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# Supplementation of Whole Wheat Diet on Lipid Profile in Hypertensive Females of Various Ethnic Groups in Balochistan

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**Abstract.-** The effects of supplemented whole wheat diet consumption for 4 weeks on body mass index (BMI), systolic and diastolic blood pressure, total cholesterol, low density lipoprotein cholesterol, high density lipoprotein cholesterol and triglycerides in sera were studied in hypertensive female subjects of 4 major ethnic groups *i.e.*, Pathan, Baloch, Hazara, and Punjabi in Quetta region. Two groups each of 32 hypertensive female subjects and comprising 8 subjects from each ethnic group were chosen. The control subjects used the conventionally available refined carbohydrates in meals and the treated group consumed 50g wheat cereals in breakfast and whole wheat chapattis in lunch and dinner. Twelve hours fasting blood sample was taken from control and treated subjects a day after the completion of experiment duration. The whole grain diet subjects' BMI was insignificantly lower in all ethnic groups compare to their respective controls. Lower systolic blood pressure was noticed in all ethnic groups; however, significantly in Punjabi group only; and diastolic blood pressure was lower significantly in Baloch, Pathan and Punjabi groups. Total cholesterol was lower significantly in Pathan, Hazara and Punjabi groups. Significantly lower concentration of low density lipoprotein cholesterol was observed in Baloch, Pathan and Punjabi groups. High density lipoprotein cholesterol and triglycerides were remarkably and significantly lower in treated volunteers of all the ethnic groups compared to their corresponding controls. In general there are matching responses of ameliorating lipid profile among the various ethnic groups; however, the variations observed are likely of nutrigenomic impact.

**Key words:** Blood pressure, cholesterol, ethnic groups, HDL cholesterol, LDL cholesterol, supplementation, triglycerides, whole wheat diet.

## INTRODUCTION

Hypertension is one of the leading causes of death worldwide; its prevalence in 2000 was 26% of the adult population globally and estimated that in 2025 the prevalence would increase by 24% in developed countries and 80% in developing countries (Kearney *et al*., 2005). The national health surveys reported that 33% of Pakistani population above the age of 45 had hypertension (Pakistan Medical Research Council, 1998); and another data analysis revealed that the prevalence was 19% in people of age 15 or above (Jafar *et al*., 2003). Hypertension was pointed to be particularly important in women because it is a modifiable risk factor that is extremely prevalent in older women (August and Oparil, 1999). Obesity and sedentary lifestyles are also major risk factors for hypertension (Manson *et al*., 2007). Therefore, the prevalence of hypertension is also rising at a faster rate than predicted.

Elevated serum total cholesterol and LDL cholesterol concentrations are identified risk factors for coronary artery disease (NCEP, 1993; Appel *et al.*, 1997). Cross-sectional studies have suggested a link between abnormal lipids and hypertension (Haffner *et al*., 1996; Oparil *et al*., 2003). Karim *et al*. (2006) found that patients with hypertension showed increased serum cholesterol and its lipoprotein LDL-C.

Body mass index had been found to be the most important predictor of both types of blood pressure independent of life style and family history (Fu *et al.*, 2003; Saito *et al.* 2003). Further, researches have suggested that low glycemic index diets may assist with weight management through effects on satiety and fuel partitioning (Marsh and Brand-Miller, 2008). Numerous studies have been done on the relationship of intake of dietary fiber and hypertension and have suggested an inverse relation between daily servings of whole-grain foods and incident hypertension among women (Wang *et al.*, 2007). Higher whole-grain intake is associated with a reduced risk of hypertension in middle-aged and older women (Wang *et al*., 2007) and men

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(Flint *et al*., 2009) suggesting a potential role for increasing whole-grain intake in the primary prevention of hypertension and its cardiovascular complications.

There is much evidence now that intake of dietary fibre reduces the risk of hypertension and cardiovascular complications; however, it is yet to understand the mechanisms in this relationship. In this regard an approach may be to observe, in general the effect of fibre intake on pertinent lipid targets and specifically to assess the characteristic of such responses in various ethnic sub-population inhabiting matching environments. Evidence of ethnic specificity to nutrition on metabolic targets is being gradually understood in term of nutrigenomics, and studies on the relationship are being reported. Klimentidis *et al.* (2012) have asserted on the differences in risk factors for elevated blood pressure among ethnic groups. The significant variation in dietary approaches to stop hypertension (DASH) goal attainment among different ethnic groups has also been reported (Gao *et al.*, 2009).

Quetta city and its surrounding population comprise four distinct sub-populations of Baloch, Pathan, Hazara and Punjabi. Despite the sub-urban nature of the city these sub-populations still mostly preserve their life style including dietary habits. The present study has been carried out to compare the effect of supplemented whole wheat diet on pertinent targets of lipid metabolism in the hypertensive females of the various ethnic sub-populations.

## MATERIALS AND METHODS

Participant volunteers of typical Baloch, Pathan, Hazara and Punjabi ethnicity were recruited from the local community in and around the city of Quetta, the selection criteria and assortment of hypertensive subjects were according to WHO (1978) standard.

Hypertensive volunteers were recruited to receive 50g wheat cereal in breakfast; it was planned for the subjects to take compulsorily whole grain chapatti in lunch and also at dinner time along with normal eating habits for four weeks. Cereals (Fauji Foundation, Rawalpindi, Pakistan) and raw flour of whole wheat grains (freshly milled) were provided to all participants. Meetings with the selected volunteers were held to explain the protocol of the study. Hypertensive volunteers on whole wheat supplementation diet were finally screened for exclusion from the trial - those that did not consume whole grain diets 3 times a day or had difficulty in following the experimental requirements, smoked cigarettes and had history of atherosclerotic or metabolic disease were excluded.

A total of 32 hypertensive female subjects with the distribution of 8 from each ethnic sub-population, were contacted and provided the cereals and whole grain wheat flour and advised of the protocol for its consumption. A weekly monitoring was done to know of any of missing whole grain diet meals. The volunteers consumed whole wheat diet meals for the duration of 4 weeks. Another batch of 32, again 8 of each hypertensive females who did not consume whole grain diets for at least 4 week were the controls for the hypertensive whole wheat diet batches.

After the completion of duration of whole grain diet meals all the subjects were measured for BMI data and were sampled for the blood and the control volunteers following a 12 hours fasting with no restriction on plain water. The samples were processed to harvest sera and stored at -20°C until analysis. Sera were used for the estimation of total cholesterol, low density lipoprotein cholesterol, high density lipoprotein cholesterol and triglycerides with commercial kits (Human, Germany).

The data in the results represent the mean of each group and standard error of mean. Statistical analysis was undertaken with statistical program of Sigma Stat 3.5. Student's `t' test was used for comparison between the control hypertensive group and the bran diet consuming hypertensive group and ($P = or < 0.05$) was taken as statistically significant.

## RESULTS

*Age of participants*

The age of participating volunteers ranged at 43.1±6.0, 44.3±5.4, 47.6±5.2 and 44.9±4.2 years in hypertensive female controls and were 39.9±5.1, 57.1±6.4, 50.6±5.6 and 45.5±2.5 years in whole wheat diet consumers subjects of Baloch, Pathan,

Hazara and Punjabi volunteers groups respectively. The volunteers were almost in the middle age and compatible for comparisons among the different groups (Table I).

**Table I.- Average age (years) and BMI (kg/m²) in hypertensive female population of various ethnic groups of whole wheat diet consuming volunteers (WWD) and control (CON) volunteers.**

| Ethnic groups | Age | | BMI | |
|---|---|---|---|---|
| | CON | WWD | CON | WWD |
| Baloch | 43.1±6.0 | 39.3±5.1 | 30.7±2.0 | 28.5±1.2 |
| Pathan | 44.3±5.4 | 57.1±6.4* | 31.0±1.6 | 27.9±1.4 |
| Hazara | 47.6±5.2 | 50.6±5.6 | 28.3±1.2 | 28.8±1.8 |
| Punjabi | 44.9±4.2 | 45.5±2.5 | 32.0±1.7 | 29.0±1.5 |

*Statistically significant: P = > 0.05

*Body mass index*

Average BMI was 30.7±2.0, 31.0±1.6, 28.3±1.2 and 32±1.7 kg/m² in control hypertensive subjects and corresponding values in the whole wheat diet supplementation subjects at the completion of trial duration were 28.5±1.2, 28.5±1.2, 28.8±1.8 and 29±1.5 kg/m² in Baloch, Pathan, Hazara and Punjabi subjects respectively. Supplementation subjects' BMI was noted non-significantly lower compare to the respective controls (Table I).

*Blood pressure*

In Baloch control subjects respective systolic (SBP) and diastolic (DBP) were measured as 173.75±5.8 mm Hg and 93.50±2.5 mm Hg whereas in whole wheat diet supplementation individuals SBP was non-significantly 7.2% and DBP 4.2% significantly (P < 0.037) lowered compare to the respective controls. In the supplemented diet Pathan subjects the values of SPB was reduced 3.6% (non-significant) and DPB lowered 8.08% significantly (P < 0.008) compared to the SBP values of 181.8±5.6 mm Hg and DBP of 92.8±2.1mm Hg. The values of SBP and DBP were 5.4% and 5% non-significantly lower respectively in supplemented diet consumers compared to the values of 179.1±4.9 mm Hg SBP and 88.3±2.6 mm Hg DBP in the control Hazara subjects. In Punjabi treated group SBP and DBP were significantly 15.4%and 10.33% lowered respectively to 173±6.6 mm Hg SBP and 90±2.3mm Hg DBP values of the control volunteers (Figs. 1, 2).

In summary DBP was found reduced significantly in all ethnic groups except for Hazara, however, SBP was significantly reduced only in Punjabis.

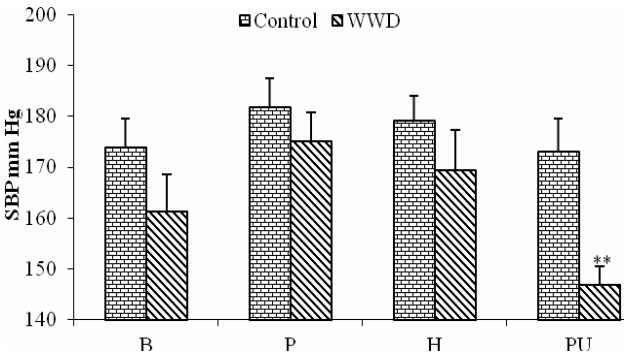


Fig.1. An average systolic blood pressure (SBP mm Hg) in hypertensive females, of controls and whole wheat diet supplementation (WWD) in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic group. ** (P < 0.01).

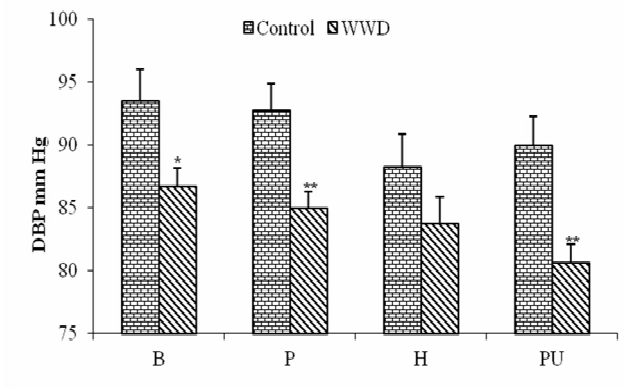


Fig.2. An average diastolic blood pressure (DBP mm Hg) in hypertensive females of controls and whole wheat diet supplementation (WWD) in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. * P < 0.05, *** P < 0.001.

*Total cholesterol*

Average total serum cholesterol values of 263.63±6.6, 261.1±7.2, 262.3±3.8 and 262±9.3 mg /dl were measured in the females hypertensive controls of Baloch, Pathan, Hazara and Punjabi respectively. The levels were 5.9%, 13.4%, 17.4%

and 14.62 % lower with the whole wheat diet in Baloch, Pathan, Hazara and Punjabi, respectively, compared to their respective controls and these were statistically significant Pathan (P<0.018), Hazara (P<0.001) and Punjabi (P<0.031) subjects, respectively (Fig. 3).

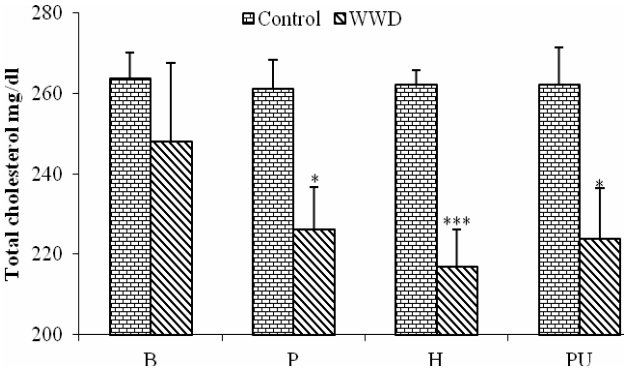


Fig.3. Serum total cholesterol (mg/dl) in hypertensive females, of controls and whole wheat diet supplementation (WWD) in P (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. * P < 0.05, *** P < 0.001.

*Low density lipoprotein cholesterol (LDL-C)*

Serum concentrations of 168.75±4.8, 164.5±7.6, 170.8±5.3 and 173±1.8mg/dl LDL-c cholesterol were observed in control hypertensive subjects of Baloch, Pathan, Hazara and Punjabi volunteers respectively. The levels were 9.81%, 13.62%, 8.9% and 5.95% lower in the supplemented diet fed Baloch, Pathan, Hazara and Punjabi ethnic groups respectively compared to their corresponding controls. The differences were significant in all (Baloch, P < 0.028; Pathan P < 0.025) and Punjabi (P < 0.043) groups except Hazaras (Fig. 4).

*High density lipoprotein cholesterol (HDL-C)*

An average level of circulatory HDL cholesterol fraction was 34.50±1.7, 35.0±1.6, 33.5±0.9 and 36±0.8 mg/dl in the hypertensive controls of Baloch, Pathan, Hazara and Punjabi subjects. The concentrations of the fraction was found to be 23%, 17%, 24.5% and 8.1% greater in the supplemented diet fed Baloch, Pathan, Hazara and Punjabi groups respectively compared to their corresponding controls. The increases were statistically significant in (Baloch, P<0.001; Pathan, P<0.006; Hazara, P<0.001, Punjabi, P<0.007) *i.e.* all the groups (Fig. 5).

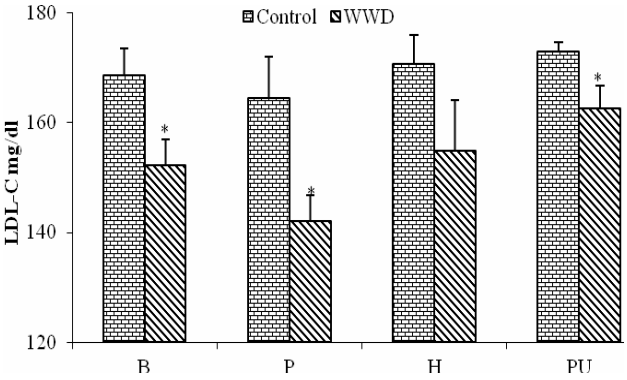


Fig.4. Serum LDL cholesterol (LDL-C) mg/dl in hypertensive females of controls and whole wheat diet supplementation (WWD) in P (Baloch), B (Pathan), H (Hazara) and PU (Punjabi) ethnic groups. * P < 0.05.

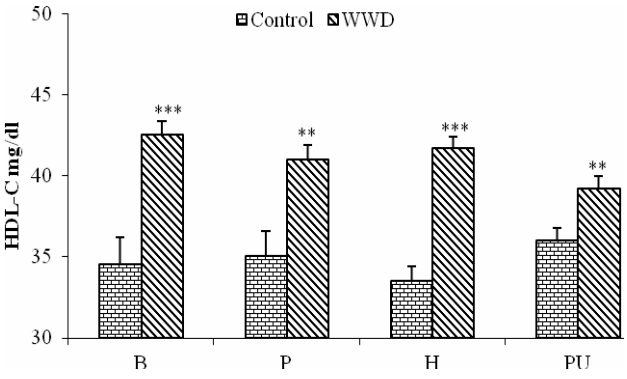


Fig.5. Serum HDL cholesterol (HDL-C) (mg/dl) in hypertensive females of controls and whole wheat diet supplementation (WWD) in P (Baloch), B (Pathan), B (Baloch), H (Hazara) and PU (Punjabi) ethnic groups. ** P < 0.01, *** P < 0.001

*Triglycerides*

Control hypertensive Baloch, Pathan, Hazara and Punjabi volunteers demonstrated mean serum concentrations of triglycerides at 198.25±1.8, 154.3±8.5, 201.5±2.8 and 197±1.8 mg/dl respectively. In whole wheat supplemented diet groups the fraction concentrations were 21%, 21.7%, 11.81%, 14.6% significantly lower in Baloch, Pathan, Hazara and Punjabi volunteers respectively compare to their corresponding controls. The respective statistical significances were P < 0.001, P < 0.001, P < 0.005, P < 0.005 in Baloch, Pathan, Hazara and Punjabi groups (Fig. 6).

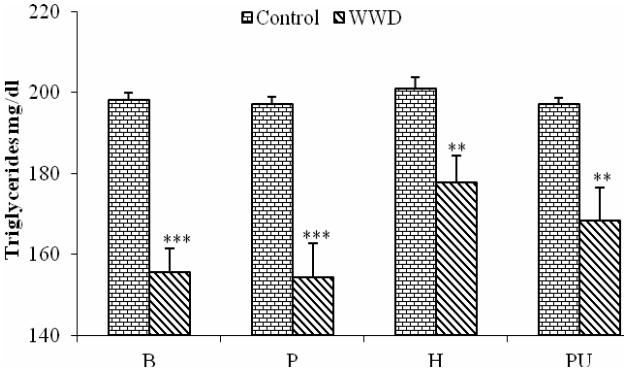


Fig.6. Serum triglycerides (mg/dl) in hypertensive females, of controls and whole wheat diet supplementation (WWD) in P (Baloch), B (Pathan), H (Hazara) and PU (Punjabi). **P < 0.01, and *** P < 0.001.

## DISCUSSION

The present study has demonstrated perceptible results of the influence of whole wheat grain supplementation on lipid metabolic targets in hypertensive females. It had been a short term trial study of four weeks; nevertheless, whole grain consumers' BMI was lower, although insignificantly, compared to the controls. Thus the lower weight gain is more likely the result of whole grain intake in the supplemented volunteers compare to the controls. Even a relationship had been deduced as in an 8-y follow-up of men in a cohort study for each 40-g/d difference in whole-grain intake, there was a relative decrease of 0.49 kg body weight (Koh-Banerjee *et al*., 2004).

In fiber supplemented volunteers in the present study a significant lower SBP was observed in the Punjabi group only when in all other groups it was also considerably less compared to their respective controls, however, not significantly so. The consumers of the supplemented diet exhibited significantly lower DPB in all studied groups except Baloch volunteers. Therefore this intervention has shown amelioration in the status of hypertension. Improvements in BP reduction with whole grain foods have been reported in some earlier studies (Keenan *et al.*, 2002; Saltzman *et al.*, 2001) although some workers did not observe significant change in small trials (Davy, 2002; Kestin *et al*., 1990; Swain *et al*., 1990). Most studies have reported benefits of consumption of whole-grain wheat cereal and had associated it with improved BP control and decreased doses of antihypertensive medications (Pins *et al*., 2002).The present study in general is in agreement with lowering of BP following whole grain intake, however, diastolic pressure lowering had been more significant in most ethnic groups than the systolic pressure which was only reduced in the Punjabi group. Olugbenga *et al*. (2006), however, did report a significant reduction in SBP by dietary means. The present study also points out on the variation of lowering of the BPs in various ethnic groups studied.

In term of significant effect, in the present study, on both parameters of BPs there are contrasting results. Both SBP and DBP are lower in Punjabi group, the Hazara group did not demonstrate significant lowering in the pressures and in Pathan and Baloch only DBP exhibited lower values than the respective controls. The difference in the mechanisms in different ethnic groups may be considered for such contrast of responses following whole grain intake in different ethnic sub-populations. The possible mechanisms in the action of fiber diet on hypertension had been discussed to be reductions in abdominal obesity (Liu, 2003), increases in peripheral insulin sensitivity (Fukagawa *et al*., 1990), improvements in vascular endothelial function (Katz *et al*., 2001), and beneficial effects on the digestion and absorption of foods (Whelton *et al*., 2005). In other suggestions on the mechanism of lowering of BP due to whole grain consumption multiple nutritional components of whole grains were proposed factors for the beneficial effects when biological pathways remain incompletely understood (Slavin, 2005). Earlier studies have reported that dietary fiber, folate, potassium, and magnesium are all commonly found in whole grains and are inversely associated with BP in large cohort studies (Ascherio *et al*., 1992; Forman *et al*., 2005), although clinical trials of supplements with these nutrients have shown small and inconsistent effects in lowering BP (Allender, 1996; Eliasson *et al*., 1992; Whelton and Klag, 1989; Whelton and He, 1999).

Other possible mechanisms for the action of whole grain diet in lowering hypertension have been attributed to the fiber in grain that may involve reductions in abdominal obesity as discussed by Liu

(2003). Olugbenga *et al*. (2006) reported a significant reduction in SBP and proposed this reduction in the BP may be due to a significantly high level of fiber. Previously in a large randomized trial, participants who consumed higher vegetable and fruit diet, (rich in fiber) had a greater reduction in systolic and diastolic BP than did the control subjects (Margetts *et al*., 1986). It has also been argued that lower weight gain over time may be a mechanism by which whole-grain intake is related to hypertension. There is a large body of evidence from both clinical trials and observational studies linking lower weight and weight loss to lower BP and reduced risk of hypertension (Appel *et al*., 2006; Huang *et al*., 1998; Whelton *et al*., 2005). The cereal fiber of whole grains is predominantly insoluble fiber and can act through satiety reflex mechanisms to reduce energy intake, which leads to a more favorable weight pattern over time (Howarth *et al*., 2001; Porikos and Hagamen, 1986). Other researchers had shown that increased whole-grain intake has been found to be associated with lower postprandial blood glucose concentrations and thus a reduced risk of development of insulin resistance (Hallfrisch and Behall, 2000; Liese *et al*., 2003) and hypertension. Future studies will elaborate the mechanisms of lowering of BP with whole grain consumption; in view of high prevalence of disease globally even a modest reduction in hypertension risk, possibly by whole grain intake, on an individual level will substantially lower the population-wide disease burden.

Serum cholesterol is a major causative agent in the development of coronary heart disease (CHD). Karim *et al*. (2006) found that patients with hypertension showed increased serum cholesterol and its lipoprotein LDL-C. In the present study cholesterol was significantly lower in whole grain consuming groups except Baloch compared to their respective controls. In a similar comparison LDL-C was lower significantly with whole grain intake in all except the Hazara group. Triglycerides were lower significantly in all the ethnic groups compare to their respective controls. Whole grain fiber is likely to be the cause of cholesterol and triglyceride decrease. Anderson *et al*. (1988) and Jenkins *et al*. (1975) have reported that a fall in total serum cholesterol resulting from ingestion of soluble fiber, specially high cereal fiber may protect against ischemic heart disease (IHD) as well as high BP, serum cholesterol and triglyceride levels. There are several studies demonstrating lowering of cholesterol, LDL-C with whole grain consumption. Kashtan *et al*. (1992) observed the decreases with oat and wheat; Brown *et al*. (1999) found with soluble fiber from oats, psyllium, or pectin and Berg *et al*. (2003) with the combination of the fat-modified and oat bran-enriched food. The wheat bran component of whole grain products has been reported to have important serum triglyceride-lowering effects (Anderson and Hanna, 1999) which may be related to anti-estrogen characteristics of the phytoestrogens in the grain (Anderson, 1996).

In the present study HDL-C comparatively was significantly greater in whole grain volunteers of all the ethnic groups compared to their respective controls. There are studies which did not observe any effect on HDL-C with whole grain intake. Kashtan *et al*. (1992) did not observe any significant differences in high-density lipoprotein with whole grain consumption. Whole grains deliver a unique nutrient package rich in phytonutrients, vitamins and minerals, unsaturated fatty acids, tocotrienols, tocopherols, insoluble fiber, phytosterols, stanols, sphingolipids, phytates, lignans, and antioxidants like phenolic acids (Miller *et al*., 2000). Thus certain constituents in the whole grain following intake may be contributing in enhancing HDL-C.

Nevertheless in the present study the beneficial effects of whole wheat diet supplementation on lipid metabolic targets related to cardiovascular functions have been observed. However, its effect on some targets has been implemented variedly in different ethnic sub-populations. It is quite likely that certain genetic factors may be important in the outcome of the contrasting effect of fiber on lipid profile in different ethnic groups. This requires more dedicated studies from nutrigenomic aspects.

In view of the potential significance of these results to health care in Pakistan a larger trial would be well worth conducting.

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