tr>
<th></th>
<th>Number (%)</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>21 (70.0%)</td>
<td>49.67</td>
<td>6.51</td>
</tr>
<tr>
<td>Male</td>
<td>9 (30.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yr)</td>
<td></td>
<td>27.86</td>
<td>4.33</td>
</tr>
<tr>
<td>BMI (kg·m⁻²)</td>
<td></td>
<td>92.63</td>
<td>9.26</td>
</tr>
<tr>
<td>WC (cm)</td>
<td></td>
<td>129.51</td>
<td>7.82</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td></td>
<td>84.46</td>
<td>9.97</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td></td>
<td>130</td>
<td>23.63</td>
</tr>
<tr>
<td>TG (mg/dL)</td>
<td></td>
<td>52.2</td>
<td>9.75</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking steps a day</td>
<td>4,540.53</td>
<td>1,959.00</td>
<td></td>
</tr>
</tbody>
</table>

BMI: Body Mass Index; WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR:
Heart Rate; FBS: Fasting Blood Sugar; TG: Triglyceride; HDL-C: High-Density Lipoprotein Cholesterol

Results

Effects of the pedometer-based intervention on risk of metabolic syndrome

As shown in Table 2, significant decreased risk of metabolic syndrome (i.e., SBP, waist circumference, and blood glucose).

Table 2 Compared pre and post risk of metabolic syndrome by using pedometer intervention program in overweight participants.

<table>
<thead>
<tr>
<th>Walking (steps/day)</th>
<th>N</th>
<th>Pre</th>
<th>Post 12-wk</th>
<th>Mean difference</th>
<th>95% CI of the difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.27 ± 13.55</td>
<td>30</td>
<td>4,540.53 ±1,959.00</td>
<td>10,500.20 ± 2070.54</td>
<td>-5960.67</td>
<td>-6774.85 to -5146.49</td>
<td>&lt; .0001</td>
</tr>
</tbody>
</table>

WC: Waist Circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBS: Fasting Blood Sugar; TG: Triglyceride; HDL-C: High-Density Lipoprotein cholesterol; CI: Confidence Interval

Discussion

The present study evaluated the effect of an accumulation at least 10,000 steps day by using pedometer on risk of metabolic syndrome (e.g., waist circumference, blood glucose, BP, TG, HDL-C) with overweight participants. Further, these participants were leading a sedentary lifestyle (defined as accumulating less than 5,000 steps per day [11,16]. The results of the present study support and extend these findings by suggesting that walking may lead to reduce risk of metabolic syndrome in overweight participants.

Walking, an alternative of moderate physical activity is the most common type of activity and it has been recommended from AHA to increase physical activity. In addition, the benefits of walking particularly in lowering BP, central adipose tissue and blood glucose are well-documented [17-20]. High BP has been suggested as being non-communicable disease (NCDs) and it is one of the components of the definition of metabolic syndrome [1,19]. The beneficial decrease BP was demonstrated in the current study which concurred with other studies. The results confirm recent findings indicating that walking 10,000 steps per day is effective in increasing physical activity. In addition, Pal et al. [18] reported that 12 weeks of 10,000 steps per day resulted in a significantly lower SBP by 4.7% in overweight and obese women compared with baseline in the intervention group. Lee et al. [20] found that SBP was dramatically drop from 152.0 to 136.2 (decrease of 15.4 mmHg) in the walking intervention group. In a meta-analysis with eight randomized control trials and 18 observation studies, the participants who completed more than 10,000 steps a day had a statistically significant decrease in SBP of 3.8 mmHg and DBP of 0.3 mmHg. Further, decreased SBP was associated with change in steps per day [15]. Semlitsch et al. [21] reported with a systematic review and meta-analysis for randomized control trials with at least 24 weeks reported that increasing physical activity could reduce of SBP and DBP (5-10 mmHg and 1-6 mmHg, respectively). Besides, loss of central adipose tissue was demonstrated in the current study which concurred with other studies; decreased waist circumference. Waist circumference was decreased after a 12-week intervention [22].

In addition, results of this study are in accord with other studies showing that increasing physical activity (i.e., walking exercise) can reduce blood glucose and mortality linked to diabetes [23,24]. A large prospective cohort study indicated that walking which is moderate-intensity exercise significantly decreased the risk for incident hypertension by 7.2%, hypercholesterolemia by 7.0% and diabetes mellitus by 12.3% [25].

A considerable number of studies have reported that increasing physical activity including walking program can decrease hypercholesterolemia. In addition, a meta-analysis of randomized controlled trials with 25 studies revealed that walking induced decrease of 5% and 6% for LDL-C and TG [26]. Although this study found a significant decrease in WC, TG and HDL-C were no significantly difference between before and after a 12-week intervention program. One possible
explanation for these findings is that the relatively normal baseline values. In the present study, mean TG, HDL-C and WC levels for baseline were 144.82 mg/dL, 54.27 mg/dL (40.50 mg/dL for male and 57.11 mg/dL for female) and 92.63 cm (87.11 cm. for male and 95 cm for female), respectively. According to the definition of metabolic syndrome, TG levels were ≥ 150 mg/dL, HDL-C levels were male < 40 mg/dL, and female < 50 mg/dL and WC in male > 102 cm or female > 88 cm. Therefore, the potential for change in the study were not observed either in TG or HDL-C. Coghill and Cooper [27] acclaimed that a higher baseline levels providing a larger potential for change in the study were not observed either in TG or HDL-C. Coghill and Cooper [27] acknowledged that decreases in LDL-C and TC and declines in HDL-C levels are the most important risk factors for the development of metabolic syndrome in overweight adults. Further, these results showed that increase in physical activity can be used to prevent or delay the development of metabolic syndrome and cardiovascular disease.

Thus, the results of the present study suggest that the effects of a pedometer may be attributed, at least in part, to a decrease in metabolic syndrome by which a reduced BP, waist circumference (i.e., central adipose tissue) and blood glucose then resulted in a reduction and risk of cardiovascular disease.

There are a number of limitations with the present study. The control group was not examined; a randomized control trial might be needed. In addition, dietary intake, physical activity, lifestyle, habit and behavior should be a consideration. Further, the study had a relatively small sample size and most of the participants that were recruited from females. Seventy percentages of the participants were recruited from female and those were aged over 50 of the present study. It has been appeared that levels of HDL-C, LDL-C and TG are associated with postmenopausal and premenopausal women [26,28-30]. Accordingly, gender and hormonal status are needed to understand the relationship between these parameter and risk of metabolic syndrome and 10,000 steps a day.

Therefore, results may not be used to draw conclusions for the whole population. Because the purpose of this study was to determine the effect of an average of 10,000 steps per day on the risk of metabolic syndrome in overweight adults, a larger sample size with random control trials are focused. Despite the limitations noted previously, the study use of laboratory investigation (i.e., blood sample tests) which allowed for more complete and sophisticate ascertainment of metabolic syndrome than relying on self-reported data alone.

In conclusion, the accumulating at least 10,000 steps per day resulted in a reduction resting systolic blood pressure, blood glucose and waist circumference which are a risk of metabolic syndrome in overweight participants. This shown that increase in physical activity by accumulating at least 10,000 steps per day can reduce the risk of cardiovascular disease and hypertension in overweight adults. Further, these factors probably lead to decreased risk of metabolic syndrome and therefore the accumulating 10,000 steps a day probably helps to decrease risk of metabolic syndrome and cardiovascular disease.

Acknowledgements

We acknowledge the help of Mr. Pairoon Dhar, the head of community health service and Mrs. Somsong Duren, a registered nurse for organizing and overseeing participant recruitment in the community. In addition, we would also like to thank the participants in the community for their participation.

Funding

This study was fully supported by grant from Thammasat University.

Competing and conflicting interests

There is no competing and conflict of interest in the present study.

References


