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Supplementation of Whole Grain on Body Weight and Lipid Profile in Obese Females of Various Ethnic Groups in Balochistan, Pakistan

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Abstract: The effects of supplemented whole grain consumption for 4 weeks on Body Mass Index (BMI), total Cholesterol (CHO), Triglyceride (TG), High Density Lipoprotein Cholesterol (HDL) and Low Density Lipoprotein Cholesterol (LDL) in obese female subjects of 4 major ethnic groups in Quetta, i.e., Pathan (P), Baloch (B), Hazara (H) and Punjabi (PU) were studied. Two groups each of 32 obese female subjects and comprising 8 subjects from each ethnic group were chosen from the volunteers on the selection criteria according to World Health Organization (1998). The subjects of the group taken as control used the conventionally available carbohydrates in meals and another batch referred as treated subjects consumed 50g cereals in breakfast and whole grain chapattis in lunch and dinner for 4 weeks. Twelve hours fasting blood sample was taken from control and whole grain treated obese subjects a day after the completion of experiment duration. Lower BMI had been observed in the subjects of all the ethnic groups compared to their respective control, however, significantly ($p < 0.01$) only in PU group. Significantly lower concentration of total cholesterol in fiber consuming subjects of B ($p < 0.01$) and PU ($p < 0.05$) ethnic groups was demonstrated compare to their respective controls. Similarly Triglycerides (TG) concentrations were lesser in all ethnic groups but not significant statistically. Trend of greater concentration of HDL cholesterol and lower LDL cholesterol in the fiber taking subjects in all the ethnic groups was only significant ($p < 0.05$) compare to their controls in P and PU groups, respectively.

Key words: Cholesterol, HDL cholesterol, LDL cholesterol, obesity, TG, whole grain

INTRODUCTION

Overweight and obesity are high on public health agenda because they are now common and have serious effects in the short and long term. World Health Organization estimated that 1.6 billion adults were overweight and at least 400 million were obese; in developed countries of US, UK and Australia, comprising around 20-30% of adults as obese and more than 60% overweight. This is expected to increase to 2.3 billion overweight adults and more than 700 million obese adults by 2015 (WHO, 2006). In the developing countries also the incidence of being overweight and obesity is increasing with the change in life style. Overweight and obesity lead to serious health consequences, with the risk increasing progressively with Body Mass Index (BMI) and consequently risk of cardiovascular disease, type 2 diabetes and some cancers including endometrial, breast and colon cancer (WHO, 2006).

There is increasing evidence that both the amount and type of carbohydrate play an important role in weight management and risk of chronic disease. Classifying carbohydrates according to their post-prandial glycemic effect (ie, the glycemic index of foods) has yielded more useful insights than the historical distinctions of simple versus complex chemical structure. Diets based on carbohydrate foods that are more slowly digested and

absorbed (i.e., low glycemic index diets) have been independently linked to reduced risk of type 2 diabetes, cardiovascular disease, and some types of cancer. Research also suggests that low glycemic index diets may assist with weight management through effects on satiety and fuel partitioning (Marsh and Brand-Miller, 2008).

Weight control consciousness is although increasing in developed and also in the developing countries, however, the lack of awareness is failing the goal (Mokdad *et al.*, 1999; Mokdad *et al.*, 2001) even with the use of prescription drugs for treatment of obesity (Serdula *et al.*, 1999; Khan *et al.*, 2001). Thus at both individual and population levels, strategies that improve nutrition and increase physical activity are fundamental to the control of the epidemic of overweight and obesity (Clinical guide line, 1998; Liu and Manson, 2001a). Yet the long-term efficacy of any specific dietary approach to weight control remains to be determined (WHO, 1997; Willett, 1998; Liu and Manson, 2001b). Because of the belief that diets rich in fiber are generally low in saturated fat, many national authorities have long recommended greater consumption of grain products to control weight (US department of Agriculture and US department of Health and Human Services, 1995; US department of Agriculture, 2000; US department of Health and Human Services, 2000; Krauss *et al.*, 2000).

Most grain products consumed are highly refined (Slavin *et al.*, 1999; Putnam *et al.*, 2002). Refined-grain products have higher starch content but lower fiber content (i.e., greater energy density) than do whole grains. Concentrations of vitamins, minerals, essential fatty acids and phytochemicals that are important in carbohydrate metabolism are also lower in refined grains (Liu, 2002). Whole grains on other hand may have beneficial effects on weight control through promoting satiety (Jenkins *et al.*, 1987; Jenkins *et al.*, 1988; Slavin *et al.*, 1999). The intake of whole grains may also slow starch digestion or absorption, which leads to relatively lower insulin and glucose responses that favor the oxidation and lipolysis of fat rather than its storage (Jenkins *et al.*, 1987; Jenkins *et al.*, 1988; Slavin *et al.*, 1999). Weight gain had been reported in several reviews to be inversely associated with the intake of high-fiber (Burton-Freeman, 2000; Howarth *et al.*, 2001; Slavin, 2005; Schulz *et al.*, 2005; Pereira and Ludwig, 2001; Roberts *et al.*, 2002 and Lara-Castro and Garvey, 2004), whole-grain foods but positively related to the intake of refined-grain foods, which indicated the importance of distinguishing whole-grain products from refined-grain products to aid in weight control.

Diets that are rich in whole-grain foods have been linked to a lower prevalence of the metabolic syndrome (Sahyoun *et al.*, 2006; McKeown *et al.*, 2004; Esmailzadeh *et al.*, 2005) a condition characterized by disturbed glucose and insulin metabolism, central obesity, mild dyslipidemia, and hypertension (Reaven, 1988). The metabolic syndrome has been linked with an increased risk of both type 2 diabetes and CVD (Hanson *et al.*, 2002; Resnick *et al.*, 2003; Lakka *et al.*, 2002).

Fiber diets such as oat bran and bean diets have been reported to significantly decrease serum cholesterol concentrations in human (Kirby *et al.*, 1981) and rat (Chen and Anderson, 1979) and calculated low density lipoprotein cholesterol (Anderson *et al.*, 1984). There are numerous studies where diets containing wheat bran have been associated with lower serum cholesterol or lipoprotein concentrations (Gariot *et al.*, 1986; Persson *et al.*, 1970; Rhodes *et al.*, 1977; Munoz *et al.*, 1979; Van Berge-Henegouwen *et al.*, 1979; Kashtan *et al.*, 1992; Vorster *et al.*, 1986; McDougall *et al.*, 1978; Moore *et al.*, 1985; Heaton and Pomare, 1974; Lampe *et al.*, 1991; Anderson *et al.*, 1991).

The present study is organized to investigate the influence of whole grain diet containing fiber in the already obese female subjects on the weight and the associated lipid profile in the various ethnic populations of Quetta region with specific environmental characteristics of being at higher altitude.

MATERIALS AND METHODS

The study was performed in different ethnic groups [Pathan (P), Baloch (B), Hazara (H) and Punjabi (PU)] in Quetta, Balochistan. Participant volunteers were recruited from the local community, primarily through

newspaper advertisements and through pasting posters in all departments of University of Balochistan, Bolan Medical College, hospitals, telephonic messages, emails and by counseling in different communities and also in various medical camps.

Volunteers were screened and those were excluded from the trial that could not consumed whole grain diets 3 times a day or difficulty in follow the experimental requirements, smoked cigarettes and had history of hypertension or atherosclerotic or metabolic disease. Meetings with the selected volunteers were held to explain the protocol of the study. Thirty two female obese subjects, 8 from each ethnic group, participated in the study. Volunteers were solicited for 50 g cereals in breakfast, one must whole grain chapatti in lunch and also at dinner time along with normal eating habits for four weeks. Selection of the subjects were according to the WHO, 1998 criteria where BMI = 30-34.9 is considered as obese I (at a moderate risk of co-morbidities) BMI = 35-39.9 is obese II (at a severe risk of co-morbidities) and BMI > = 40 is obese III (at a very severe risk of co-morbidities).

The obese female subjects of both the control and the whole grain meals taking for 4 weeks categories were sampled for blood after at least 12 h fast and general data was collected. BMI in the general observations and blood samples of both groups were subjected for estimation of total cholesterol, triglycerides, HDL and LDL with commercial kits (Human Gesellschaft fur Biochemica und Diagnostica mbH), Germany.

Statistical analysis was undertaken with statistical program of Sigma Stat 3.5. Student t test was used for comparison between normal and obese subject groups and $p < 0.05$ was considered as statistically significant.

RESULTS

BMI: Body mass index of the female subjects of different ethnic group taking 50 g cereal in breakfast and whole grain chapattis in lunch and dinner time for 4 weeks, showed slightly lower values compared to the respective controls. Only the PU exhibited statistically significant ($p < 0.01$) reduction of 7%, however, other groups 4.2, 4.5 and 4.2% reduction did not reach the customary level of statistical significance. The fiber containing diet did not let the body weight increased compared to the controls and showed significant lowering effect in PU subjects.

Total cholesterol: In control obese female subjects of different ethnic groups, total cholesterol ranged between 216.1 ± 1.9 to 245.1 ± 1.3 mg/dl. After taking prescribed diet for given time in the whole grain consumers the fraction concentration was significantly 3.6% lower in B ($p < 0.004$) and 4% lesser in PU ($p < 0.023$) subjects in comparison to their respective controls. In other ethnic groups' subjects non significant lower cholesterol at 1.4 and 2.5% in was observed in P and H respectively (Fig. 1). The whole cereal diet has exhibited total cholesterol lowering characteristics in the female obese subjects.

Table 1: Body mass index Kg/m² of control and whole grain supplemented group in the subjects of various ethnicities

	Baloch	Pathan	Hazara	Punjabi
Control group (BMI)	38±1.0	40.4±0.8	41.3±1.0	40.4±0.6
Whole grain supplemented group (BMI)	37.3±0.8	38.6±0.9	39.6±0.7	37.6±0.5*

BMI = Body Mass Index, Data are mean±Standard Deviations. *p>0.05 significant level

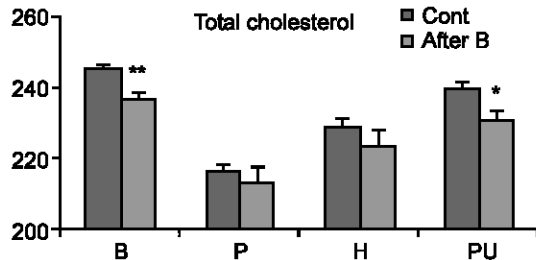


Fig. 1: Serum cholesterol mg/dl in obese female subjects, before and after taking supplemented whole grain diet in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. *p<0.05, **p<0.01

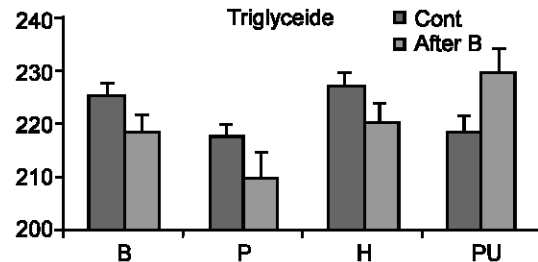


Fig. 2: Serum triglyceride mg/dl in obese female subjects, before and after taking supplemented whole grain diet in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. *p<0.05

Triglycerides: In control obese subjects TG level ranged between 217.5±2.3 to 235.9±2.8 mg/dl in females of all ethnic groups. In a comparison of the respective control values in the diet using subjects of the various ethnic groups' 2.9, 3.7, 3.2 and 3.3% non significantly lower triglycerides concentration was estimated in B, P, H and PU subjects respectively ((Fig. 2). The whole grain diet did not demonstrate evident effect on the triglycerides concentration in the blood.

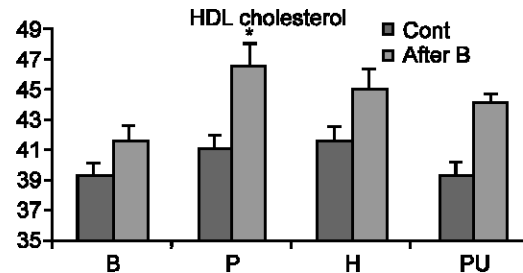


Fig. 3: Serum HDL cholesterol mg/dl in obese female subjects, before and after taking supplemented whole grain diet in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. *p<0.05

High Density Lipoprotein Cholesterol (HDL): In female obese subjects of the control category the concentration of HDL cholesterol ranged between 39.3±0.8 to 41.5±1.0 mg/dl. The supplemented diet, seems to be most effective on P group and manifested statistically significant (p<0.05) 12.8% greater concentration in the fraction levels to the respective controls. In sub-populations of other ethnic groups 5.5, 8.1 and 11.9% higher concentration compare to the respective controls was estimated diet fed B, H and PU groups, respectively. The differences, however, were non significant statistically (Fig. 3). Whole grain consumption has shown the ability of increasing HDL cholesterol concentration.

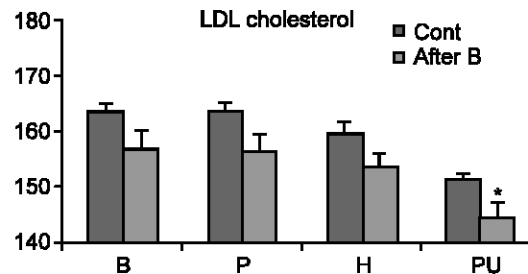


Fig. 4: Serum LDL cholesterol mg/dl in obese female subjects, before and after taking supplemented whole grain diet in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. *p<0.05

Low Density Lipoprotein Cholesterol (LDL): In obese untreated subjects, LDL cholesterol levels in female obese subjects were displayed between 151.5±0.9 to 163.6±1.7 mg/dl. In the subjects consuming whole grain diet, PU group showed statistically significant (p<0.05) 4.7% lower LDL cholesterol to its respective controls. In the remaining groups in contrast to the controls 4.1, 4.3 and 3.7% lower fraction concentration was shown in B, P and H groups respectively (Fig. 4). The whole grain

diet has exhibited LDL cholesterol characteristic also at least in PU ethnic female subjects.

DISCUSSION

The prevalence of overweight and obesity continues to increase in the United States as evidenced by national surveys (Ogden *et al.*, 2004; Ruhm, 2007) as well as all over the world (Lew, 1985). It is the result of changes in life style with increase in caloric consumption and sedentary habits. In the life style due to high social production activities processed foods have gain importance. These processed foods contribute significantly in weight gains. Therefore, the health concerning quarters are emphasizing on the characteristics of the food and nutrition. Refined carbohydrate diets are found to contribute in weight gain and associated syndromes and it is understood that traditional high fiber containing carbohydrates foods have beneficial role in body weights etc. The present study is thus to observe the effect of high fiber diet in already weight affected obese in specific environment and diverse ethnic groups living same environment. The females are chosen for the study as this gender's number in metabolic syndrome is increasing because of socially confined and inactive life style.

The results of current study have reflected that whole grain diet affects beneficially on BMI in obese female in all ethnic groups residing in Quetta. The most effective group was PU where statistically significant ($p < 0.01$) 7% lower BMI has been observed in the fiber taking subjects compare to the controls. Other ethnic groups also exhibited noticeable reduction in BMI following supplementation of whole grain diet for 4 weeks in female obese subjects. The results of this study agree with the results of other prospective studies. Liu *et al.* (2003a), in conjunction with the Nurses' Health Study, used a FFQ to assess the dietary habits of their large cohort. Results indicated that women whose consumption of fiber increased the most over the 12-y period gained less weight than their counterparts. Additionally, Ludwig *et al.* (1999), using data from the CARDIA study, found that weight gain over a 10-y period was more strongly predicted by consumption of fiber than by fat consumption. Furthermore, Newby *et al.* (2004) and Koh-Banerjee *et al.* (2004) has reported similar results in their prospective cohort studies. Consistent with cross-sectional studies that used FFQs, they found that high whole-grain diets were associated with a lower BMI (Jacobs *et al.*, 1998; Liu *et al.*, 1999; McKeown *et al.*, 2002; Liu *et al.*, 2003b). In addition, longitudinal studies have reported that persons who have higher intakes of whole grains gain less weight than do persons who have low intakes of whole grains (Liu *et al.*, 2003b; Koh-Banerjee *et al.*, 2004).

Although there is substantial research supporting the inverse relationship between fiber intake and changes in body weight, some contradictory results have been published. In experimental studies by Baron *et al.* (1986) and Thompson *et al.* (2005), the efficacy of fiber for

weight loss was not established. Moreover, the relationship between fiber intake and change in body fat has been studied minimally. In short, as fiber intake increased, energy intake decreased and body weight and body fat decreased as well; because fiber adds to food weight and volume without increasing energy consumption. Thus, more food can be eaten without a commensurate increase in energy intake, or the same total volume of food can be consumed with less total energy.

The present study adds important validation to the protective role that fiber intake can play against gains in weight also in female subjects already in weight crises. It would be correct to conclude that decreases in fiber intake increase the risk of weight gain in women. Hence, it would be wise to encourage most women to increase their fiber intake without increasing their energy intake, thus making it easier to lose weight or at least to slow the rate of weight gain. The current recommendation for fiber intake in the United States, according to the official Dietary Guidelines for Americans, 2005, is that 14 g of dietary fiber be consumed per 1000 kcal (US department of health and human services and USDA 2005). Hence, a major objective of nutrition education should be to highlight and promote fiber-rich foods in the diet. Emphasis should be placed on eating whole-plant foods, such as vegetables, whole grains, fruits and legumes.

The results of this study have shown that total cholesterol was comparatively significantly lower in fiber taking subjects of B and PU ethnic groups, non significantly lesser triglycerides in all the groups, significantly higher HDL cholesterol in P subjects and significantly lower LDL cholesterol in PU female subjects using the fiber diet compare to their respective controls. The results of present study demonstrated that supplemented whole grain diet indicated of some beneficial effects on lipid profile at least in certain ethnic sub populations. This study is of short duration treatment as it was assumed that in obese subjects there may be quicker response to the planned diet. It is proposed that a long term study on this concept will be quite useful for valuable results on lipid profile. Further more, if the lipid profile of obese subjects would come in improved range than these subjects would be curing themselves from many chronic diseases.

The result of the present modest study further support the studies as in the Framingham Offspring Cohort, whole-grain intake was associated with lower concentrations of total and LDL cholesterol (McKeown *et al.*, 2002). Randomized clinical trials (Ripsin *et al.*, 1992) and metabolic studies (Johnston *et al.*, 1998) have shown that oats and oat bran, both sources of whole grains, reduce total blood cholesterol. Thus, improved lipid profiles may be a potential mediating pathway whereby whole grains reduce CVD mortality. Findings of

Sahyoun *et al.* (2006) demonstrated that higher intakes of whole grain foods were favorably associated with both total and LDL cholesterol, although the trend did not reach statistical significance.

The results of beneficial effects of fiber diet on BMI and lipid profile add further to the beneficial effects of whole-grain intake on CVD risk. The improved effects include endothelial function, fibrinolysis and coagulation (Pereira and Ludwig, 2001; Katz *et al.*, 2001). Sahyoun *et al.* (2006) observe a significant trend in reduced CVD mortality across increasing quartile categories of whole-grain intake. This finding is consistent with findings from other studies that linked high-fiber and whole-grain foods to CVD mortality (Anderson *et al.*, 2000). In the Nurses' Health Study, a greater intake of whole-grain foods was associated with a 25% reduction of coronary artery disease and a 31% reduction of ischemic stroke, when compared with those with a lower intake of whole grains. Liu *et al.* (2003b) found that CVD mortality was 20% lower in persons who consumed a whole grain breakfast cereal daily. Recent evidence suggests that the bran component of whole-grain foods may contain the most important bioactive constituents (Anderson, 2004). In the Framingham Offspring Cohort, middle-aged men and women who reported consuming ~ 3 servings of whole grains/d had a 32% lower prevalence of the metabolic syndrome than did those who reported consuming less servings per day (McKeown *et al.*, 2004). Similarly, the prevalence of the metabolic syndrome was 32% lower with higher intakes of whole grains in Tehranian adults (Esmailzadeh *et al.*, 2005). In contrast, Yoo *et al.* (2004) reported no association between whole-grain intake and the prevalence of the metabolic syndrome in young adults.

The increasing trend of obesity in the developing country like Pakistan specifically in females because these are socially subjected to sedentary life pattern is concerning. The management in the diet and nutrition in slowing down the trend can be taken up immediately compare to the social attitudes that will take very long time. Thus public health authorities are strongly suggested to focus on dietary aspects and in the light of the results of the present study sponsor long term such investigations.

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