ORIGINAL ARTICLE

Effect of 10,000 Steps Goal Program on Waist Circumference in Obese Adolescences

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ABSTRACT

Background: Genetic predisposition, physical inactivity, poor dietary choices are primary contributors to the problem of obese. Walking is recognized as an easily accessible mode of physical activity and is therefore supported as a strategy to promote health and well-being.
Aim: To investigate the effect of a pedometer based walking intervention on waist circumference in obese adolescences.
Method: This study was a randomized controlled pre and post trial. Twenty-four participants who met the criteria were divided to intervention and control group. The intervention group was given 10,000 steps goal program using pedometer 5 days a week for 6 weeks, and the control group was given pedometer without goal program. Waist circumference was measured before and after the 6 weeks intervention. Wilcoxon, Mann whitney and t-test were used to analyzed the data.
Results: There was no significant difference in waist circumference (WC) score at baseline in the intervention and control group (p=0.578). However, there were significant differences in WC scores after 10,000 steps goal program between intervention and control group (p=0.034) and before-after the program in the intervention group (p=0.000).
Conclusion: 10,000 steps goal program can decrease waist circumference in obese adolescences.
Keywords*:* 10,000 steps, obesity, waist circumference

INTRODUCTION

Obesity is one of the most common health problems with increasing prevalence worldwide among people of all ages.[1] Obesity is defined as an excessive accumulation of adipose tissue that leads to health problem. According to the 2007 WHO anthropometric standard for children aged 5-18 years, nutritional status is determined based on the Z score of Body Mass Index per Age (IMT / U), in which a nutritional status of children categorized as obese is with Z score > + 2SD. According to the results of Basic Health Research in 2013, the prevalence of obese nutritional status in adolescents aged 16-18 years rose from 1.4 percent in 2007 to 7.3 percent in 2013 and Central Java was one of the provinces with prevalence of obese nutrition status above national prevalence.[2,3] Obesity during childhood and adolescence is supposed to be an important determinant of whether a subject will become obese as an adult. The prevalence of obesity has reached alarming levels worldwide, where obesity people with disability will ultimately pose a serious threat to the national health system. Obesity has a profound effect on disability and quality of life[4,5].

Many authorities agree that genetic predisposition, physical inactivity, poor dietary choices and a toxic environment are primary contributors to the problem of overweight children. In fact, complex social and environmental factors contribute to this imbalance, including changing food habits, declining physical activity, and increasingly sedentary lifestyles. Regarding the relationship between obesity and physical activity, several studies have shown that overweight/obesity was inversely related to physical activity. For example, high body mass index and waist circumference are related to decreased physical activities[3-5]. Recently, programs that increase the number of daily walking steps have been promoted to improve physical activity and a pedometer or step-counting device has been commonly used to measure and promote physical activity. The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) have recommended individual accumulations of at least 30 minutes of moderate intensity physical activity (e.g., brisk walking) 5 days per week or 150 minutes per week for all group population.[6] Other studies have shown that accumulating at least 10,000 steps meets that minimum requirement[7,8].

A simple counting device called a pedometer is a method growing in popularity. By counting the number of steps accumulated in a day, both sedentary behaviors and indicators of insufficient activity can be identified.[9] The use of a pedometer does not only motivate, but also promote an increase in the amount of daily activity a person performs[10]. Overweight/ obesity related to decreased physical activity, so targeting children's patterns of physical activity is especially important given the argument that increasing physical activity in childhood might be essential for the lifetime of regular physical activity. That's why the authors are encouraged to do research on the effect of 10,000 steps goal program on waist circumference in obese adolescence.

MATERIAL AND METHODS

This study was a randomized controlled pre and post trial which carried out in Nusaputera Senior High School and General High School 11 Semarang in February 2018. The subjects were 24 high school students aged 15 – 17 years old with obesity. The inclusion criteria were meeting the

obesity criteria based on Z score IMT/U > +2 SD - < +3 SD, aged 15 – 17 years old, able to understand instructions, having good lower extremity muscle strength, having low physical activity (>3999 - < 7000 steps per day), and able to walk more than 15 minutes without aids. While the exclusion criteria were 6mwt score before experimental < 3 METs, having hypertension, smoking, having surgery history at low movement organs ≤ 6 months, having fracture history, dislocated at low movement organs ≤ 6 months, having history/clinical signs of heart and lung illness, having history of joint disease in lower extremities, having peak flowmeter values less than normal, following activities out of school, having 1 or more yes answers to the PAR-Q questionnaire.

The samples were randomly selected. Twenty four students fulfilling the inclusion criteria became the research sample. If the participants did not participate in a 3-time consecutive training program or attendance rate of less than 75% or achievement rate of less than 75%, and did not follow the final assessment of the research, they were excluded from the study. However, there was no drop out in this study. This study obtained ethical clearance from the Ethical Commission of Medicine Research of Medical Faculty of Diponegoro University/Dr. Kariadi Hospital.

The subjects were randomly divided into two groups, intervention and control groups. The intervention group was given a pedometer for use during daily activities (only released during bathing and sleeping), lifestyle modification education to walk on target, and supervisory walking exercises, with a minimum of 3,000 steps and a maximum number of steps to complete as many as 10,000 steps on the day with moderate intensity (minimum speed of 100 steps/ minute but no running). This program was carried out for 5 working days whereas on saturday and Sunday, participants were required to move as usual before the treatment. If the study subjects did not meet the 10,000 step target while following the walking exercise, the subject were required to continue to meet its own target. Total treatment was 6 weeks with details of first week target of 8,000 steps, second week target of 9,000 steps, third week target and onward of 10,000 steps.

The study was carried out from February 2018 until March 2018. If the research subject during the day was not able to reach the target of 10,000 steps then the subject of the study was asked to write down the reason why they were not be able to meet the target and given the motivation to reach the target of 10,000 steps in the next day. If one day the study subjects exceeded the maximum of 10,500 steps per day then the results were still recorded and the subject was asked to follow the target of 10,000 steps for the next day. Every day, research subjects recorded the achievement of the number of steps in one day and report the results of that achievement. Patients were found to successfully meet the 10,000 step target if the number of steps per day ≥9500 steps per day but no more than 10,500 steps per day to prevent excessive exercise. The control group received a closed pedometer during their activities, the study subjects only noted the number of daily steps at night before bed and reported the results of the achievement to enlarge the study subjects in the control group remained in the sedentary or low physical activities. The subject of the study were measured the waist circumference before and after treatment. Waist circumference was measured at the level of umbilicus.

Data were collected in the data collector sheet then they were coded, tabulated and entered into the computer. Distribution normality was checked by Shapiro-Wilk test. Normally distributed data then were tested using unpaired t-test, while the data which were not normally distributed were tested using Mann-Whitney test. Differences before and after treatment were analyzed using paired t-test and Wilcoxon test. The p value was considered significant if the p value was less than 0.05 with 95% of confidence interval.

RESULTS

Characteristics of Research Subjects: Characteristics of research subjects in table 1 showed no significant difference in mean age (p=0.830) and gender (p=0.276) between the intervention and control group. The mean body weight showed no significant difference between the two groups (p=0.248), as well as height (p=0.726) and Body Mass Index (BMI) (p=0.073). The mean number of steps per day in the intervention group did not differ significantly with the control group (p=0.078).

Waist Circumference: In table 2, the waist circumference (WC) was assessed in both groups. There was no significant difference in WC score at baseline (p=0.578), however, after treatment-WC scores were significantly different between the intervention and control group (p=0.034). There was a significant difference in WC score before and after treatment in the intervention group (p=0.000) but there was no significant difference in the control group at the start and end of the study (p=0.136). The delta value (change of mean) of WC score before and after treatment in the intervention group was significantly different compared to control group (p=0.000).

Table 1: Characteristics of Research Subjects

Variable	**Control Group (n=12)**	**Intervention Group (n=12)**	***p***
Age	16 (15 - 17)*	16 (15 - 17)*	0.830[y]
Gender			
Man	5 (41.6%)	7 (58.4%)	0.276[x]
Woman	7 (58.4%)	5 (41.6%)	
BMI(kg/m^2)	32.54(29.72-35.34)*	30.16(29.09-35.53)*	0.073[y]
Body weight	89.07±11.28[x]	83.61±11.27[x]	0.248[z]
Body height	165.25±9.27[x]	163.83±10.23[x]	0.726[z]
Average of steps/ day	4773 ± 520.96[x]	5177 ± 550.01[x]	0.078[z]

Note : Significance p ≤ 0,05. [x]Mean±SD; *median(minimum-maximum); [x] Chi square, [z]*Independent sample T test*; [y] *Mann-Whitney*

Table 2: Waist circumference in the intervention and control group

Variable	Group		*p*
	Control	Intervention	
WC pre	103.09±4.00	102.08±4.72	0.578[w]
WC post	103.15±3.97	99.36±4.24	0.034*[x]
P	0,136[y]	0,000*[z]	
ΔWC	-0.05(0.20-0.30)	2.60(3.60-1.90)	0.000

Note: WC=waist circumference; * Significance p < 0.05; [y] Wilcoxon test; [z] Paired t-test; [w] Independent t-test; [x] Mann Whitney test

DISCUSSION

There was a significant improvement in the waist circumference (WC) score in the intervention group compared with control group. In the intervention group, there was a decrease in WC while it did not decline in the control group. This may due to the physical activities especially increased walks so the body fat has reduced, while the muscle mass increases. The mechanism may increase resting metabolic rate (RMR), thus further promote energy imbalances. Increases in energy expenditure during post exercise may induce a short term rise in metabolic rate for more than 24 hours. There was no significant difference of WC score before and after treatment in the control group (p=0.136). This may due to low physical activities, unlike the intervention group.

This is consistent with Venables and Jeukendrup[11] who suggested that exercise is effective in improving obesity because it leads to a decrease in body fat, an increase in fat-free mass, and an overall activation of body function, compared with other measures. Fat will be accumulated in the abdominal and abdominal adipose tissue is better mobilized than gluteal adipose tissue. So, measurement of the waist circumference of the abdomen makes it possible to estimate excess weight or weight loss. This corresponds to one study which found that 80% of overweight individuals and 29% of individuals with normal BMI had a body fat percentage of "obese".[12] It appears that adiposity measurements in the abdomen (waist circumference) better predict the health compared to BMI[13]

Centrally located excess weight is even more clearly associated with health risk. Additionally, a decrease in waist circumference from exercise indicates a decrease in abdominal fat and this is effective in decreasing the risk for cardiovascular and metabolic diseases.[14] Regular exercise decreases abdominal fat, neutral fat, blood pressure, but increases high density lipoproptein cholesterol (HDLC) and insulin sensitivity. Regarding the relationship between obesity and physical activities, several studies have shown that obesity was inversely related to physical activities. For example, high body mass index (BMI) and waist circumference (WC) are related to decreased physical activities.[15,16] In both women and men, physical activities are strongly associated with health independently from BMI and WC[17]. Increases in physical activities trigger a positive impact on weight management as well as directly enhance subjective well-being.[18]

The autonomic nervous system is a key component in energy balance and fat storage regulation. Exercise seems to have a direct effect in sympathethic nervous system. A lower sympathethic activity was suggested to lead to lower levels of energy expenditure allowing a positive energy balance and weight gain. The adipose tissue is more sensitive to either the sympathethic nervous system or to the rising levels of circulating catecholamines. Either situations would increase lipid mobilization.[19]

The ACSM recommends walking as a safe aerobic exercise to reduce obesity.[20] Programs that increase the number of daily walking steps have been promoted to improve physical activity and a pedometer or step-counting device has been commonly used to measure and promote physical activity. Walking 10,000 steps per day is effective in increasing physical activity. Research has shown that people meeting the 10,000 steps/day target are more frequently classified as normal weight and those individuals with values less than 5,000 steps/day are more frequently classified as obese.[9] In particular, a meta-analysis of 26 studies from 1966 to 2007 suggested that using a pedometer increased physical activity.[22] Further, the beneficial change in weight demonstrated in the current study agrees with other studies, which showed that 10,000 steps per day resulted in a significant decrease in body weight, BMI, %BF and WC.[21-23]

Physical activities are also an ideal focus because it has many other benefits in addition to body weight regulation and improving body composition such as psychological and social well-being. Physical activity is hypothesized to protect from the development of obesity through several channels: 1) Physical activity results in an increase in energy expenditure due to the cost of the activity itself and is also hypothesized to increase resting metabolic rate (RMR), [24] 2) Physical activity has beneficial effects on substrate metabolism, with an increased reliance on fat, relative to carbohydrate, for fuel utilization.[25]

Relative fat utilization is higher during activity of moderate intensity such as walking and physical activity promotes an overall increase in muscle mass. So, effects of 10,000 steps per day will decrease central obesity with decrease waist circumference and increase muscle mass. Previous studies have shown that there is a strong dose-response relationship between increasing amounts of physical activity and improvements in measures of central obesity.[26]

CONCLUSION

10,000 steps goal program during 5 days a week for 6 weeks decreased waist circumference in obese adolescent. Future research should continue the work done in this study by examining the body weight and nutritional intake in each participant.

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REFERENCES

1. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960–1994. Int J Obes. 1998; 22(1): 39.
2. Kementerian Kesehatan Republik Indonesia. Riset kesehatan dasar [Basic health research]. Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia; 2013. Indonesian.
3. Pataky Z, Armand S, Müller-Pinget S, Golay A, Allet L. Effects of obesity on functional capacity. Obesity. 2014; 22(1): 56-62.
4. Adólfsdóttir S, Sørensen L, Lundervold AJ. The attention network test: a characteristic pattern of deficits in children with ADHD. Behav Brain Funct. 2008; 4(1): 9.
5. Syarif D. Childhood obesity: evaluation and management. Paper presented at the Surabaya: National Obesity Symposium II; 2003; Surabaya, Indonesia.
6. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of

Sports Medicine and the American Heart Association. Circulation. 2007; 116(9): 1081.
7. Le-Masurier GC, Sidman CL, Corbin CB. Accumulating 10,000 steps: does this meet current physical activity guidelines?. Res Q Exercise Sport. 2003; 74(4): 389-394.
8. Tudor-Locke C, Hatano Y, Pangrazi RP, Kang M. Revisiting "how many steps are enough?". Med Sci Sports Exerc. 2008; 40(7): S537-S543.
9. Pillay JD, Kolbe-Alexander TL, Proper KI, van Mechelen W, Lambert EV. Steps that count-physical activity recommendations, brisk walking and steps per minute-how do they relate?. J Phys Act Health. 2014; 11(3): 502-8.
10. Behren TK, Hawkins SB, Dinger MK. Relationship between objectively measured steps and time spent in physical activity among free-living college students. Meas Phys Educ Exerc Sci. 2005; 9(2): 67-77.
11. Venables MC, Jeukendrup AE. Physical inactivity and obesity: links with insulin resistance and type 2 diabetes mellitus. Diabetes Metab Res Rev. 2009; 25(S1).
12. Gómez-Ambrosi J, Silva C, Galofré J, Escalada J, Santos S, Millán D, et al. Body mass index classification misses subjects with increased cardiometabolic risk factors related to elevated adiposity. Int J Obes. 2012; 36(2): 286.
13. Simpson JA, MacInnis RJ, Peeters A, Hopper JL, Giles GG, English DR. A Comparison of adiposity measures as predictors of all-cause mortality: The Melbourne Collaborative Cohort Study. Obesity. 2007; 15(4): 994-1003.
14. Rezende FAC, Rosado LEFPL, Ribeiro RCL, Vidigal FC, Vasques ACJ, Bonard IS, et al. Body mass index and waist circumference: association with cardiovascular risk factors. Arq Bras Cardiol. 2006; 87(6): 728-734.
15. Ara I, Moreno LA, Leiva MT, Gutin B, Casajús JA. Adiposity, physical activity, and physical fitness among children from Aragon, Spain. Obesity. 2007; 15(8): 1918-24.
16. Lohman TG, Ring K, Pfeiffer K, Camhi S, Arredondo E, Pratt C, et al. Relationships among fitness, body composition, and physical activity. Med Sci Sports Exerc. 2008; 40(6): 1163.
17. Lee IM, Djousse L, Sesso HD, et al. Physical activity and weight gain prevention. JAMA. 2010; 303: 1173-79.
18. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. Int J Behav Nutr Phys Act. 2010; 7: 40.
19. Peterson HR, Rothschild M, Weinberg CR, Fell RD, McLeish KR, Pfeifer MA. Body fat and the activity of the autonomic nervous system. N. Engl. J. Med.1988; 318(17): 1077-83.
20. The American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Philadelphia, PA: Wolter Kluwer Health; 2013.
21. Chan CB, Ryan DA, Tudor-Locke C. Health benefits of a pedometer-based physical activity intervention in sedentary workers. Prev. Med. 2004; 39(6): 1215-22.
22. Murphy MH, Nevill AM, Murtagh EM, Holder RL. The effect of walking on fitness, fatness and resting blood pressure: a meta-analysis of randomised, controlled trials. Prev. Med. 2007; 44(5): 377-85.
23. Schneider PL, Bassett-Jr DR, Thompson DL, Pronk NP, Bielak KM. Effects of a 10,000 steps per day goal in overweight adults. Am J Health Promot. 2006; 21(2): 85-9.
24. Poehlman ET. A review: exercise and its influence on resting energy metabolism in man. Med Sci Sports Exerc.1989; 21(5): 515-25.