ISSN: 2347-467X, Vol. 10, No. (3) 2022, Pg. 1130-1139

Current Research in Nutrition and Food Science

www.foodandnutritionjournal.org

Effects of Walking Exercise Program Based on Duration on the Body Composition and Lipid Profile in Overweight and Obesity Female College Students

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Abstract

The lack of physical activity is one factors that causes the increased prevalence of overweight and obesity in Indonesia. A walking exercise program is a simple strategy for weight loss and the prevention of various chronic diseases. This research aims to analyze the effects of walking exercise programs base on duration which involve an increased number of daily steps on the body's composition and lipid profile. The quasi-experimental design included 40 female university students aged 20–30, whose body mass index (BMI) was ≥25 kg/m^2. They are divided into two groups 60 minutes (WE-60) and 40 minutes (WE-40) walking program. All groups performed the program intervention five times per week, carried out for a total of 12 weeks, with a heart rate of 50%-75%. The results showed that an additional 60-minute walking exercise program led to a greater increase in the total daily steps (P<0.001), and it has a significant effect on weight (P=0.005), BMI (P=0.002), WC (P=0.003), visceral fat (P=0.001), fat mass (P=0.001) and the body fat percentage (P=0.007), compared to the 40 minutes walking group intervention. However, the lipid profiles of both groups were not significantly different. In conclusion, the addition of a 60-minute walking exercise program (WE-60) five times per week, improved the daily steps and significantly affected body composition, but it had no significant effect on the lipid profile.

Article History
Received: 15 August 2022
Accepted: 29 November 2022

Keywords
Body composition;
Daily steps;
Lipid profile;
Obese;
Walking exercise.

Introduction

Being overweight can cause severe problems and they have also become a global epidemic. The prevalence of obesity and overweight among adults aged 18 years, was 13% and 39%, respectively.[1] Furthermore, the Basic Health Research 2018 in Indonesia revealed that the number of cases among people over 18 years increased by 13.6% and 21.8%,

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Doi: http://dx.doi.org/10.12944/CRNFSJ.10.3.26

respectively.[2] These conditions are more dominant in women than men at all sociodemographic levels.[3] A study on 18-29-year-olds in Indonesia showed the overweight and obesity rate for women was 43%, while 26.4% was obtained for men.[4] Physical inactivity is one of the causes of obesity, and it frequently leads to several degenerative diseases, including hypertension, type 2 diabetes mellitus, and hyperlipidemia, all of which are considered major risk factors for cardiovascular diseases.[5,6] Basic health research in Indonesia showed its rate increased from 26% in 2013 to 33.5% in 2018.[2]

Walking exercise is a strategy that can increase physical activity based on the number of daily steps. It also has a low injury risk and is effective as an intervention for weight loss and other chronic diseases.[7,8] The American Sports Medicine Association (ACSM) recommends that overweight adults exercise at least 150 minutes a week to maintain their health. However, a duration of over 250 minutes per week is advised for long-term weight loss.[9] A previous study recommended over 250-420 minutes per week when the diet is not controlled.[10] Engaging in prolonged aerobic physical activity of more than 150 minutes per week plays a vital role in weight loss and long-term maintenance.[11] Duration is the time a person performs an exercise in constant motion. A duration of 30-60 minutes with moderate intensity is more effective in improving the body's fitness and weight loss.[12] This is because the speed of fat oxidation into energy increases when exercise is carried out for a long period.[13]

Fats and carbohydrates are the main fuel for energy production during exercise, which is determined by the duration and intensity. When it is carried out for 60-120 minutes with moderate intensity, the contribution of fat as an energy source is more dominant, while more carbohydrates are used up during shorter periods and high intensity.[14] Therefore, they are related to each other, but the duration becomes more important and the intensity must be adjusted when there is a need to burn excess calories. A previous study stated that walking with a heart rate of 50% HRmax for 2x20 minutes also reduced body mass index (BMI), body fat, and waist circumference by 2.13 kg/m^2, 2.7%, and 4.5. cm after 2 months, respectively.[15] Several studies reported that performing a walking program for 20-50 minutes with a frequency of two times per week can increase HDL by 0.14 mmol/l after a 12-week intervention.[16] It can also reduce the levels of Low-density lipoprotein (LDL), Triglycerides (TG), Total cholesterol (TC), and increase High-density lipoprotein (HDL).[17,18]

The programs on recommended steps have been widely implemented but are not entirely realistic for everyone. The results showed that taking 10,000 steps per day was not achieved through daily routine activities because there was a shortage of 3000-4000.[19] Several studies also revealed that increasing the number of daily steps has a positive impact on health, while its duration, intensity, and frequency have no effect 20,21 A previous study showed that brisk walking for at least 30-60 minutes, 3 times per week had a significant impact on body composition.[22] Studies on additional walking exercise duration programs are still limited, especially in Indonesia. Therefore, this research purpose is to investigate the effect of walking exercise program based on duration to improve daily steps on body composition and lipid profile after a 12-week intervention.

Methods

Participant & Study Design

The participants consisted of undergraduate and postgraduate female college students who were recruited through complete personal data obtained from university staff. The inclusion criteria were BMI ≥25 kg/m^2 and subjects between 20-30 years old. The BMI cutoff was selected for overweight and obesity based on the global WHO criteria.[23] Furthermore, students suffering from chronic diseases, pregnant, undergoing treatment, taking medication/dietary supplements, doing strenuous physical activity, and being unwilling to use smart bands until the intervention ended were excluded. A total of 40 people were elected, and they all signed the informed consent before the process. During the intervention, two participants were excluded due to registered illnesses, while the remaining[38] continued. The Research Ethics Involving Human Subjects (KEPMSM) committee approved this study with reference number 289/IT3. KEPMSM-IPBelectedSK/2020.

This study was carried out with a quasi-experimental design using pre and post-intervention for 12 week. The 38 participants were divided into two groups,

i.e., a 60-minute walking exercise program (WE-60 = 19) and a 40-minute walking exercise program (WE-40 = 19). The activities were carried out at the nutrition laboratory and Gymnasium of IPB University. Measurements were then taken before and after the intervention.

Measurements

Step counting data for the walking exercise program and heart rate monitoring were carried out using the smart band version 4.0 (Xiaomi Communication Co., Ltd., China). Furthermore, its validity and accuracy level have been compared with other variants.[24,25] The smart band is a bracelet that was attached to the wrist during activities and was only removed during showers. A bioelectrical impedance analysis (BIA Inbody 270. Co. Ltd, Seoul, Korea) was used to determine BMI, body weight, fat percentage, fat mass, visceral fat, skeletal muscle mass, and total body water. Waist and hip circumference were measured with a measuring tape (One med OD 235), while body height was measured using a stadiometer.

After a 12-14 overnight fast, the subject attended the laboratory in the morning to measure their lipid profile, furthermore a 5 mL blood sample was obtained by venipuncture. The serum TC level was determined using the CHOD PAP method, serum LDL and HDL using the homogeneous method, and serum TG using the glycerol correction method. The laboratory medical team performed the analysis and blood collection directly.

Intervention Program

Before the intervention program was implemented, all participants were asked to follow the instruction session to understand the smart band procedures. They were also asked to perform daily routines for seven consecutive days. The number of steps were recorded, measured, and divided by seven to produce a total average daily baseline for each participant.

The intervention was carried out for a total of 12-weeks. The participants were divided into two groups, where WE-60 performed a walking exercise for 60-minutes, while WE-40 carried out 40-minute walking with a 10-minute warm-up. They were instructed to perform walking exercises a frequency of five times per week. The intensity was maintained with a target heart rate (HR) of 50%-75% HRM, which was calculated based on a formula, namely 220-age x HR target. After the process, cooling down was carried out for 10 minutes. Walking exercise program were combined with the total daily steps taken for 24 hours in both groups, hence, the participants are required to use a smart band all day, except while taking a shower. They were also required to monitor their activities through the application, which was downloaded on a smartphone. Subsequently, their training history was recorded in a form that was provided.

Dietary Intake

All participants were not given specific dietary control, including the selection of certain types of food during the intervention and to examine whether dietary intake affected the results, a 24-hour recall (weekdays and weekend) was performed between the pretest and post-test periods for all participants. Analysis of daily calories and macronutrient intake (such as carbohydrates, protein, and fat) was analyzed using nutritional analysis software (the Indonesian version of Nutrisurvey) and carried out by a nutritionist

Statistical Analysis

The collected data were analyzed with SPSS 21.0. (IBM Corporation., Armonk, New York, USA) for Windows. The data were presented as mean and standard deviations and normality is evaluated using Shapiro-Wilk. Pair sample t-test and Wilcoxon signed ranking tests were used to compare participants in groups. Meanwhile, independent and Mann–Whitney T-tests were used to comparing the two groups. The significance level was set at $P<0.05$

Results

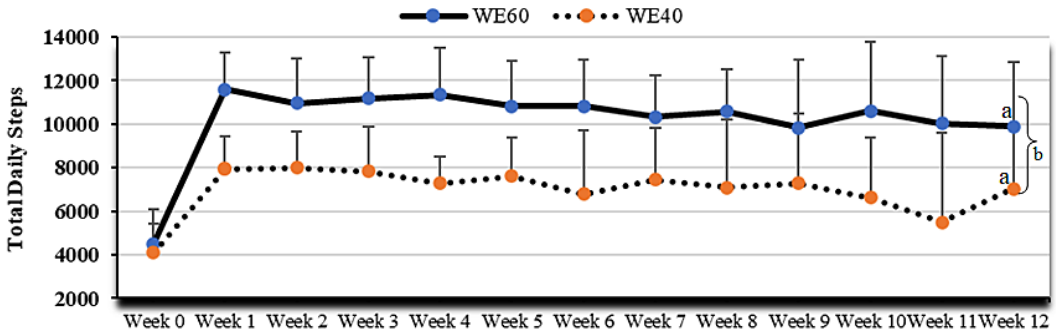
A total of 40 participants met the inclusion criteria, but two of them were excluded due to illness registered later. The remaining 38 were then divided into two equal groups. The findings showed no significant differences in age, body composition, lipid profile, and daily steps between the two groups. This indicates that they are comparable in characteristics at baseline interventions, as shown in Table 1. The analysis of dietary assessment data revealed that daily calories and macronutrient intake did not differ between groups and within groups before and after the intervention (data not shown)

Table 1: The characteristics of participants at baseline in both groups

Variable	WE-60 (n=19) mean ± SD	WE-40 (n=19) mean ± SD	*p* -value[a]
Age, Years	24 ± 1.87	23 ± 2.40	0.232
Height, cm	154.17 ± 6.01	156.27 ± 4.53	0.231
Body weight, kg	72.26 ± 13.65	72.79 ± 13.49	0.905
Body mass index, kg/m2	30.50 ± 4.41	29.83 ± 5.52	0.681
Waist circumference, cm	93.21 ± 11.84	95.16 ± 9.80	0.584
Waist-to-hip ratio	0.91 ± 0.04	0.91 ± 0.04	0.863
Body fat, %	44.80 ± 4.07	43.26 ± 5.01	0.307
Visceral fat	16.00 ± 3.07	15.0 ± 3.04	0.346
Skeletal muscle mass, kg	21.45 ± 3.94	22.18 ± 2.96	0.526
Fat mass, kg	32.64 ± 8.00	31.91 ± 9.62	0.255
Total body water, Ltr	28.98 ± 4.83	29.94 ± 3.67	0.496
Total cholesterol, mg/dL	169.37 ± 25.08	171.21 ± 18.98	0.800
Low-Density Lipoprotein, mg/dL	118.16 ± 25.66	123.16 ± 20.45	0.511
High-Density Lipoprotein, mg/dL	50.74 ± 7.95	48.74 ± 8.96	0.472
Triglycerides, mg/dL	93.95 ± 41.77	93.79 ± 25.21	0.989
Average daily steps	4,508 ± 1562	4,089 ± 1334	0.380

WE-60, walking exercise 60-minute, WE-40, walking exercise 40-minute, aindependent *t*-test

This study accumulated the daily steps and a walking exercise program for 24 hours. For the WE-60 group, the average daily steps after 12 weeks were 10,621, a significant increase from their baseline average (P<0.001). Meanwhile, the WE-40 averaged 7200, which was significantly higher than the baseline (P<0.001). As shown in Figure 1, the results revealed a significant difference in the number of steps between the groups (P<0.001).



WE-60, walking exercise 60-minute; WE-40, walking exercise 40-minute; [a]p<0.05 significantly change before and after the intervention; [b]p<0.05 significantly between the two groups

Fig. 1 : Average total daily steps in each group with a 12-week intervention

Table 2 shows that the body weight differences between the two groups were not significant (p=0.129).). However, there were significant differences in WE-60 and WE-40 weights before and after the intervention, namely -3.03kg (P=0.005) and -1.45kg (P=0.002), respectively. The results showed that the change in the BMI between the two groups was not significant (P = 0.093), but

a significant change occurred after the intervention in WE-60 and WE-40, namely -1.31 kg/m^2 (p=0.002) and -0.57 kg/m^2 (p=0.003), respectively. Both groups had a significant difference in waist circumference (p=0.022), and after the intervention, a more significant decrease occurred in the WE-60 group compared to the WE-40, namely -4.16cm and -1.89cm, respectively. There was also a significant difference in waist-to-hip ratio (WtHR) between the two groups (p=0.003), with WE-60 having a more significant change of -0.04 (p=0.001), but the WE-40 was not significant.

In the two groups, there were no significant differences in body fat percentage (p=0.050), but after the intervention, the WE-60 group had a more significant change of -2.02% (P=0.007) compared to WE-40 (P=0.348). Both groups had a significant difference in visceral fat (P=0.007), but WE-60 had a greater reduction of 1.78 (P=0.001) than WE-40, which was insignificant (P=0.266). There was a significant difference in fat mass change between the two groups (P=0.011), but WE-60 had a more significant decrease of -2.66 kg (P=0.002) than WE-40, which was insignificant. There was no difference in the skeletal muscle mass (SMM) and total body water (TWB) of the two groups with p-values of 0.358 and p=0.298, respectively.

All group lab tests (including TC, LDL, HDL, and TG), had no significant differences between them (P>0.05). As shown in the table. 3

Table 2: Body composition data before and after the 12-week intervention

Variable	Groups	Before mean±SD	After mean±SD	P-value	Δ	P value
Body Weight (kg)	WE-60 (n=19)	72.26 ± 13.65	69.23 ± 13.07	0.005[a]	-3.03	0.129
	WE-40 (n=19)	72.79 ± 13.49	71.34 ± 13.28	0,002[a]	-1.45	
IMT (kg/m^2)	WE-60 (n=19)	30.50 ± 4.41	29.19 ± 4.30	0,002[a]	-1.31	0.093
	WE-40 (n=19)	29.83 ± 5.52	29.26 ± 5.51	0,003[a]	-0.57	
WC (cm)	WE-60 (n=19)	93.21 ± 11.84	89.05 ± 11.23	0.003[a]	-4.16	0.022[b]
	WE-40 (n=19)	95.16 ± 9.80	93.26 ± 9.71	0.000[a]	-1.89	
WtHr	WE-60 (n=19)	0.91 ± 0.04	0.87 ± 0.05	0.00[a]	-0.04	0.003[b]
	WE-40 (n=19)	0.91 ± 0.04	0.91 ± 0.05	0.532	0.00	
Body fat (%)	WE-60 (n=19)	44.80 ± 4.07	42.77 ± 5.08	0.007[a]	-2.03	0.050
	WE-40 (n=19)	43.26 ± 5.01	42.77 ± 5.59	0.348	-0.49	
Visceral fat	WE-60 (n=19)	16.00 ± 3.07	14.21 ± 3.59	0.001[a]	-1.79	0.007[b]
	WE-40 (n=19)	15.05 ± 3.04	14.63 ± 3.45	0.266	-0.42	
SMM (kg)	WE-60 (n=19)	21.45 ± 3.94	21.43 ± 4.04	0.922	-0.02	0.335
	WE-40 (n=19)	22.18 ± 2.96	21.84 ± 2.90	0.113	-0.34	
Fat mass (kg)	WE-60 (n=19)	32.64 ± 8.00	29.97 ± 8.00	0.001[a]	-2.67	0.011[b]
	WE-40 (n=19)	31.91 ± 9.62	31.11 ± 9.74	0.103	-0.8	
TWB (ltr)	WE-60 (n=19)	28.98 ± 4.83	28.85 ± 4.81	0.879	-0.13	0.298
	WE-40 (n=19)	29.94 ± 3.67	29.93 ± 4.22	0.983	-0.01	

WE-60, walking exercise 60-minute, WE-40, walking exercise 40-minute, BMI, body mass index, WC, waist circumference, WtHR, waist to hip ratio; TWB, Total body water, SMM, Skeletal muscle mass, [a]p<0.05 significantly change before and after the intervention, [b]p<0.05 significantly difference between the two groups

Table 3: Change in lipid profile after the 12-week intervention

Variable	Groups mean±SD	Before mean±SD	After	P Value	Δ	P value
TC (mg/dL)	WE-60 (n=19)	169.37 ± 25.08	171.21 ± 24.21	0.564	+1.84	0.680
	WE-40 (n=19)	171.21 ± 18.98	174.53 ± 18.94	0.062	+3.32	
LDL (mg/dL)	WE-60 (n=19)	118.61 ± 25.66	116.47 ± 24.15	0.510	-2.14	0.335
	WE-40 (n=19)	123.16 ± 20.45	123.58 ± 16.51	0.851	-0.42	
HDL (mg/dL)	WE-60 (n=19)	50.74 ± 7.95	52.95 ± 9.99	0.237	+2.21	0.541
	WE-40 (n=19)	48.74 ± 8.96	48.89 ± 6.91	0.919	+0.15	
TG (mg/dL)	WE-60 (n=19)	93.95 ± 41.77	99.68 ± 58.21	0.571	+5.73	0.358
	WE-40 (n=19)	93.79 ± 25.21	95.42 ± 27.19	0.771	+1.63	

WE-60, walking exercise 60-minute, WE-40, walking exercise 40-minute, LDL, Low-density lipoprotein, TG, Triglycerides, TC, Total Cholesterol, HDL, High-density lipoprotein, Not significant p>0.05

Discussion

Walking is a natural daily physical activity that is often used for weight management and to evaluate exercise tolerance in people who cannot perform high-intensity tasks, namely, the elderly or obese.[26] This study provides an intervention, namely a walking exercise duration program, which increases daily steps and physical activity levels. A previous study stated that people with over 1000 daily steps are active, while others with less than 7000 are considered inactive.[27,28] The results showed that the WE-60 had a greater increase in mean total daily steps than the WE-40. Similar results were also obtained in a study where it was combined with moderate-intensity walking exercise for 30 minutes three times per week, and there was an increase in daily steps by 12,131 in obese adults.[29] Another study revealed that taking 10.000 steps per day can increase physical activity in obese.[30] This is consistent with other studies that adults with over 1000 daily steps are active.[31] The American College of Sports Medicine (ACSM) suggests that overweight adults must engage in at least 150-250 minutes of exercise per week.[9] Furthermore, a clinical trial study showed that long-term weight loss and body composition management was achieved with 300 minutes of exercise per week compared to only 150 minutes weekly.[32]

Walking is also considered the most effective method of increasing physical activity, and it is often used as an intervention to reduce chronic diseases, such as obesity and cardiovascular disorders.[33,7] The two groups were asked to perform walking exercises five times per week with moderate intensity 50%-75% of the maximum heart rate, but with different durations to achieve the daily step target, which has a positive impact on health. Several studies revealed that an intensity of 50%-60% as well as a minimum of 60 minutes of exercise duration significantly improved body composition and weight loss[34] The WE-60 group had a greater significant reduction before and after intervention in their body weight, BMI, waist circumference, and WtHR compared to the WE-40. These findings support a previous study that brisk walking for 50 minutes per week or two 25-minute sessions per week for 24 weeks significantly reduced body weight, BMI, and waist circumference.[35] Another study showed that carrying out the intervention for 30 minutes with an objective of 12.000 steps per day for eight weeks can reduce waist circumference and visceral fat[29]

Body fat percentages, visceral fat, and fat mass decreased significantly in the WE-60 group, while there were no significant changes in the WE-40. This finding indicates that it was more effective in

reducing all body composition variables compared with the other group, which only experienced a decrease in body weight, BMI, and WC. Furthermore, this result is consistent with a previous study that walking three times per week with a duration of 60-120 minutes for 12 weeks and a heart rate (HR) of 50%-60% significantly caused changes in body composition.[36] Similar findings were also obtained in a study carried out for eight weeks, where moderate exercise three times a week at an intensity of 60%-70% of maximal heart rate for 45 minutes had a significant change in fat percentage and free fat mass.[37] Other studies showed that moderate aerobic exercise, such as brisk walking for at least 300-420 minutes per week or 60 minutes daily was effective for weight loss and total adiposity reduction. It can also prevent more weight gain compared to a duration of less than < 300 minutes per week.[38]

Low to moderate-intensity walking produces energy through the aerobic metabolic system, namely the use of fatty acids as the primary source of ATP (*Adenosine Triphosphate*). Therefore, the longer the duration of the exercise, the higher the ATP produced. This finding indicates that duration and intensity have an essential role in improving body composition and weight loss.[39] Fat is designed to be the primary fuel during aerobic exercise as well as the source of energy during low to the moderate exercise of 60-120 minutes per session. It also contributes ATP during the recovery process.[14] This study shows that performing a moderate-intensity walking program five times per week, for 40 minutes is the threshold, and it is only effective for weight loss, but longer duration of 60 minutes can reduce weight indicators and body fat levels.

There were no changes for all lipid parameters before and after the intervention in both groups. However, there was a tendency to decrease LDL and increase HDL in the WE-60 after the process, although not statistically significant. In the WE-40, there was a tendency to increase TC, LDL, and TG. These results are consistent with a previous study that walking for 40-50 minutes twice per week did not affect the lipid profile after 12 weeks.[16] A meta-analysis of 37 RCTs also showed that the 8-week intervention had no significant impact on the serum lipids.[40] Other studies revealed that there were no changes in the HDL-C and triglyceride parameters after taking 10.000 steps per day for 12 weeks.[41] Furthermore, this finding is inconsistent with a study that moderate- intensity walking for 60-120 minutes thrice per week had a significant effect on TG and HDL-C after a 24-weeks intervention[36]

The effect of exercise on blood lipids in overweight people depends on age, sex, blood fat before exercise, intensity, duration, calorie intake, and lifestyle.[42] In this study, the participants had an optimal serum TC, HDL, and TG, while the LDL was in the near-optimal category. This indicates that younger people have better health conditions in terms of metabolic syndrome compared to adults. The diet was not monitored in both groups, hence, it does not influence on the composition of blood lipids, such as TG, HDL, TC, and LDL.

One of the limitations of this study is that do not consider nutritional intake in all group, and they were only advised to maintain their daily eating habits. Furthermore, the duration of the intervention was 12 weeks, which indicates that its long-term effects are unknown. The subjects were also limited to young females consisting of a small sample. Despite these limitations, this study provides clinical empirical evidence that a walking exercise duration program without calorie restriction has a significant effect on weight loss and body composition in overweight and obese female college students.

Conclusion

The addition of a 60-minute walking exercise program (WE-60) five times per week significantly increased the average total daily steps and had a beneficial effect on weight loss, BMI, WC, WtHR, body fat percentage, fat mass and visceral fat compared to a 40 minutes intervention (WE-40), which only had a significant effect on body weight, BMI, and WC after 12 weeks intervention. However, both interventions did not change the lipid profile parameters in both group. Further study with a prolonged intervention period of > 12 weeks, and caloric and diet follow-up is needed to thoroughly understand why the lipid profile was unchanged.

Acknowledgements

The authors are grateful to the study assistants for the assistance rendered as well as the participants.

Funding

This research was funded by the Ministry of Education and Culture of the Republic of Indonesia through the Doctoral Dissertation Research Grant Program 2020

Conflict of Interest

The authors declare that there are no conflicts of interest

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