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ORIGINAL ARTICLE

The Effect of Whole Wheat and White Breads on Serum Lipid Profile, Malondialdehyde, and C-Reactive Protein in Over-Weight and Obese Patients with Coronary Stent

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ABSTRACT

Background: Observational studies showed that intake of whole-grain is associated with a reduced risk of coronary heart disease, hypertension, hyperlipidemia. However, only a few dietary intervention trials have investigated the effect of whole-grain consumption on health outcomes. So we aimed to examine the effect of whole wheat vs. white bread on serum lipid profiles, malondialdehyde (MDA); and C-reactive protein (CRP) in overweight and obese patients with coronary stent.

Methods: In a randomized, single-blind, parallel trial, 90 participants who had stent and body mass index (BMI)≥25 were divided into two groups. Intervention group consumed 150 g of whole-wheat bread daily accompanied with a low-calorie diet and the control group consumed 150 g of white-wheat bread as well as a low-calorie diet. The intervention was continued for 12 weeks. Outcomes such as BMI, lipid profile, MDA, high-sensitivity (hs)-CRP, blood pressure, waist and hip circumferences were evaluated at baseline and end of the study.

Results: Whole- bread diet in comparison with white diet could significantly reduce weight ,BMI, cholesterol, Low Density Lipoprotein (LDL), systolic blood pressure and MDA. No significant differences were noted between the two diets for triglyceride, High Density Lipoprotein (HDL) and hs-CRP levels.

Conclusion: The present results suggest that whole bread can significantly reduce oxidative and inflammatory marker level and several cardiovascular risk factors among overweight or obese patients with coronary stent.

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Introduction

Obesity is closely related to the risk of developing cardiovascular diseases (CVD) (1) and is currently considered as a serious public health concern (1, 2). Obesity is believed to cause a number of established risk factors for CVD such as hypertension, dyslipidemia, and diabetes (3). Globally, the burden of CVD is enormous, contributing to nearly 20 million deaths/year in men and women >40 years of age (4). Coronary artery disease (CAD) is a leading cause of mortality, morbidity, and disability in Iranian population. It accounts for nearly 50 percent of all deaths per year. CAD is characterized by the presence of atherosclerosis in the epicardial coronary arteries. Although the impact of CVD have declined in most economically advanced countries, the growing prevalence of obesity is assumed to increase the global CVD burden (5).

Nutrition and the management of overweight and obesity are central features in all clinical practice guidelines for reducing CVD risk (6). Some studies have suggested that diets rich in foods which contribute to Western diseases including CAD (7). Moreover, high levels of refined carbohydrate intake may lead to endothelial disorders and inflammatory responses which increase the risk of hypertension and atherosclerosis (8). Whole grain are a rich source of fiber, minerals (magnesium, potassium, phosphorous, selenium, manganese, zinc, and iron), vitamins (especially high in vitamins B and E), phenolic compounds, phytoestrogens (lignans), and related antioxidants may have favorable effects on health by alleviating oxidative stress and inflammation (9).

Diets that are rich in whole grains are associated with a decreased risk of many diseases and conditions, including CVD, obesity, type 2 diabetes, cancer, and mortality (10, 11). Studies of whole-grain diet interventions have shown that whole grains may lower blood pressure, fasting glucose, cholesterol, and inflammation (12). On one hand, due to the high incidence of coronary artery disease in Iran and the underlying cause such as overweight and obesity and on the other hand, low fiber intake; the present study has been conducted to assess the effect of whole wheat in comparison with white bread on serum lipid profiles, malondialdehyde (MDA); and C-reactive protein (CRP) in overweight and obese patients with coronary stent.

Materials and Methods

We conducted a randomized, single-blind, parallel trial with declaration of Helsinki and good Clinical Practice guidelines. Our inclusion criteria were nonsmoking, willingness to participate, having stent for atherosclerosis, Body Mass Index (BMI)≥25, whole grain product consumption≤ 3 servings/day. Participants were excluded if they had a history of chronic disease (e.g. renal, hepatic, and type 2 diabetes), and flowing special regimen. The study was approved by the Ethical Committee of the Shiraz University of Medical Sciences. Informed consent was obtained from all participants. The sample size was calculated using the formula comparing two means and using the serum CRP level as a key dependent variable. $n=(Z_{1-\alpha/2}+Z_{1-\beta})^2(SD_1+SD_2)^2/(\mu_1-\mu_2)^2$; where considering $\alpha=0.05$ and $1-\beta=80\%$, $SD_1=5.1$, $SD_2=2.9$, $\mu_1-\mu_2=-2.6$. In the present study, 90 participants were needed for adequate power (12).

Using a table of random numbers, participants were randomly divided into two groups of intervention and control. For two weeks, all of subjects recorded their diet in a questionnaire to calculate the energy they received. Energy intake for each individual was calculated based on maintenance energy needs minus 500–700 kcal/day depending on their BMI. After two weeks, the control group received hypocaloric diet with 150 g white bread and treatment group received hypocaloric diet with 150 g whole bread for 12 weeks, 90 g of whole wheat bread for breakfast and 60 g at dinner.

New batches of both experimental and control bread were prepared by Hadith Factory in Shiraz (Health Produce Ministry: 36/12435, Lic No.: 817072, Health Benefit Ministry No.: 9137) and then delivered at home to each subject once a week based on their request. In addition, the participants were instructed to keep a detailed 3-day diet record at the first, fourth, eight and twelfth week that would be reviewed by the dietitian during the 12-week protocol. Both groups were asked to continue their routine levels of physical activity and not to consume fiber supplements, weight loss drugs, herbal medicines, or laxatives. During the 10-week course of the intervention, the participants attended weekly visits with an internist and a nutritionist (who evaluated their daily intake of food items).

A polyethylene catheter was inserted into an antecubital vein and fasting blood samples were taken to determine high-sensitivity (hs-CRP), serum levels of MDA, triacylglycerol (TG), total cholesterol (TC), LDL cholesterol and HDL cholesterol. All participants were examined for height, weight, pulse rate, and systolic and diastolic blood pressures. All measurements were performed with one particular tool. A Seca scale was used for measuring weight. Blood pressures were taken after 20 minutes of rest and in sitting position. BMI was calculated as weight divided by height squared. Hip and waist

circumference were also measured.

Statistical analysis was performed using SPSS software for Windows (Version 21, Chicago, IL, USA). Chi-Square test for qualitative variables and Kolmogorov Smirnov for quantitative variables were used to assess normality. Statistical significance was assessed at the 0.05 probability level in all analyses. All the values are given as mean±standard deviation (mean±SD) or numbers. Independent sample t test was used for comparing two groups.

Results

A total of 140 patients were evaluated for being invited for the study. From these patients, 90 were eligible to participate. Fourteen patients discontinued the intervention. Finally 76 patients started the experiment and completed the study. Mean age of the participants was 60.37 years and 56.6 % (n=43) were male. There was no difference between the whole bread and white bread groups in age (61.45±7.58 versus 59.29±7.68 years), gender (female 56.7% versus 56.7%), or other baseline characteristics.

Physical anthropometry in both groups taking whole bread and white bread has shown whole bread diet occurred a decrease in physical anthropometric characteristics such as: weight and BMI significantly in comparison with white bread (p=0.025 and p=0.038, respectively). There was no significant difference in waist circumference between the two groups. Systole blood pressure level significantly (p=0.032) decreased in whole bread diet compared with white bread diet, but no significant difference was found in diastole blood pressure level between the two groups (Table 1).

Biochemical parameters in groups of whole bread and white bread were shown in Table 2. In the whole bread diet, MDA level decreased significantly in comparison with white bread diet (p=0.002). There was no significant difference in inflammatory marker (hs-CRP) level between the two groups. TC and LDL decreased significantly in comparison with white bread diet (p=0.007 and p=0.037, respectively). No significant changes were noted for serum lipids concentrations such as TG, and HDL. The analysis of whole wheat bread compositions in comparison with white bread in the Faculty of Nutrition Research Laboratory was shown in Table 3.

Discussion

The aim of the current study was to assess the effect of whole wheat vs. white bread on serum lipid profiles, MDA; and CRP in overweight and obese patients with coronary stent. According to our results, whole bread diet in comparison with white bread diet could significantly reduce weight, waist circumference, BMI, systole blood pressure, TC, LDL and MDA levels. In this study, diet with whole bread could reduce waist circumference, a strong risk factor for cardiovascular disease, weight and BMI. These results are consistent with previous findings of Kazemzadeh *et al.* (13) who noted Brown rice (BR) diet in comparison with White rice (WR) diet that could significantly reduce weight, waist

Table 1: Physical characteristics in intervention and control groups

Variable	Group 1	Group 2	*p*-value
TG (mg/dl)			
Week 0	132.82±36.47	133.16±70.06	0.98
Week 12	116.39±38.88	128.76±65.5	0.32
TC (mg/dl)			
Week 0	141.95±25.44	139.32±24.8	0.65
Week 12	121.79±19.99	136.24±25.4	0.007
LDL (mg/dl)			
Week 0	85.18±21.39	76.58±22.53	0.09
Week 12	72.26±16.02	81.58±21.73	0.04
HDL (mg/dl)			
Week 0	37.29±7.69	36.29±10.3	0.63
Week 12	38.76±7.46	38.03±11.62	0.74
Hs-CRP (mg/dl)			
Week 0	1.98±1.85	1.91±1.68	0.88
Week 12	1.97±2.14	2.13±1.54	0.13
MDA (mg/dl)			
Week 0	5.18±1.74	4.91±1.58	0.44
Week 12	4.09±1.1	4.94±1.16	0.002

TG: Triglyceride; TC: Total Cholesterol; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; Hs-CRP: High sensitive_c reactive protein; MDA: Malondialdehyde

Table 2: Biochemical parameters in intervention and control groups

Variable	Group 1	Group 2	*p*-value
Weight (kg)			
Week 0	75.07±10.46	76.93±11.76	0.47
Week 12	70.50±9.49	76.08±11.63	0.03
BMI (kg/m²)			
Week 0	29.52±3.05	29.77±3.94	0.76
Week 12	27.76±3.06	29.43±3.8	0.04
WC (mg/dl)			
Week 0	101.08±7.21	97.71±8.3	0.06
Week 12	97.75±7.26	96.30±7.99	0.41
SBP (mmHg)			
Week 0	131.05±14.88	130.21±17.32	0.82
Week 12	118.26±9.46	126.66±16.46	0.03
DBP (mmHg)			
Week 0	75.79±9.98	73.34±10.46	0.23
Week 12	70.45±11.26	72.82±10.40	0.34

BMI: Body Mass Index; WC: Waist circumference; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

Table 3: Composition of whole wheat bread and white bread

Variable	Whole bread	White bread
Fiber (mg/100 g)	1.40	0.81
Ash (mg/100 g)	1.86	0.125
Wet (mg/100 g)	26.95	22.96
Fat (mg/100 g)	1.095	0.91

and hip circumferences and BMI.

An earlier study of similar design showed a significant decrease in mean BMI (14). Contrary to the study, three previous studies have shown that there was no significant reduction in the anthropometric characteristics between the intervention (whole bread diet) and control group. However, several mechanisms explain the effects of high intake of whole-grain bread on weight loss and BMI in various studies. It has been proposed that the dietary fiber present in whole grains increased the viscosity of the digesta and bound to bile acids in the small intestine, thus contributing to decreased sugar and lipid (cholesterol) absorption. In addition, fiber could increase chewing, which promoted the secretion of saliva and gastric juice, resulting in an expansion of the stomach and increased satiety (13-15).

Although the evidence is limited, the consumption of more whole-grain foods has been associated with reduced CVD risk, including reductions in Systolic blood pressure (SBP). Our results for blood pressure are consistent with a randomized trials of whole-grain dietary interventions conducted by Paula *et al.* in 2010 (16). This study showed that daily consumption of 3 portions of whole-grain foods could significantly reduce CVD risk in middle-aged people mainly through blood pressure–lowering mechanisms. Contrary to the study that diastole blood pressure was not significantly different between control and intervention groups, findings of Kazemzadeh *et al.* (13) showed that BR replacement in the diet decreased the diastolic blood pressure among non-menopausal overweight or obese females. According to studies, soluble fibers could reduce blood pressure by reducing insulin resistance, insulin levels and body weight, in healthy and diabetic people (17).

There are conflicting results regarding the effect of BR on serum lipid profiles. In a recent study, consumption of oat for 6 weeks was associated with reduction in serum lipids among people with hypercholesterolemia (18). Three recent short-term interventions indicated no significant benefits of substituting whole grains for refined grains on blood lipids (19). But in the study with cross-over design overweight and obesity patients were instructed to consume whole grains (WG) for 6 weeks, lipid related markers included TG and HDL improved on WG diet, but it did not reduce TC and LDL levels (20).

These findings were similar to the results of another study in which lipid profiles were lower for whole grain when compared with white grain (21). Whole grain diets can also suppress hypercholesterolemia via 3 mechanisms. (i) dietary fibers may interact directly with the lipase and/or co-lipase, thereby reducing their enzyme activity, (ii) dietary fibers may adsorb around lipid droplets and

form a protective coating that prevents the lipase/co-lipase from coming into close contact with the lipid substrate inside the droplets, and (iii) some dietary fibers bind bile salts, which may prevent them from emulsifying the lipids in the small intestine (22). However, in our study, whole bread diet in comparison with white bread diet, did not have any significant effects on other serum lipid profiles such as TG and HDL.

Few studies are available about the effects of whole grain on inflammatory risk markers and oxidative stress. Two previous studies did not find any significant benefits of substituting whole grains for refined grains on interleukin-6 and hs-CRP. In a study consumption of 3 portions/day, whole-grain foods for 12 week did not have any effects on mentioned markers (19). This result was consistent with results from a 14-week pilot trial using a crossover design in 30 participants (23). Possible mechanism for the anti-inflammatory effects of whole grains is that the free ferulic acid and the metabolites produced in large intestine due to fermentation of grain fiber decreased peripheral inflammation (24). The present results suggest that whole bread can significantly reduce oxidative and inflammatory marker level and several cardiovascular risk factors among overweight or obese patients with coronary stent.

Conclusion

As far as we know, a recent study is the first randomized controlled clinical trial in the Middle East on cardiovascular risk factors in patients with coronary stents. Our findings showed that, intake of low_calorie diet rich in wheat bread compared with refined bread significantly reduced some anthropometric indicators(weight , BMI), lipid profiles (TC, LDL) and oxidative stress(MDA). However, according tio limitations of this study and few studies are available about the effects of whole grain or whole bread on inflammatory risk markers to compare our results.

Thus, it is better to do larger randomized controlled clinical trials with higher quality methodology in the future.

Therefore, Daily intake of 5 serving of Whole_bread could reduce significantly cardiovascular risk factors and events in middle_age and elder coronary patients with coronary stents but not only through the decreasing weight.

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The present study has the ethics committee approval of Shiraz University of Medical Sciences and IRCT confirmation code (IRCT2015021021039N1). The authors like to thank all collaborative individuals in the present study along with vice chancellor for research of Shiraz University of medical Sciences.

Conflict of Interest

None declared.

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