

Original Research Article

Macronutrient intake and its association with nutritional status and lipid profiles among healthy adults in a training institute of Western Maharashtra

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ABSTRACT

Background: Dietary macronutrient composition can influence nutritional status and lipid profile, key determinants of cardiometabolic health. Limited evidence exists from institutional populations with regimented dietary provision. To assess the type of diet and its macronutrient composition, and examine associations with nutritional status and lipid profiles among healthy adults in a training institute of Western Maharashtra.

Methods: A cross-sectional study was conducted among 251 healthy trainees consuming a regimented mess diet, categorized as vegetarian, non-vegetarian and egg vegetarian. Dietary intake over three non-consecutive days was assessed and macronutrients were calculated using Indian Food Composition. Anthropometric indices and fasting lipid profiles were measured following standard protocols. Data were analysed using SPSS v26.0 with Chi-square, Students' t-test, ANOVA and post-hoc comparison.

Results: Among 251 participants (132 males, 119 females; mean age 23.16±2.11 years), vegetarians derived more energy from carbohydrates (64.8%) and less from fat (21.4%), while non-vegetarians consumed more protein (15.6%) and fat (29.1%). Vegetarians had lower total cholesterol, triglycerides, low density lipoprotein and higher high-density lipoprotein (HDL) (all $p<0.05$). Males had higher Body mass index, waist hip ratio and systolic blood pressure whereas females had higher triceps skinfold thickness and HDL (all $p<0.01$). Post-hoc confirmed significant vegetarian vs. non-vegetarian differences.

Conclusion: Dietary preference and gender significantly influenced cardiometabolic indicators despite uniform feedings. Vegetarian diets were associated with favourable lipid profiles supporting their promotion in institutional catering.

Keywords: Dietary preferences, Macronutrients, Vegetarian diet, Cardiometabolic health

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of death globally, accounting for an estimated 17.9 million deaths each year, with dyslipidaemia being a major modifiable risk factor in their pathogenesis.^{1,2} The burden of dyslipidaemia is rising disproportionately in low- and middle-income countries (LMICs), including India, where

rapid urbanization, lifestyle transitions, and dietary shifts are reshaping nutritional patterns.^{3,4}

Dietary intake and cardiometabolic health: Dietary macronutrient distribution plays a central role in metabolic health. Diets rich in saturated fats and refined carbohydrates elevate triglycerides (TG) and low-density lipoprotein cholesterol (LDL-C), while lowering high-

density lipoprotein cholesterol (HDL-C), thereby increasing atherogenic risk.^{5,6} Conversely, plant-based diets high in complex carbohydrates, fibre, and unsaturated fats demonstrate lipid-lowering and cardioprotective effects.⁷ While vegetarian and non-vegetarian diets have been studied extensively, limited research exists on eggetarian diets in which food preference is plant-based with inclusion of eggs but exclusion of meat and fish. This dietary form, common in Indian communities, is hypothesized to influence lipid metabolism differently due to its higher protein and cholesterol content.⁸ Nutrition epidemiology in institutional young adults: Young adults in regimented institutional settings, such as paramedical and training institutes, represent a unique study population. Their diets are typically standardised through common mess facilities, yet dietary preferences (vegetarian, non-vegetarian, eggetarian) persist. Unlike urban free-living populations, these settings minimize confounding from affordability and food access, thereby providing a clearer assessment of diet-health associations.⁹ Given their young age, high physical activity, and absence of chronic disease, observed differences in nutritional status and lipid profiles are more likely attributable to dietary type and macronutrient composition.

Anthropometric and biochemical indicators

Anthropometric indices such as body mass index (BMI), waist-to-hip ratio (WHR), and triceps skinfold thickness (TSFT) provide practical measures of nutritional status and cardiometabolic risk.¹⁰ Complementing these, lipid profiles including total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), and TG offer biochemical insight into cardiovascular risk.¹¹ Together, these parameters provide a comprehensive framework for assessing diet-health relationships in young adult populations.

Public health relevance and evidence gaps

Understanding the impact of diet on nutritional status and lipid profiles in institutional young adults plays a vital role in early detection of diet-related dyslipidaemia risk, enabling targeted counselling, and informing institutional food policy and menu planning for optimal energy balance without compromising long-term cardiovascular health. While global studies report consistent associations between vegetarian diets and favourable lipid profiles, Indian findings remain mixed.^{12,13} Furthermore, eggetarian diets remain underexplored, and data from controlled institutional environments are scarce.

Study rationale and hypothesis

This study examined the association between dietary types (vegetarian, non-vegetarian, eggetarian), macronutrient composition, nutritional status, and lipid profiles among healthy adults in a training institute of Western Maharashtra. The use of centrally prepared mess

diet reduced variability in sourcing and preparation ensuring robust comparison. Null hypothesis (H_0) stated that there would be no significant differences in anthropometric (BMI, WH ratio, TSFT) or biochemical (TC, LDL-C, HDL-C, TG) parameters across dietary groups and gender. The alternate hypothesis (H_1) proposed that at least one dietary group differs significantly in these parameters, and that dietary effects on cardiometabolic outcomes may vary by gender.

METHODS

A cross-sectional study was conducted in a training institute of Western Maharashtra. The setting provided a controlled dietary environment, as all participants consumed meals from common mess facilities having regimented menu.

Sampling and sample size

Sample size was estimated using mean BMI differences between vegetarians (25.9 ± 5.2 kg/m²) and non-vegetarians (28.7 ± 6.4 kg/m²).¹⁴ At 95% confidence and 80% power, 69 per group were required. To increase statistical power, ≥ 100 per group was targeted. The final sample comprised 251 participants: 132 males, 119 females; 101 vegetarians, 119 non-vegetarians, and 31 eggetarians.

Participants

Eligible participants were healthy male and female trainees enrolled in B.Sc. (paramedical and nursing) programmes, residing in institutional hostels and consuming regimented mess food for at least six months prior to recruitment to this study. Participant flow included eligibility screening, exclusions with reasons and the final analysed cohort (Figure 1).

Data collection

Dietary assessment

Dietary intake was recorded over three non-consecutive days (two weekdays, one weekend day) using a food diary. Macronutrient composition (carbohydrates, proteins & fats) and caloric values were calculated using the Indian Food Composition Tables (National Institute of Nutrition, 2017) and Microsoft Excel.

Anthropometric indices

Anthropometric and clinical measurements were obtained using standardised procedures to ensure accuracy and reproducibility. Body weight was recorded with participants barefoot and in light clothing to the nearest 0.1 kg using a calibrated digital weighing scale. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer, with the head aligned in the Frankfurt horizontal plane.

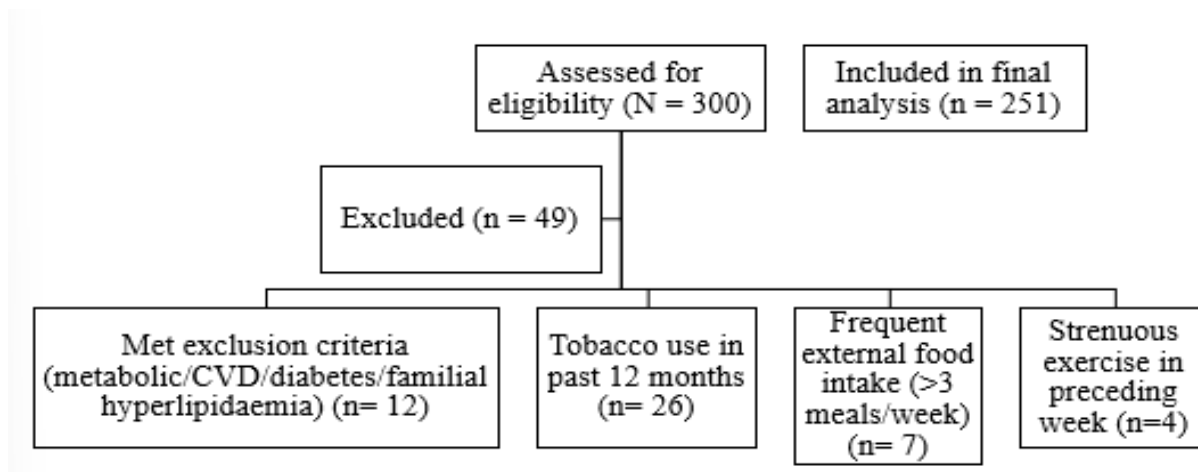


Figure 1: Participant enrolment, exclusion and final sample (n=251).

TSFT was assessed using a Lange skinfold calliper, and the mean of three consecutive readings was calculated for analysis. Waist circumference was measured at the midpoint between the lower rib margin and the iliac crest, while hip circumference was measured at the widest part of the buttocks; the WHR was then derived by dividing waist by hip circumference in MS excel sheet. Blood pressure was assessed using an automated BP monitor, with two readings obtained after five minutes of rest and averaged to minimize measurement variability.

Portion weight estimation

To ensure accurate dietary intake assessment, calibration of serving sizes using standard utensils was performed (Table 1). The weight of food contained in each standard serving utensil were measured with a digital weighing scale. Participants were trained in portion size estimation using these calibrated utensils, supported by visual aids.

Biochemical measurements

Fasting venous blood samples (≥ 8 h) were collected on consented individuals. Lipid profiles (total cholesterol, triglycerides, LDL-C, HDL-C) were analysed using enzymatic colorimetric methods on an Erba XL-640 automated analyser with internal and external quality control.

Statistical analysis

Data were analysed using MS Excel and SPSS version 26. Normality was assessed using the Kolmogorov–Smirnov test. Between-group differences in continuous variables were evaluated using one-way ANOVA, followed by Bonferroni-adjusted post-hoc pairwise comparisons to control for multiple testing. Independent t-tests compared gender differences. Categorical variables were analysed using the Chi-square test. A p value < 0.05 was considered statistically significant.

RESULTS

Participant characteristics

A total of 251 participants were included, comprising 132 males (52.6%) and 119 females (47.4%). The mean age was 23.16 ± 2.11 years, with males being significantly older than females (24.16 ± 2.03 vs. 21.78 ± 1.92 years; $p < 0.05$). All were unmarried and residing in hostels, consuming meals exclusively from a common mess. Dietary preference distribution was as non-vegetarians (47.4%), vegetarians (40.2%), and eggetarians (12.4%) (Figure 2). Mean duration of mess stay was highest among vegetarians (2.3 years) compared to non-vegetarians (2.1 years) and eggetarians (2.0 years).

Gender-based comparisons

Male study participants and females differed significantly in anthropometry, blood pressure, lipid profile, and dietary intake (Table 1). Males had higher BMI, waist circumference, and waist–hip ratio. Mean systolic blood pressure was higher in males (121.86 mmHg vs. 113.01 mmHg, $p < 0.001$). Females study participants exhibited greater triceps skinfold thickness (TSFT). Biochemically, male participants had higher triglycerides, whereas female participants had higher HDL. Dietary intake showed significantly greater carbohydrate, protein, fat, and total caloric intake among male participants (all $p < 0.001$). Female participants, however, derived a higher percentage of energy from fat, whereas males derived more from carbohydrate and protein (Figures 3 and 4).

Dietary preference comparisons

Comparisons across vegetarians, non-vegetarians, and eggetarians revealed significant differences (Table 2). Non-vegetarians had the highest mean BMI, cholesterol, LDL, and triglyceride levels, whereas vegetarians had more favourable lipid profiles. The HDL: TG ratio was significantly higher among vegetarians and eggetarians

compared to non-vegetarians (0.79 vs. 0.66; $p=0.038$). Eggetarians reported the highest protein and fat intake, vegetarians consumed the least protein but the highest proportion of energy from carbohydrates, and non-vegetarians had the highest caloric intake overall (Figures 4 and 5).

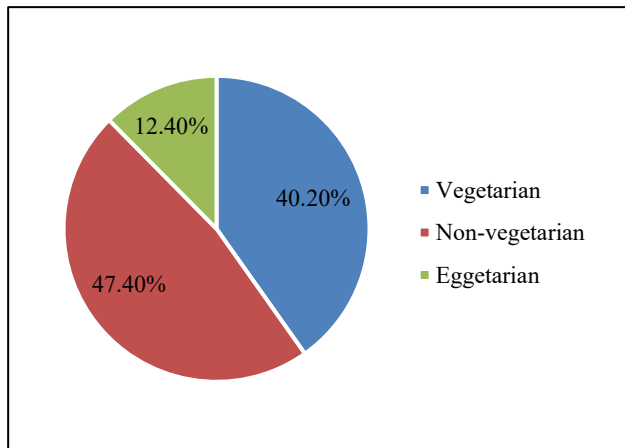


Figure 2: Dietary preference distribution among study participants.

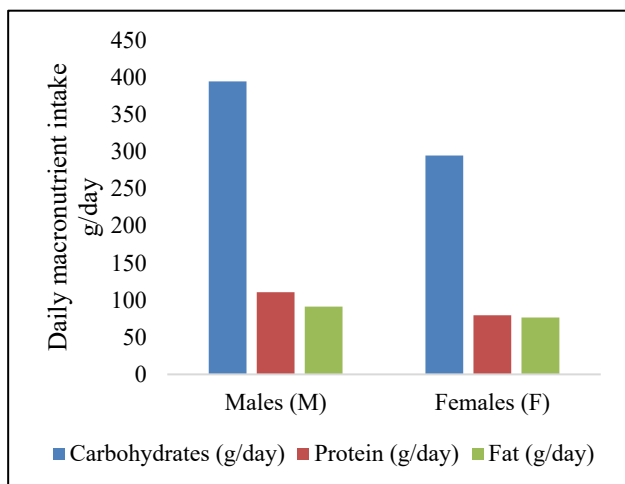


Figure 3: Mean daily macronutrient intake (g/day) by gender.

Post-hoc analysis

Bonferroni-adjusted pairwise comparisons revealed distinct dietary group differences. Non-vegetarians had significantly higher BMI compared to vegetarians ($p=0.01$). Total cholesterol and LDL levels were

markedly elevated in non-vegetarians relative to vegetarians ($p<0.01$), with eggetarians occupying an intermediate position. Triglycerides were also significantly higher in non-vegetarians compared to vegetarians ($p=0.03$). In terms of dietary intake, protein consumption was significantly greater in both non-vegetarians and eggetarians than vegetarians ($p<0.001$). Fat intake was highest among eggetarians, exceeding that of vegetarians ($p=0.02$). Conversely, vegetarians reported significantly higher carbohydrate intake compared to non-vegetarians ($p=0.04$). These findings confirm that dietary preferences are associated with distinct anthropometric and biochemical patterns, even after adjusting for multiple comparisons using the Bonferroni method.

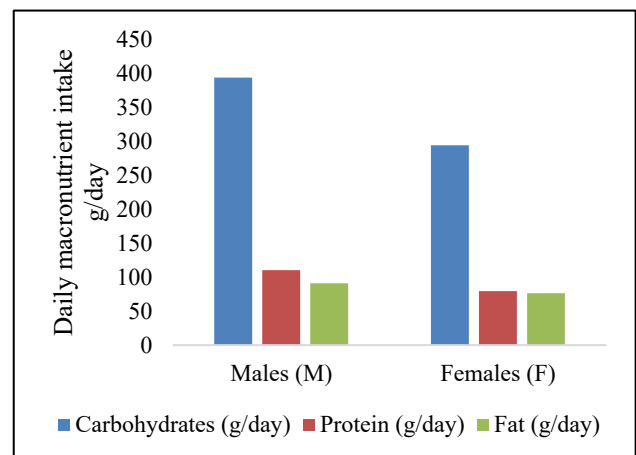


Figure 4: Percentage of energy contribution of carbohydrates, protein, and fat in study participants.

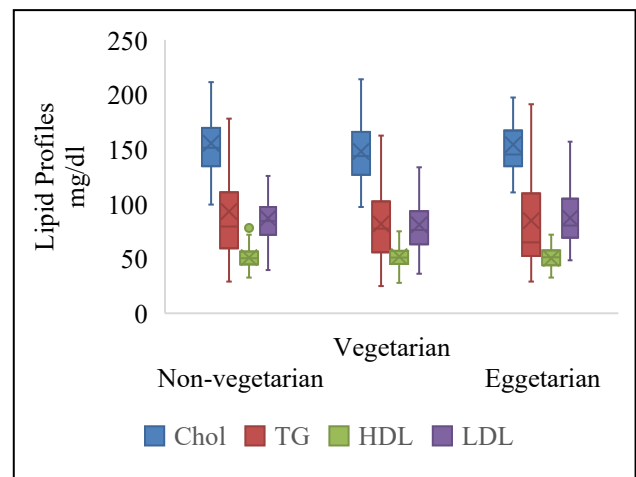


Figure 5: Diet preference and lipid profile parameters.

Table 1: Standardised serving portion weights for mess utensils and food items.

S. no.	Food item (per utensil serving)	Male mess (g)	Female mess (g)
1	Boiled egg (1 piece)	42.55	42.55
2	Bread slice (1 piece)	19.33	19.33
3	Chapati (1 piece)	47.05	47.05

Continued.

S. no.	Food item (per utensil serving)	Male mess (g)	Female mess (g)
4	Rice (1 ladle)	200.00	69.46
5	Dal (1 ladle)	163.44	110.00
6	Mix-Veg (1 ladle)	110.00	110.00
7	Curd (1 bowl)	180.00	180.00
8	Chicken curry (1 bowl)	186.00	186.00

Table 2: Anthropometric, biochemical, and dietary intake differences between males and females (n=251).

S. no.	Variable	Females (n=119) Mean±SD	Males (n=132) Mean±SD	P value
1	Weight (kg)	55.71±6.71	66.35±5.67	0.01
2	Height (cm)	160.17±6.83	172.18±4.47	0.01
3	BMI (kg/m ²)	21.69±2.00	22.38±1.72	0.004
4	Waist-hip ratio	0.82±0.067	0.89±0.055	0.001
5	SBP (mmHg)	113.01±6.85	121.86±5.96	0.001
6	TSFT (mm)	12.45±1.92	10.90±2.34	0.001
7	TG (mg/dl)	70.75±31.13	103.79±45.06	0.001
8	HDL (mg/dl)	53.56±9.12	49.28±7.68	0.001
9	Carbohydrates (g/day)	294.55±41.73	394.34±52.29	0.001
10	Protein (g/day)	79.64±16.37	110.62±20.73	0.001
11	Fat (g/day)	76.60±14.94	91.15±15.40	0.001
12	Total energy (kcal/day)	2186.19±309.41	2840.26±344.84	0.001

Table 3: Differences across dietary preference groups (n=251).

S. no.	Variable	Non-vegetarian (n=119)	Vegetarian (n=101)	Eggetarian (n=31)	P value
1	BMI (kg/m ²)	22.44±1.76	21.71±2.00	21.71±1.70	0.01
2	Cholesterol (mg/dl)	159.74±25.74	143.32±25.52	154.26±32.24	0.001
3	TG (mg/dl)	96.76±46.72	78.99±32.08	84.76±48.48	0.007
4	LDL (mg/dl)	89.68±21.50	78.69±22.46	87.28±27.83	0.02
5	HDL:TG ratio	0.66±0.34	0.79±0.42	0.79±0.41	0.038
6	Carbohydrates (g/day)	356.28±65.93	331.26±67.00	362.88±77.87	0.01
7	Protein (g/day)	104.77±22.29	84.27±22.28	100.00±23.26	0.001
8	Fat (g/day)	87.19±14.60	78.51±17.33	91.68±17.71	0.001
9	Energy (kcal/day)	2628.9±409.2	2676.7±499.1	2368.7±468.6	0.001

DISCUSSION

This cross-sectional study examined the impact of dietary preferences vegetarian, non-vegetarian, and eggetarian on macronutrient intake, anthropometry, and lipid profiles among healthy young adults in a controlled institutional mess environment in Western Maharashtra. The findings demonstrate significant gender-based and diet-based variations in nutritional and biochemical parameters.

Gender-based differences

Males exhibited significantly higher BMI, waist circumference, systolic blood pressure, triglycerides, and total energy intake, while females demonstrated higher HDL cholesterol and a greater proportional fat intake. These findings align with prior studies in Indian and global cohorts, where men showed higher visceral adiposity and triglycerides, while premenopausal women

displayed cardioprotective HDL profiles influenced by estrogen.¹⁵

Dietary preference differences

Vegetarians had the most favourable lipid profiles, with significantly lower total cholesterol and LDL compared to non-vegetarians and eggetarians. Non-vegetarians exhibited higher LDL, triglycerides, and less favourable HDL:TG ratios. Eggetarians, although a smaller subgroup, consumed the highest protein and fat but demonstrated intermediate biochemical outcomes. These trends are consistent with meta-analyses linking plant-based diets to reduced cardiovascular risk.¹⁶

Public health and nutritional implications

The results highlight the potential of mess-based interventions to optimize diet quality. Vegetarian diets

showed cardioprotective benefits, while non-vegetarian diets posed higher lipid-related risks. Given that all groups exceeded protein recommendations, but fat intake was relatively high, particularly among eggetarians and non-vegetarians, moderation of saturated fat and inclusion of fibre-rich foods could mitigate long-term risk. Gender-sensitive interventions are warranted, with emphasis on calorie moderation for males and fat quality education for females.

Strengths

A uniform mess-based setting minimized dietary variability, with objective anthropometric and biochemical assessments enhancing data reliability. Inclusion of the rarely studied eggetarian group adds contextual value.

Limitations

The cross-sectional design limits causal inference, physical activity and micronutrient/ fatty acid intake were not assessed, and the small eggetarian subgroup reduced statistical power for comparisons.

CONCLUSION

This study demonstrates that even in a uniform feeding environment, both dietary preference and gender exert significant influence on nutritional intake and lipid profiles among young, healthy adults. Vegetarians exhibited the most favourable cardiometabolic indicators, with higher HDL-C and lower total cholesterol, LDL-C, and triglycerides. In contrast, non-vegetarians displayed higher LDL-C and triglycerides, coupled with less favourable HDL: TG ratios, while eggetarians characterized by the highest protein and fat consumption showed intermediate outcomes. Gender-based differences were also evident, with males presenting higher BMI, triglycerides, and caloric intake, whereas females demonstrated higher HDL and greater proportional fat intake. Collectively, these findings underscore the role of dietary pattern as an independent determinant of cardiometabolic risk and support the promotion of plant-forward dietary practices within institutional catering systems.

Dietary pattern matters

Even in a uniform mess-based feeding environment, dietary preferences significantly influenced lipid and nutritional profiles.

Vegetarian advantage

Vegetarians showed the most favourable lipid outcomes, including higher HDL-C and lower total cholesterol, LDL-C, and triglycerides.

Intermediate outcomes in eggetarians

Eggetarians consumed the highest protein and fat, with lipid parameters falling between vegetarians and non-vegetarians.

Gender differences

Males had higher BMI, triglycerides, and total caloric intake, whereas females showed higher HDL-C and greater proportional fat intake.

Public health implication

Findings highlight the potential of plant-forward diets in reducing cardiometabolic risk among young adults in institutional settings.

Recommendations

Institutional nutrition policies should emphasize fibre-rich, plant-based foods while limiting saturated fat and cholesterol-laden options in mess menus. Routine health monitoring with annual anthropometric and lipid screenings is recommended to enable early detection and counselling. Targeted dietary counselling is essential males should focus on calorie moderation and balanced macronutrient intake, while females should be encouraged to ensure adequate protein and healthy fat quality. Nutrition education programs must highlight the dietary–lipid link and promote culturally appropriate, cardioprotective diets. Future longitudinal studies are needed to establish causality and evaluate interventions that optimize macronutrient ratios in institutional settings.

Future directions

Longitudinal studies integrating dietary quality, physical activity, and advanced biomarkers (e.g., ApoB, hs-CRP) could strengthen causal understanding. Interventional trials modifying macronutrient ratios in institutional messes are recommended to validate these associations and guide evidence-based dietary policy.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. World Health Organization. Cardiovascular diseases (CVDs). Geneva: WHO. 2023.
2. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. *Lancet*. 2020;395:10226.

3. Tripathy JP, et al. Burden and risk factors of dyslipidemia—results from a national study in India and global context. *Diabetes Metab Syndr*. 2017.
4. Sharma S. Trends in epidemiology of dyslipidemias in India. *Indian Heart J*. 2024;76(4):64.
5. Sacks FM, Lichtenstein AH, Wu JHY, Appel LJ, Creager MA, Kris-Etherton PM, et al. Dietary fats and cardiovascular disease: a presidential advisory from the American heart association. *Circulation*. 2017;136(3):1–23.
6. Harvard TH. Chan School of Public Health. Types of Fat Cutting back on saturated fat while avoiding refined carbohydrates lowers LDL, reduces HDL, and raises triglycerides. *Nutrition Source*. 2024.
7. Koch CA, Zhu JR, et al. Vegetarian and vegan diets are associated with reduced concentrations of total cholesterol, LDL-C, and apolipoprotein B: meta-analysis of randomized controlled trials. *Eur Heart J*. 2023;44(28):2609–17.
8. Ferdowsian HR, Barnard ND. Effects of plant-based diets on plasma lipids: a systematic review. *Am J Cardiol*. 2009;104(7):948–56.
9. Satija A, Hu FB. Plant-based diets and cardiovascular health. *Trends Cardiovasc Med*. 2018;28(7):437–41
10. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004;363(9403):157–63.
11. National Cholesterol Education Program (NCEP) Expert Panel. Third Report of the NCEP Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA*. 2001;285(19):2486–97.
12. Koch CA, Abbas KE, Huang J-C, Jové M, Griffin BT, Beckmann N, et al. Vegetarian and vegan diets are associated with reduced concentrations of total cholesterol, low density lipoprotein cholesterol, and apolipoprotein B: meta-analysis of randomized controlled trials. *Eur Heart J*. 2023;44(28):2609–17.
13. Shridhar K. Influence of vegetarian diets on serum lipid profiles in an Indian population: mixed findings in observational studies. *Int J Lipid Sci Technol*. 2014;2(1):45–52.
14. Rizzo NS, Jaceldo-Siegl K, Sabaté J, Fraser GE. Nutrient profiles of vegetarian and nonvegetarian dietary patterns: Findings from the Adventist Health Study-2. *J Acad Nutr Diet*. 2013;113(12):1610–9.
15. Steiner BM, Kimler BF. The regulation of adipose tissue health by estrogens. *Front Endocrinol (Lausanne)*. 2022;13:889923.
16. Koch CA, Abbas KE, Huang JC, Jové M, Griffin BT, Beckmann N, et al. Vegetarian and vegan diets are associated with reduced concentrations of total cholesterol, low-density lipoprotein cholesterol, and apolipoprotein B: meta-analysis of randomized controlled trials. *Eur Heart J*. 2023;44(28):2609–17.

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