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Original Article

Efficacy of a Culturally Adapted High-Legume Plant-Based Diet for LDL-Cholesterol Reduction in Pakistani Adults With Hypercholesterolemia

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ABSTRACT

Background: Dietary strategies using culturally familiar plant foods may provide a practical approach to lipid management in populations with hypercholesterolemia. Objective: To evaluate the effect of replacing habitual daily meat intake with locally available legumes on serum low-density lipoprotein cholesterol (LDL-C) in Pakistani adults with moderate hypercholesterolemia. Methods: This single-blind, parallel-group randomized controlled trial enrolled 84 adults aged 30–65 years from tertiary outpatient cardiology clinics in Chitral District, Pakistan. Participants were randomized 1:1 to replace daily meat intake with 150–200 g of cooked legumes or continue their usual diet for 12 weeks. Seventy-nine participants completed follow-up and were included in the reported analysis. Results: LDL-C decreased from 158.1 ± 13.9 to 139.4 ± 12.1 mg/dL in the intervention group and from 157.2 ± 13.5 to 155.8 ± 12.9 mg/dL in controls. At week 12, LDL-C was 16.4 mg/dL lower in the intervention group (95% CI −22.0 to −10.8; p<0.001). Total cholesterol was also lower, whereas between-group differences in HDL-C, triglycerides, body mass index, blood pressure, and waist circumference were not statistically significant. Conclusion: A 12-week culturally adapted legume-based dietary substitution was associated with lower LDL-C and total cholesterol compared with usual diet among completers with moderate hypercholesterolemia. Keywords: Cardiovascular Diseases; Diet Modification; Fabaceae; Hypercholesterolemia; Lipids; Lipoproteins, LDL; Pakistan.

INTRODUCTION

Cardiovascular disease remains a major cause of morbidity and mortality worldwide, and elevated low-density lipoprotein cholesterol (LDL-C) is an important modifiable contributor to atherosclerotic cardiovascular disease.

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This concern is particularly relevant in South Asian populations, where the burden of cardiovascular disease has increased alongside urbanization, metabolic risk factors, and changes in dietary patterns (1). In Pakistan, dyslipidemia represents an important component of this cardiovascular risk profile and is influenced by dietary practices characterized by energy-dense foods, refined carbohydrates, fats, and animal-based food consumption (2). Although pharmacological lipid-lowering therapies are central to the management of hypercholesterolemia, dietary modification remains an important component of cardiovascular risk management and may provide a practical complementary approach, particularly where sustained lifestyle interventions are feasible (3).

Dietary strategies that emphasize plant-based foods have received increasing attention because of their potential effects on serum lipid concentrations and other cardiovascular risk factors. Diets incorporating greater quantities of plant foods generally provide soluble and insoluble fiber, plant-derived bioactive compounds, and lower amounts of saturated fat when they replace selected animal-based foods (4). Legumes, including chickpeas, lentils, and beans, are particularly relevant in this context because they provide dietary fiber, complex carbohydrates, plant protein, and other nutrients that may contribute to favorable lipid metabolism. Dietary fiber may influence cholesterol homeostasis through several mechanisms, including increased intestinal bile-acid binding and fecal excretion, while replacement of foods containing greater amounts of saturated fat may further support reductions in circulating LDL-C (5). These mechanisms provide a biological rationale for evaluating legume-based dietary substitutions as a non-pharmacological approach to hypercholesterolemia.

The effectiveness of dietary recommendations, however, depends not only on their biological potential but also on whether they can be incorporated into the habitual food practices of the target population. Plant-based dietary approaches may be difficult to sustain when they require unfamiliar foods, substantial changes in meal preparation, or major departures from established dietary preferences (6). This consideration is especially important in Pakistan, where meat-based dishes are widely incorporated into routine meals, whereas pulses and legumes are also familiar, accessible, and commonly consumed foods. A dietary strategy based on replacing a habitual meat portion with locally available legumes therefore offers an opportunity to modify the nutritional composition of the diet while retaining culturally familiar ingredients and meal patterns. Evidence from observational and interventional research indicates that greater consumption of plant-based foods can favorably influence lipid and lipoprotein profiles, although the magnitude of benefit varies according to the composition of the dietary intervention and the population studied (7).

Despite the broader evidence supporting plant-focused dietary patterns, important uncertainty remains regarding how such interventions perform when adapted to specific South Asian dietary contexts. Much of the available literature has evaluated broader plant-based dietary patterns or nutritional components rather than a pragmatic substitution in which routinely consumed meat is replaced with culturally familiar legumes. This distinction is relevant because the metabolic effects of a dietary intervention may depend on baseline eating patterns, the food being replaced, the amount and type of dietary fiber introduced, and adherence to the prescribed dietary change. Dietary fiber is recognized as an important nutritional component with potential metabolic and cardiovascular benefits, but its effectiveness in practice depends on its incorporation into sustainable dietary patterns (8). Consequently, evidence from culturally adapted randomized interventions is needed to determine whether a structured legume-based meat substitution can produce a measurable improvement in LDL-C among Pakistani adults with hypercholesterolemia.

A culturally tailored intervention using chickpeas, lentils, and beans may therefore offer a practical approach to improving lipid profiles without requiring participants to abandon familiar dietary practices. Evaluating such an intervention against usual dietary intake is particularly important because it can determine whether the dietary substitution produces an additional lipid-lowering effect beyond changes that might occur over time without targeted dietary modification. Accordingly, this randomized controlled trial aimed to evaluate the effect of replacing daily meat intake with 150–200 g of cooked locally available legumes for 12 weeks, compared with continuation of the usual diet, on fasting serum LDL-C among Pakistani adults aged 30–65 years with moderate hypercholesterolemia. Secondary outcomes included total cholesterol, high-density lipoprotein cholesterol, triglycerides, body mass index, blood pressure, and waist circumference.

MATERIAL AND METHODS

This single-blind, two-arm, parallel-group randomized controlled trial was conducted in tertiary outpatient cardiology clinics in Chitral District, Khyber Pakhtunkhwa, Pakistan, between March and July 2025. The study was designed to evaluate the effect of a culturally adapted dietary substitution involving locally available legumes on serum low-density lipoprotein cholesterol (LDL-C) among adults with moderate hypercholesterolemia. The overall study period was approximately five months and included participant recruitment and baseline assessment, a 12-week dietary intervention, and post-intervention clinical and laboratory evaluations. Chitral District was selected as the study setting because the population was considered relatively homogeneous with respect to customary dietary practices, thereby reducing background variability in food preparation and habitual dietary exposure.

The target population comprised adults aged 30–65 years with moderate hypercholesterolemia, defined as a fasting serum LDL-C concentration of 130–189 mg/dL. Eligible participants were required to be non-smokers, habitually consume meat at least once daily, and have no history of lipid-lowering medication use during the preceding three months. Individuals were excluded if they had severe hypertriglyceridemia, defined as serum triglycerides >400 mg/dL, familial hypercholesterolemia, chronic kidney disease, hepatic dysfunction, uncontrolled diabetes mellitus, systemic inflammatory disease, gastrointestinal malabsorption, or a known allergy to legumes. A total of 112 individuals were screened for eligibility, of whom 84 fulfilled the study criteria and were enrolled. Written informed consent was obtained from all participants before enrollment and baseline assessment.

The required sample size was calculated using G*Power software. The calculation assumed an expected between-group difference of 12 mg/dL in serum LDL-C, a standard deviation of 18 mg/dL, 80% statistical power, a two-sided alpha level of 0.05, and an anticipated dropout rate of 15%. On this basis, a total sample of 84 participants was recruited. Following completion of baseline assessments, participants were randomized in a 1:1 ratio to the dietary intervention group or the control group, with 42 participants initially allocated to each arm. Randomization was performed using a computer-generated random sequence. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes, which were opened by an independent research coordinator after participant enrollment.

Participants assigned to the intervention group were instructed to replace their daily principal meat intake with 150–200 g of cooked legumes for 12 consecutive weeks. The prescribed legumes consisted of locally available chickpeas, red lentils, black lentils, and kidney beans. Participants were provided with culturally adapted preparation guidance emphasizing standardized low-fat and low-spice cooking methods using canola oil. The dietary strategy was intended to modify the habitual meal pattern through substitution of the principal meat component rather than through complete adoption of a vegetarian diet. Participants allocated to the control group continued their usual dietary practices, including their habitual meat intake, and did not receive targeted dietary restriction or structured dietary counseling during the study period.

Adherence to the intervention was monitored throughout the 12-week period using bi-weekly 24-hour dietary recalls, weekly telephone follow-up, and weekly review of participant food logs. These procedures were used to assess compliance with the prescribed dietary substitution and to identify deviations from the intervention protocol. Because the intervention involved an identifiable change in food intake, blinding of participants was not feasible. To reduce measurement and analytical bias, outcome assessors, laboratory personnel, and data analysts were kept blinded to group allocation.

The primary outcome was the change in fasting serum LDL-C concentration from baseline to the end of the 12-week intervention. Secondary outcomes included serum total cholesterol, high-density lipoprotein cholesterol (HDL-C), triglycerides, systolic and diastolic blood pressure, body mass index, and waist circumference. Biochemical outcomes were assessed at baseline and week 12 following a 12-hour overnight fast. Serum lipid concentrations were determined using enzymatic colorimetric methods on automated chemistry analyzers. Anthropometric and physiological outcomes were assessed at the same study time points. Baseline demographic and clinical characteristics were recorded before randomization, and outcome measurements were repeated after completion of the dietary intervention.

Continuous variables were summarized using means and standard deviations, while categorical variables were summarized using frequencies and percentages. Distributional assumptions for continuous variables were

assessed using the Shapiro–Wilk test. Within-group changes from baseline to week 12 were evaluated using paired-samples t-tests, whereas between-group comparisons were assessed using independent-samples t-tests. Changes in LDL-C over time between the intervention and control groups were further examined using repeated-measures analysis of variance, including assessment of the main effects of time and group and the time-by-group interaction. Associations between dietary adherence scores and changes in lipid parameters were evaluated using Pearson correlation coefficients. All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant.

Five of the 84 randomized participants did not complete the 12-week follow-up. Three were from the intervention group, including two who withdrew because of gastrointestinal discomfort and one who was lost to follow-up following relocation, while two control participants were lost to follow-up for personal reasons. Consequently, the reported post-intervention analyses were based on 79 participants with complete follow-up data, comprising 39 participants in the intervention group and 40 participants in the control group. Participant attrition and reasons for withdrawal were documented to permit evaluation of follow-up completeness and potential attrition-related bias.

Ethical approval was obtained from an Institutional Ethics Review Committee before initiation of participant recruitment. All study procedures were conducted following ethical principles for research involving human participants, and written informed consent was obtained before enrollment. Participant information was collected for research purposes and outcome assessment was conducted with group allocation concealed from assessors wherever feasible.

RESULTS

A total of 112 individuals were screened, of whom 84 met the eligibility criteria and were randomized equally to the intervention and control groups, with 42 participants in each arm. Five participants did not complete the 12-week follow-up. Three were from the intervention group, including two who withdrew because of gastrointestinal discomfort and one who was lost to follow-up after relocation, while two participants in the control group were lost to follow-up for personal reasons. The complete-case analysis therefore included 79 participants, comprising 39 in the intervention group and 40 in the control group. Baseline demographic, anthropometric, blood-pressure, and lipid characteristics were similar between groups, with mean LDL-C concentrations of 158.4 ± 14.2 mg/dL in the intervention group and 156.9 ± 13.8 mg/dL in the control group.

At week 12, LDL-C decreased from 158.1 ± 13.9 to 139.4 ± 12.1 mg/dL in the intervention group, corresponding to an absolute within-group reduction of 18.7 mg/dL, or approximately 11.8% of the baseline value. In the control group, LDL-C decreased by 1.4 mg/dL, from 157.2 ± 13.5 to 155.8 ± 12.9 mg/dL. The week-12 LDL-C concentration was 16.4 mg/dL lower in the intervention group than in the control group (95% CI −22.0 to −10.8; p<0.001), with a Hedges g of −1.30. Repeated-measures analysis also demonstrated a time-by-group interaction for LDL-C (F=28.64, p<0.001), indicating different changes in LDL-C over the study period between the two groups.

Table 1. Baseline demographic and clinical characteristics of randomized participants (N=84)

Characteristic	Total (N=84)	Intervention (n=42)	Control (n=42)	p-value
Age, years	47.8 ± 7.2	48.1 ± 7.0	47.5 ± 7.5	0.706
Male sex, n (%)	46 (54.8)	22 (52.4)	24 (57.1)	0.661
BMI, kg/m²	27.4 ± 2.8	27.6 ± 2.9	27.2 ± 2.7	0.515
Systolic BP, mmHg	128.5 ± 9.4	129.1 ± 9.1	127.9 ± 9.8	0.562
Diastolic BP, mmHg	82.3 ± 6.1	82.8 ± 5.8	81.8 ± 6.4	0.455
Total cholesterol, mg/dL	236.2 ± 18.5	237.5 ± 19.1	234.9 ± 18.0	0.523
LDL-C, mg/dL	157.6 ± 14.0	158.4 ± 14.2	156.9 ± 13.8	0.625
HDL-C, mg/dL	43.1 ± 5.2	42.8 ± 5.0	43.4 ± 5.5	0.602
Triglycerides, mg/dL	177.5 ± 24.1	179.2 ± 25.3	175.8 ± 22.9	0.520

Values are mean ± SD unless otherwise indicated. Continuous-variable p-values were recalculated from the reported group means, SDs, and sample sizes using two-sample Welch t-tests. The sex comparison used Pearson's chi-square test. BMI, body mass index; BP, blood pressure; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.

Table 2. Changes in serum lipid parameters from baseline to week 12 among participants with complete follow-up (n=79)

Outcome	Intervention baseline (n=39)	Intervention week 12 (n=39)	Intervention change	Within-group p-value	Control baseline (n=40)	Control week 12 (n=40)	Control change	Within-group p-value	Week-12 between-group difference (95% CI)	Between-group p-value	Hedges g
LDL-C, mg/dL	158.1 ± 13.9	139.4 ± 12.1	−18.7	<0.001	157.2 ± 13.5	155.8 ± 12.9	−1.4	0.340	−16.4 (−22.0 to −10.8)	<0.001	−1.30
Total cholesterol, mg/dL	237.1 ± 18.8	216.5 ± 16.4	−20.6	<0.001	235.2 ± 17.8	233.8 ± 17.2	−1.4	0.420	−17.3 (−24.8 to −9.8)	<0.001	−1.02
HDL-C, mg/dL	42.9 ± 4.9	43.5 ± 4.8	+0.6	0.280	43.3 ± 5.4	43.1 ± 5.2	−0.2	0.650	+0.4 (−1.8 to 2.6)	0.723	+0.08
Triglycerides, mg/dL	178.8 ± 24.9	168.2 ± 22.1	−10.6	0.010	176.1 ± 22.5	175.0 ± 21.8	−1.1	0.580	−6.8 (−16.6 to 3.0)	0.173	−0.31

Values are mean ± SD. Change was calculated as week 12 minus baseline. Within-group p-values are those reported in the manuscript. Week-12 between-group differences, 95% CIs, p-values, and Hedges g values were derived from the reported week-12 means, SDs, and sample sizes. Negative between-group values indicate lower concentrations in the intervention group. Between-group tests used Welch two-sample t-tests. HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol.

Table 3. Physical and physiological outcomes at week 12 among participants with complete follow-up (n=79)

Outcome	Intervention (n=39)	Control (n=40)	Between-group difference (95% CI)	p-value	Hedges g
BMI, kg/m²	27.1 ± 2.7	27.3 ± 2.6	−0.2 (−1.4 to 1.0)	0.740	−0.07
Systolic BP, mmHg	127.4 ± 8.5	128.2 ± 9.1	−0.8 (−4.7 to 3.1)	0.690	−0.09
Diastolic BP, mmHg	81.5 ± 5.4	82.0 ± 6.0	−0.5 (−3.0 to 2.0)	0.700	−0.09
Waist circumference, cm	91.2 ± 6.1	92.0 ± 5.8	−0.8 (−3.4 to 1.8)	0.550	−0.13

Values are mean ± SD. Between-group differences, 95% CIs, and p-values are reported in the manuscript. Hedges g values were calculated from the reported means, SDs, and sample sizes. BMI, body mass index; BP, blood pressure.

Table 4. Repeated-measures and adherence analyses for LDL-C

Analysis	Statistical estimate	95% CI	p-value
Main effect of time	F = 32.41	—	<0.001
Main effect of group	F = 12.85	—	0.001
Time × group interaction	F = 28.64	—	<0.001
Dietary adherence score vs LDL-C change	r = −0.48	−0.69 to −0.19	0.002

F statistics and p-values are reported in the manuscript. The 95% CI for Pearson's r was calculated using Fisher's z transformation based on n=39 intervention participants. LDL-C, low-density lipoprotein cholesterol.

Total cholesterol decreased from 237.1 ± 18.8 to 216.5 ± 16.4 mg/dL in the intervention group, whereas the control group changed from 235.2 ± 17.8 to 233.8 ± 17.2 mg/dL. At week 12, the intervention group had a 17.3 mg/dL lower total cholesterol concentration than the control group (95% CI −24.8 to −9.8; p<0.001; Hedges g=−1.02). HDL-C showed little change in either group, or the week-12 between-group difference was 0.4 mg/dL (95% CI −1.8 to 2.6; p=0.723).

Triglycerides decreased by 10.6 mg/dL within the intervention group, from 178.8 ± 24.9 to 168.2 ± 22.1 mg/dL (p=0.010), compared with a 1.1 mg/dL reduction in the control group. However, the week-12 between-group difference was −6.8 mg/dL (95% CI −16.6 to 3.0; p=0.173), with a Hedges g of −0.31. Thus, although a within-group triglyceride reduction was observed in the intervention arm, the available summary data did not demonstrate a statistically significant difference between groups at week 12.

No material differences between-group differences were observed at week 12 for BMI, systolic blood pressure, diastolic blood pressure, or waist circumference. The corresponding between-group differences were −0.2 kg/m² (95% CI −1.4 to 1.0; p=0.740), −0.8 mmHg (95% CI −4.7 to 3.1; p=0.690), −0.5 mmHg (95% CI −3.0 to 2.0; p=0.700), and −0.8 cm (95% CI −3.4 to 1.8; p=0.550), respectively.

Within the intervention group, dietary adherence scores were inversely correlated with LDL-C change (r=−0.48, 95% CI −0.69 to −0.19; p=0.002). The repeated-measures analysis additionally showed a main effect of time (F=32.41, p<0.001) and a main effect of group (F=12.85, p=0.001), alongside the time-by-group interaction.

DISCUSSION

The present randomized controlled trial found that replacing habitual daily meat intake with a culturally adapted legume-based dietary intervention for 12 weeks was associated with a substantial reduction in LDL-C among Pakistani adults with moderate hypercholesterolemia. The intervention group also had lower total cholesterol at follow-up, whereas HDL-C, body mass index, blood pressure, and waist circumference did not differ materially between groups. Although triglycerides decreased within the intervention group, the between-group difference at week 12 was not statistically significant. Taken together, these findings suggest that the principal measurable effect of the intervention over the 12-week period was on LDL-C and total cholesterol rather than on anthropometric or blood-pressure outcomes.

The observed lipid findings are broadly consistent with evidence supporting plant-focused dietary strategies for management of cardiovascular risk factors. Previous literature has described favorable changes in lipid and lipoprotein profiles when diets emphasize plant foods and reduce dietary sources of saturated fat (4,6,7). The present findings extend this concept to a culturally adapted dietary substitution in which familiar legumes were used to replace habitual meat intake rather than requiring participants to adopt an entirely vegetarian dietary pattern. This distinction may be relevant in settings where the long-term acceptability of dietary interventions depends on their compatibility with established food preferences and meal preparation practices. The reduction in LDL-C observed in the intervention group therefore supports further evaluation of culturally appropriate food substitutions as a component of dietary management of hypercholesterolemia.

Several biological mechanisms could plausibly contribute to the observed lipid changes. Chickpeas, lentils, and beans provide dietary fiber, plant protein, and other bioactive dietary constituents that may influence cholesterol metabolism. Soluble and viscous fiber can reduce intestinal reabsorption of bile acids, increase their fecal excretion, and promote hepatic utilization of cholesterol for bile-acid synthesis, mechanisms that may contribute to reductions in circulating LDL-C (5,8). Plant-based whole foods have also been associated with metabolic pathways relevant to LDL-C regulation and cardiovascular health (6). In addition, replacing meat-containing meals with legumes may reduce saturated-fat exposure while increasing complex carbohydrate and fiber intake. Legumes have consequently been investigated as functional foods with potential cardiovascular benefits (12). However, the present intervention incorporated several simultaneous dietary changes, including replacement of meat, increased legume consumption, low-fat preparation methods, and use of canola oil. The observed lipid effect should therefore be attributed to the overall dietary intervention rather than to legumes alone.

The magnitude and pattern of change are also important when interpreting the findings. At week 12, LDL-C was 16.4 mg/dL lower in the intervention group than in the control group, with a confidence interval excluding no difference and a large standardized between-group effect. Total cholesterol demonstrated a similar between-group pattern. In contrast, HDL-C remained relatively stable. Although triglycerides decreased within the intervention group, the week-12 between-group estimate was −6.8 mg/dL with a 95% confidence interval of −16.6 to 3.0 mg/dL and therefore did not provide clear evidence of a between-group effect. This distinction is important because a statistically significant change within one treatment arm does not itself establish a statistically significant treatment effect relative to the control group.

The absence of substantial changes in body mass index, waist circumference, or blood pressure over 12 weeks suggests that the observed lipid differences occurred without a corresponding detectable between-group change in these measures during the study period. This does not establish the biological mechanism responsible for the lipid response, but it indicates that the LDL-C difference was not accompanied by substantial short-term differences in body size or blood pressure. Dietary modification is recognized as an important component of cardiovascular risk-factor management, particularly alongside established clinical approaches to dyslipidemia (13,14). A dietary strategy based on commonly available foods may therefore have practical relevance in settings where culturally acceptable lifestyle modification is desirable. Nevertheless, the present trial evaluated surrogate cardiovascular risk markers rather than cardiovascular events, and its findings should not be interpreted as direct evidence of reduced cardiovascular morbidity or mortality.

The inverse correlation between dietary adherence scores and LDL-C change provides additional evidence that greater adherence to the intervention was associated with a larger favorable change in LDL-C. This finding should nevertheless be interpreted cautiously because adherence was assessed using self-reported dietary recalls and

food logs, and the correlation was evaluated within the intervention group rather than through randomized comparison. Self-reported dietary assessment is susceptible to recall and reporting errors, and adherence itself may be related to other health behaviors. Accordingly, this association supports the internal coherence of the intervention findings but does not independently establish a dose-response relationship.

Several features of the study strengthen interpretation of the findings. Random allocation, allocation concealment using sequentially numbered opaque sealed envelopes, and blinding of outcome assessors, laboratory personnel, and data analysts reduced several important selection and measurement bias. The intervention also used foods familiar within the local dietary context and incorporated repeated adherence monitoring through dietary recalls, telephone follow-up, and food logs. Retention was high, with 79 of 84 randomized participants competing follow-up. The control group provided a concurrent comparison against usual dietary practices, allowing the observed changes to be distinguished from simple pre-post variation within the intervention group.

The study also has important limitations. First, the primary reported analyses were based on the 79 participants with complete follow-up rather than all 84 randomized participants. Although attrition was limited, complete-case analysis may introduce bias if withdrawal or loss to follow-up was related to intervention response or participant characteristics. Two participants in the intervention group withdrew because of gastrointestinal discomfort, which also indicates that tolerability should be considered when evaluating sustained use of the dietary strategy. Second, the 12-week duration was sufficient to examine short-term changes in lipid concentrations but cannot establish long-term adherence, durability of lipid changes, or effects on clinical cardiovascular outcomes. Third, dietary adherence relied on self-reported recalls and food logs, creating potential measurement and reporting bias. The available data also do not permit separation of the effects of increased legume intake from those of reduced meat consumption, altered cooking methods, or canola-oil use. Finally, recruitment from tertiary outpatient cardiology clinics in Chitral District and restriction to adults who habitually consumed meat at least once daily limit direct generalization to other Pakistani populations, urban populations, individuals with different baseline diets, or populations outside Pakistan.

These findings support further investigation of culturally adapted dietary substitution as part of non-pharmacological lipid management. Longer-duration and multicenter randomized studies would be useful for determining whether the observed LDL-C reduction can be maintained across more diverse populations and dietary environments and for more fully evaluating adherence and tolerability. Future studies should also quantify changes in total energy intake, dietary fiber, saturated fat, meat consumption, legume intake, and cooking-fat exposure so that the nutritional components contributing to lipid changes can be characterized more precisely.

CONCLUSION

Among Pakistani adults with moderate hypercholesterolemia who completed 12 weeks of follow-up, a culturally adapted dietary intervention replacing habitual daily meat intake with locally available legumes resulted in lower LDL-C and total cholesterol compared with continuation of the usual diet. No clear between-group differences were observed for HDL-C, triglycerides, body mass index, blood pressure, or waist circumference. These findings indicate that a culturally familiar legume-based dietary substitution may provide a useful non-pharmacological approach for improving LDL-C and total cholesterol over the short term, while longer-term studies are needed to establish the durability and broader applicability of these effects.

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