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Research

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Combined Effects of Six Weeks Oat Bran Consumption and Brisk Walking Exercise on Blood Lipid Profiles in Hypercholesterolemia Women Aged 40 to 50 Years

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ABSTRACT

Purpose: The aim of this study was to investigate the additional beneficial effects of combined oat bran consumption and brisk walking exercise compared to oat bran consumption alone and sedentary without oat bran consumption on body weight, body composition and blood lipid profiles among hypercholesterolemia women with age ranged from 40 to 50 years old.
Methods: Thirty-three hypercholesterolemia women were randomly assigned into 3 groups: sedentary without oat bran consumption control (C), oat Bran consumption alone (Ob) and combined oat bran consumption and brisk walking exercise (ObEx) groups. Pre-and post-tests were carried out to measure participant's body anthropometry, body composition and blood lipid profiles, i.e. serum total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C). During 6 weeks of study period, participants in Ob and ObEx groups consumed 18 g of oat bran daily. Participants in ObEx executed brisk walking exercise at intensity of 55%-70% of the participants' heart rate maximum for 30 minutes per session, 3 sessions per week for 6 weeks. Participants in ObEx group consumed oat bran 1 hour prior to brisk walking exercise on the exercise days.
Results: After 6 weeks of study period, body weight decreased significantly in both Ob (p=0.013) and ObEx (p=0.02) groups, however there were no significant changes in percentage of body fat and fat free mass in all the groups. There were significant decrease in serum total cholesterol (TC) (p=0.02) and low density lipoprotein cholesterol (LDL-C) (p=0.019) concentrations in ObEx group.
Conclusion: Six-weeks of oat bran consumption with 18 g of oat bran per day combined with brisk walking exercise for 30 minutes per session, 3 sessions per week could significantly reduce body weight, serum total cholesterol (TC) and low density lipoprotein cholesterol (LDLC) concentrations. Therefore, this combination can be proposed as guidelines in nutritional and exercise promotion programme to improve lipid profiles in 40 to 50 years old hypercholesterolemia women.

KEYWORDS: Oat bran consumption; Brisk walking; Lipid profiles; Hypercholesterolemia women.

ABBREVIATIONS: LDL-C: Low Density Lipoprotein Cholesterol; TC: Total Cholesterol; CVD: Cardiovascular Disease; EFSA: European Food Safety Authority.

INTRODUCTION

Physical inactivity is a state of concern as it leads to major health problems like obesity, hypertension and various metabolic disorders. Physical activity is defined as any bodily movement

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produced by skeletal muscles those results in energy expenditure above the basal level.[1] The world now is in the era where great advances of technology conceal people from doing physical activity, and it leads to the decrement in physical activity regardless of the scientific evidence has increased showing the importance of physical activity for health and well-being. Blair et al[2] stated that low-levels of physical activity are important precursor of mortality and associated with higher rates of disease and premature death. Furthermore, Karmen[3] also mentioned that sedentary lifestyle with lack of exercise can increase the susceptibility of getting cardiovascular disease, which is related to high blood cholesterol. Cardiovascular disease (CVD) continues to be the major cause of morbidity and death in the world. Hypertension, dyslipidemia and excess body weight are among most potent accepted risk factors for CVD. In 2007, the American College of Sports Medicine suggested that adults should complete at least 30 minutes of moderate exercise intensity aerobic activity at 3 days per week.[4]

Although there are many contributing factors to cardiovascular disease (CVD), inactivity has been shown to be one of the major risk factors.[5] Numerous previous studies reported about the positive effects of exercise on blood lipid profiles.[6-8] According to Spate and Keyser,[9] moderate-intensity training over a 12-week period was sufficient to improve HDL-C profile, and high-intensity training appeared to have no further advantage as long as training volume is constant in healthy adult female. It is also known that exercise with moderate activity can improve body composition by decreasing percentage of body fat and increasing lean body mass.[10] Chen[11] stated that brisk walking is an underestimated and underused modality to cope and overcome the issue of obesity in Malaysia and in other parts of the world since it can be performed in minimal instruction and not costly.

Oats contain many health-promoting components, such as dietary fibres, proteins and minerals.[12] Oat bran contains β-glucan, and it has been reported that oat bran can improve lipid profiles level of an individual.[13-15] It has been claimed by both US Food and Drug Administration (USFDA)[16] and European Food Safety Authority (EFSA)[17] as a health benefits supplement. USFDA has passed a ruling that allowed oat bran to be registered as the first cholesterol-reducing food at an amount of 3 grams of β-glucan daily. In 2011, European Union allowed food producers to market products containing 1 g β-glucan per portion with claims to reduce blood cholesterol concentrations and to attenuate post-prandial glycemic response.[17]

Regarding combined effects of nutritional supplementation and exercise, there are several previous studies reported about the positive findings.[18-20] According to animal study by Oh et al,[19] combination of soy supplementation and exercise showed its effectiveness by lowering serum total cholesterol, triglycerides and LDL-C in rats. To date, information are lacking on the additional beneficial of combined effects of brisk walking and oat bran consumption compared to oat bran consumption alone and sedentary without consumption of oat bran on body weight, body composition and blood lipid profiles among hypercholesterolemia women aged 40-50 years old. Thus, this study was proposed.

METHODS AND MATERIALS

Participants

In this study, 33 women participants, with age ranged from 40 to 50 years old were recruited. Participants were screened in order to determine the inclusion criteria and they were asked to provide informed consent form. The inclusion criteria of participants were individuals who were free from any chronic disease, hypercholesterolemia with total cholesterols ranged between 5.2 to 7.0 mmol/L, and non-smokers. The exclusion criteria were individuals who have the habit of taking oat bran as daily consumption prior to the experiment, engaged in any training programmed and exercised more than once per week. This study was approved by the Human Research Ethic Committee of Universiti Sains Malaysia (JEPeM Code: USM/JEPeM/15100389).

Experimental Design

Participant's grouping: The participants were assigned into three groups, with 11 participants per group (n=11), i.e. sedentary without oat bran consumption group (C), oat bran consumption alone group (Ob) and combined oat bran consumption with brisk walking exercise group (ObEx). Participants in the control group (C) did not perform brisk walking exercise or having oat bran consumption for 6 weeks. Meanwhile, participants in oat bran consumption alone group (Ob) consumed 18 g of oat bran per day without performing brisk walking exercise for 6 weeks. Whereas participants in combined oat bran consumption and brisk walking exercise group (ObEx) consumed 18 g of oat bran per day for 6 weeks and performed brisk walking exercise 30 minutes per session, 3 sessions per week for 6 weeks.

Anthropometric measurement and blood sample taking: Anthropometric parameters such as body height, body weight and body composition (percentage of body fat and fat free mass) were measured during pre- and post-tests. A stadiometer (Seca 220, Germany) was used to measure the body height. Meanwhile, body composition and body weight were measured using a body composition analyzer (Tanita, TBF-410). Approximately 6 mL of blood was taken before and after the experimental period. The participants fasted overnight form 10 p.m. until the next morning of blood sample taking at 8.30 a.m. Blood taking sessions for participants in ObEx for the post-test were carried out at 8.30 a.m. the next morning after performing brisk walking exercise, i.e. 14 hours post exercise. The blood sample was then centrifuged for 10 minutes at 4000 rpm and 4 °C (HettichZentrifuger-Rotina 46RS, Germany), only serum was collected and stored at -70 °C for subsequent analysis.

Oat bran consumption: The participants in both oat bran con-

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sumption alone group (Ob) and combined oat bran consumption with brisk walking exercise group (ObEx) consumed oat bran with 2 sachets per day of oat bran powder BG22™ (18 g of oat bran powder containing 3.6 g of β-glucan) diluted with water, 7 days per week for 6 weeks. The participants were required to consume one sachet of oat bran powder which was mixed with 250 ml of plain water before breakfast and another one sachet of oat bran which was mixed with 250 ml of plain water before dinner. On the exercise days, the participants in ObEx group consumed oat bran one hour before performing brisk walking exercise.

Brisk walking exercise: Participants in the combined oat bran consumption with exercise group (ObEx) carried out brisk walking programme for 6 weeks. In the 6 weeks of study period, the participants were required to perform brisk walking 3 times per week in the evening. In each session, five minutes of warming up session with stretching activities was carried out, then followed by 30 minutes of brisk walking exercise and ended with five-minutes of cooling down session with stretching activities. The estimated walking distance covered was approximately 2.0 km. The exercise intensity during brisk walking was set at 55%-70% of the participants' age-predicted HR_{max} (HR_{max}=220- age). The intensity of brisk walking exercise was estimated by referring to the heart rate of the participants after finishing the exercise, in which a heart rate monitor (Polar watch) was worn by participant throughout the brisk walking session. In order to ensure that the exercise intensity was maintained with the targeted range, the participants were required to record their post exercise heart rate at the end of brisk walking session. If the walking pace did not elicit a heart rate within the targeted heart rate, the participants were requested to change their pace during the subsequent walking session. This programme was carried out under the supervision of the researchers at the jogging track in Health Campus of Universiti Sains Malaysia.

Blood biochemical analysis: Blood samples were analysed for blood lipid profiles of total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) by enzymatic method using commercial kits (RANDOX laboratories, UK) on ARCHITECT automated analyser.

Statistical Analysis

Data was analyzed using statistical software in the Statistical Package for Social Science (SPSS) Version 22.0. All the data are expressed as means and standard deviation (±SD). Repeated measure ANOVA was performed to determine the significance of the difference between and within the groups. Statistical significance was accepted at $p<0.05$.

RESULTS

Anthropometric Characteristics and Body Composition of the Participants

A total of 33-adult-women participants which were recruited in the present study had completed the study. Table 1 illustrates the mean age of the participants, and the baseline means body weight, body height, body mass index (BMI), percentage body fat and fat free mass of the participants according to groups at the beginning of the study.

Mean body weight, body mass index, percentage of body fat and fat free mass of all the groups at pre- and post-tests are shown in Table 2. At pre-test, there were no significant differences of body weight among all the groups. Similarly, at post-test, there were also no significant differences in body weight among all the groups.After 6 weeks of experimental period, means body weight were significantly lower in post-test compared to pre-test in Ob (p=0.013) and ObEx (p=0.02). The percentage decrease of body weight in ObEx was the highest (-1.4%) among the groups, and the percentage decrease of this parameter in Ob was -1.1%. The percentage change of body weight in C was 1.1%.

Regarding body mass index, there were no significant differences in this measured parameter among all the groups at pre-test. Similarly, there were also no significant differences in body mass index among the entire groups at post-test. After 6 weeks of experimental period no significant difference of body mass index was observed between pre- and post-tests in all the groups. Nevertheless, further analysis showed that the percentage change of body mass index in ObEx was the highest (-11.3%) among the groups.

Parameters	Groups (Mean±SD)		
	C	Ob	ObEx
Age (y)	44.6±4.1	45.3±4.7	45.5±3.5
Body weight (kg)	59.26±11.10	67.69±13.95	65.40±12.47
Body height (cm)	153.50±5.90	153.71±5.39	154.00±4.12
Body mass index (BMI) (kg/m^2)	24.9±5.2	28.5±4.4	32.1±9.2
Percentage body fat (%)	34.1±4.6	40.4±8.4	40.4±8.6
Fat free mass (kg)	35.8±3.5	39.2±7.2	39.7±4.4

Table 1: Mean age and baseline means body weight, body height, body mass index (BMI), percentage body fat and fat free mass.

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Groups	Body weight (kg) (Mean±SD)			Percent difference compared to pre test (%)	Body mass index (kg/m²) (Mean±SD)			Percent difference compared to pre test (%)
	Pre-test	Post-test	Mean difference between pre- and post-test (%)		Pre-test	Post-test	Mean difference between pre- and post-test (%)	
C	59.26±11.10	59.93±11.42	0.67±1.09	1.1	24.9±5.2	25.2±5.3	0.3±0.4	1.1
Ob	67.69±13.95	66.95±13.83*	-0.74±0.93	-1.1	28.5±4.4	28.2±4.4	-0.3±0.4	-1.1
ObEx	65.40±10.78	64.47±10.27*	-0.59±0.71	-1.4	32.1±9.2	28.5±5.8	-3.6±10.2	-11.3
Groups	Percentage body fat (%) (Mean±SD)			Percent difference compared to pre test (%)	Fat free mass (kg) (Mean±SD)			Percent difference compared to pre test (%)
	Pre-test	Post-test	Mean difference between pre- and post-test (%)		Pre-test	Post-test	Mean difference between pre- and post-test (%)	
C	34.1±4.6	35.7±6.5	1.5±4.1	4.5	35.8±3.5	36.1±3.9	0.5±0.2	0.7
Ob	40.4±8.4	39.9±7.8	-0.5±1.9	-1.2	39.2±7.2	38.8±7.6	2.4±0.7	-1.2
ObEx	40.4±8.6	41.3±10.6	0.9±4.9	2.2	39.7±4.4	38.8±5.9	3.6± 1.2	-2.5
*significantly different from pre test (p<0.05)								

Table 2: Means body weight, body mass index, percentage of body fat and fat free mass at pre- and post tests.

At pre-test, there were no significant differences of percentage body fat and fat free dry weight among all the groups. Similarly, at post-test, there were also no significant differences in these two measured parameters among all the groups. After 6 weeks of experimental period, results indicated that there were no significant differenceof these two parameters between pre- and post-tests in all the groups.

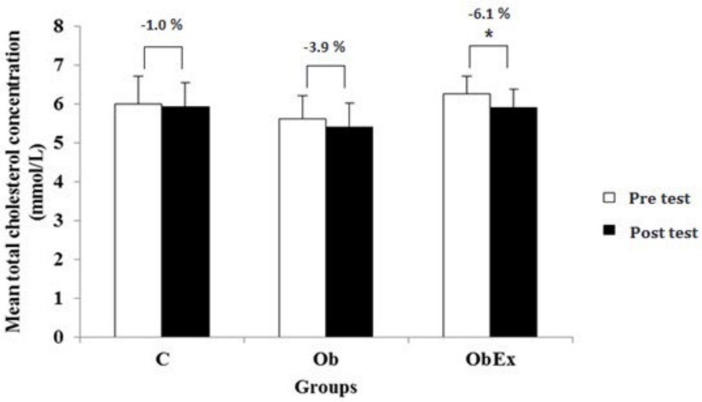
Blood Lipid Profiles

At pre-test, there were no significant differences of total cholesterol concentrations among all groups. Similarly, there were also no significant differences in TC concentrations among the entire groups at post-test. It was found that after 6 weeks of experimental period, total cholesterol concentration was significantly lower (p=0.02) in post-test compared to pre-test in ObEx (Figure 1), and the percentage decrease of total cholesterol concentration in ObEx was the highest (-6.1%) among the groups.

In serum triglycerides, the present data illustrated that there were no significant differences of serum triglycerides concentrations among the entire experimental groups at pre-test (C: 1.03±0.30, Ob: 1.25±0.48 and ObEx: 1.06±0.29 mmol/L). Similarly, there were also no significant differences of serum triglycerides concentrations among the groupsat post-test (C: 0.94±0.23, Ob: 1.12±0.46 and ObEx: 1.13±0.47mmol/L). After 6 weeks of experimental period, results indicated that there were no significant differences in triglycerides in post-test compared to pre-test in all the groups.

Regarding LDL-C, there was no significant difference of LDL-C concentrations among all groups at pre-test. It was also observed that there were no significant differences in this measured parameter among all the groups at post-test. After 6 weeks of experimental period, there was significant lower (p=0.019) value of LDL-C in post-test compared to pre-test in ObEx group (Figure 2). Further analysis showed that the percentage decrease of LDL-C in ObEx group was the highest (-7.6%) among the groups.

At pre-test, there were no significant differences of



*significantly different from pre-test (p<0.05)

Figure 1: Barriers to active commuting and corresponding healthcare interventions.

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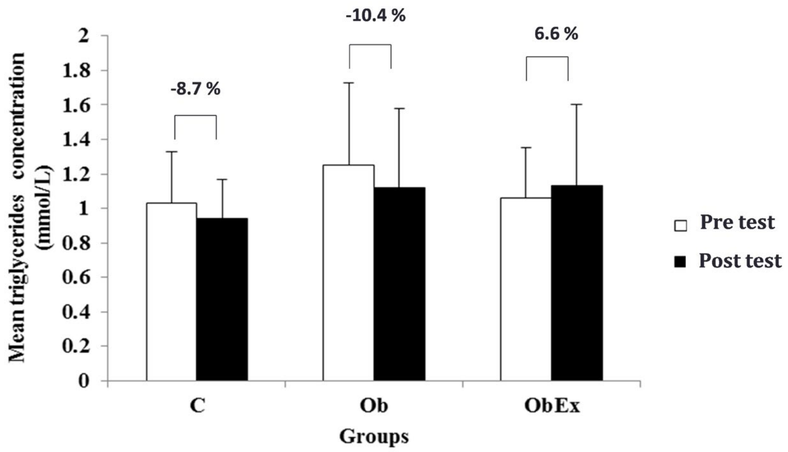

*significantly different from pre-test ($p<0.05$)

Figure 2: Mean low density lipoprotein cholesterol concentration (mmol/L) at pre- and post-tests.

HDL-C concentration among all the groups (C: 1.80±0.41, Ob: 1.60±0.19 and ObEx: 1.68±0.25 mmol/L). Likewise, at post-test, there were also no significant differences among all the groups (C: 1.69±0.28, Ob: 1.53±0.21 and ObEx: 1.62±0.11 mmol/L). After 6 weeks of experimental period, results indicated that there were no significant differences in HDL-C in post-test compared to pre-test in all the groups.

DISCUSSION

In the present study, there were no significant differences in all the measured parameters among all the experimental groups at pre-test and post-test respectively. Nevertheless, significant differences were observed in several measured parameters between pre- and post-tests. One of the main findings of this study was that there were significant reduction in body weight in both Ob and ObEx groups. As illustrated in Table 2, participants' body weight significantly decreased in Ob (p=0.013) and ObEx (p=0.02) groups after 6 weeks of experimental period. The present study also found that there were no significant differences in body composition parameters such as percentage of body fat and fat free mass between pre- and post-tests in all the groups. These findings indicated that Ob alone and ObEx could affect body weight but not body composition of the participants, and implying that 6 weeks of oat bran consumption alone and combination of oat bran consumption and brisk walking could reduce body weight significantly.

In 12 weeks previous study with another type of nutritional supplementation, Hill et al18 found that in overweight participants with age ranged from 25 to 65 years old, fish oil nutritional supplementation alone group did not appear to have any changes in body weight but there was non-statistically change in the body weight in combined fish oil supplementation and aerobic exercise group. In contrast with Hill et al,[18] the present study found that oat bran consumption alone could reduce body weight, and implying that 6 weeks of oat bran consumption alone has greater potential in reducing body weight compared to 12 weeks of fish oil supplementation.

The present study found that combined oat bran and brisk walking (ObEx) elicited slightly higher percentage of reduction (-1.4%) compared to the oat bran alone (Ob) group (-1.1%) in body weight. This finding implies that combined oat bran and brisk walking may be more effective in reducing body weight than oat bran alone. Slentz et al[21] reported in their study that there was a significant dose-response relationship between amount of aerobic jogging and walking exercise, and amount of weight loss and fat mass loss. Their study was carried for 8 months on sedentary, overweight men and women with the age ranged from 40-65 years old. In the present study, the combined oat bran consumption and brisk walking exercise (ObEx) also elicited significant effect on reducing body weight of the participants, and the positive effect could be obtained in a shorter period, i.e. 6 weeks. Comparison between Slentz et al,[21] and the present study showed that combined exercise with nutritional supplementation such as oat bran may elicit extra beneficial effects in body weight reduction than exercise alone.

Based on a study done by Ghahramanloo et al,[22] there was no reduction in body mass with endurance and concurrent types of exercise. In this previous study 23 to 28 years old healthy untrained men were involved and it was carried out for 8 weeks. Comparison between Ghahramanlooet al[22] with the present study once again indicated that extra beneficial effect in reducing body weight can be obtained from combined nutritional supplementation such as oat bran and brisk walking exercise compared to exercise alone.

In a previous study on effect of exercise training intensity on abdominal visceral fat and body composition with 27 middle-aged and obese women by Irving et al,[23] it was found that there was significant reduction in body fat after 16 weeks of aerobic exercise. Contrary to the above previous study, the

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present 6 weeks study showed that percentage body fat did not change significantly neither in Oat Bran alone (Ob) group nor combined oat bran and brisk walking (ObEx) group. It is speculated that may be longer study period and higher exercise intensity are needed for eliciting beneficial effects of oat bran alone and combined oat with exercise on reducing body fat.

Another main finding of the present study was that combination of oat bran consumption and brisk walking exercise was most effective in reducing total cholesterol (TC) and low density lipoprotein cholesterol (LDL-C) concentrations of the participants. As illustrated in Figures 1 and 2, serum total cholesterol (TC) concentration significantly reduced (p=0.02) and serum low density lipoprotein cholesterol (LDL-C) significantly reduced (p=0.019) after 6 weeks of intervention period in ObEx group. Further analysis also showed that the percentages reduction in total cholesterol (-6.1%) and LDL-C (-7.6%) in ObEx group were the highest among all the groups. However, this combination did not significantly affect the other parameters of lipid profiles, i.e. triglycerides and high density lipoprotein cholesterol (HDL-C) concentrations

The present study found that oat bran supplementation alone did not affect lipid profiles. Regarding previous studies on the effect of nutritional supplementation alone on lipid profiles, in a 6 weeks of study carried out by Momenizadeh et al[24] on 60 hypercholesterolemia patients who consumed at least 5 daily servings of oat bread which contained 6 g of β-glucan, it was found that serum total cholesterol level reduced significantly. In addition, Berg et al[14] which carried out a 4 weeks study by involving hypercholesterolemia patients to investigate the effect of oat bran enriched diet on lipid profiles reported significant decreased in total cholesterol concentration and LDL-C. These two previous studies have shown consumption of oat bran containing β-glucan alone can elicit beneficial effect in reducing serum cholesterol. Biorklund et al[25] conducted a study to investigate changes in serum lipid profiles after consumption of beverages with β-glucan from oats and barley for 3 weeks. Their study also showed that 5 g of β-glucan from oats significantly lowered serum total cholesterol concentration. However, in the present study, the changes of serum total cholesterol level in Ob group was not significant statistically. The reason may be due to the dosage of β-glucan used in this previous study and the present study was different, i.e. 5 g in Biorklundet al[25] and 3.6 g in the present study. These findings implied that higher dosage of β-glucan may elicit better result in reducing total cholesterol of the participants.

The present study found that ObEx could improve lipid profiles. Oh et al[19] demonstrated that combined treadmill running exercise for 30 minutes with supplementation of soy isofalvone lowered serum total cholesterol, triglycerides and LDLC after 12 weeks of intervention. In the present study, 6 weeks of combined oat bran with brisk walking exercise could reduce serum total cholesterol and LDL-C concentrations. Both Oh et al[19] and the present study showed that combined exercise and nutritional supplementation could give beneficial effect on improving lipid profiles. Nevertheless, comparison between Oh et al[19] and the present study showed that shorter study period as in the present study could only reduce total cholesterol and LDLC, but not triglycerides as reported by Oh et al.[19] Therefore it is recommended for lengthening the study duration in future in order to get better results, it is speculated that participants may need longer time to adapt to the exercise and supplementation physiologically.

In a study by Carvalho et al[26] with 40 women aged 60-80 years, it was found that 8 months of moderate intensity multicomponent exercise program that included endurance, strength, coordination, balance, and flexibility exercises such as jogging, squatting and single leg stance resulted in improvements of blood lipids profiles. Their study findings showed that there were significant increase in HDL-C and significant decrease in triglycerides. Whereas, the present study found that 6 weeks of combined oat bran with brisk walking could reduce total cholesterol and LDL-C concentration. In Carvalho et al[26] the multicomponent exercise training prescribed was a combination of endurance strength, balance and flexibility activities. The exercises involved almost all parts of the body muscles as the participants did walking, jogging, squatting, etc. These findings showed that exercise alone elicited different results on lipid profiles components compared to combined exercise and nutritional supplementation as the present study. The differences in the type and duration of the exercise prescribed and age of the participants in this previous study and the present study could be the reason of the improvement in lipid profiles components were different.

In a study done by Bashiri[27] on 4 weeks combined garlic supplementation and training exercise with 60-75% of heart rate maximum in 36 young inactive men, it was shown that there were no significant differences among groups in triglycerides, cholesterol, low density lipoprotein (LDL-C) and high density lipoprotein (HDL-C) levels. Nevertheless, HDL-C levels significantly increased in combined exercise training and garlic supplementation group compared to pre-test levels. In the present study, there was no significant difference in HDL-C, however total cholesterol and LDL-C concentration were significantly reduced in the post-test compared to the pre-test with 6 weeks of combined oat bran supplementation and brisk walking exercise. Although the prescribed exercise intensity was almost the same in both Bashiri[27] and present studies, improvement in HDL-C concentration can only be seen in Bashiri.[27] These findings implied that different nutritional supplementation elicited different results in lipid profile components.

The limitation of this present study was that there was absence of exercise alone group for determining the effects of brisk walking alone on the measured parameters. It is suggested to include such a group for future study. It is also recommended to carry out a future study with longer study duration, so that more beneficial effect on the measured parameters can be ob-

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served as time is required for physiological adaptation to occur in an individual.

CONCLUSION

This study found that 6 weeks of oat bran consumption with 18 g of oat bran per day combined with brisk walking exercise for 30 minutes per session, 3 sessions per week with intensity of 55%-70% of the participants' heart rate maximum can significantly reduce body weight, serum total cholesterol (TC) and low density lipoprotein cholesterol (LDL-C) concentrations in 40 to 50 years old hypercholesterolemia women. Nevertheless, participants' triglycerides (TG) and high density lipoprotein cholesterol (HDL-C) concentrations were not affected significantly with this combination in this study. In conclusion, this combination can be recommended for improving lipid profiles in hypercholesterolemia women.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

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