

Research Article

Comparative Study of Lipid Profile in Reproductive-Age and Postmenopausal Women

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ABSTRACT

Background: Menopause is accompanied by physiological and metabolic changes that may adversely affect lipid metabolism and cardiovascular risk.

Objective: To compare fasting serum lipid parameters and selected cardiovascular risk indicators between reproductive-age and postmenopausal women.

Methods: A hospital-based cross-sectional comparative observational study was conducted at Shyam Shah Medical College and associated hospitals, Rewa, from May 2024 to September 2025. Four hundred women were studied: 200 reproductive-age women and 200 postmenopausal women. Clinical, anthropometric, and fasting biochemical parameters were assessed. Total cholesterol (TC), triglycerides (TG), and HDL-C were measured by standard enzymatic methods; LDL-C and VLDL-C were calculated using Friedewald's formula where applicable.

Results: Dyslipidemia was significantly more prevalent among postmenopausal women (66.0%) than reproductive-age women (39.0%, $p < 0.001$). Mean TC, TG, LDL-C, and VLDL-C were higher, and HDL-C was lower, in postmenopausal women. Atherogenic ratios and moderate/high cardiovascular-risk categories were also more frequent after menopause.

Conclusion: In this study population, postmenopausal status was associated with a significantly more atherogenic lipid profile and greater cardiometabolic risk.

Keywords: Menopause, Lipid Profile, Dyslipidemia, HDL-C, LDL-C, Triglycerides, Cardiovascular Risk, Women.

Highlights

- 400 women were studied, equally divided between reproductive-age and postmenopausal groups.
- Dyslipidemia prevalence was 66% in postmenopausal women versus 39% in reproductive-age women.
- Postmenopausal women had higher TC, TG, LDL-C, and VLDL-C, and lower HDL-C.
- Atherogenic ratios and moderate/high cardiovascular-risk categories were higher after menopause.

INTRODUCTION

Menopause represents an important physiological transition in a woman's life and is characterized by cessation of ovarian reproductive function and a sustained decline in estrogen exposure. The transition is accompanied by changes in body composition, fat distribution, vascular physiology, and

metabolic regulation. These changes may alter the lipid profile and contribute to a more atherogenic cardiovascular risk pattern. During reproductive years, women generally show a comparatively favorable lipid profile. With advancing age and menopause, total cholesterol, triglycerides, and LDL cholesterol may rise, while HDL cholesterol may decline or

become less protective. These changes are clinically relevant because cardiovascular disease is a major cause of morbidity and mortality in women, and midlife provides an important opportunity for prevention and risk-factor modification.

Rationale of the Study

The menopausal transition is a period in which several cardiovascular risk factors may converge. The present thesis evaluated lipid profile together with anthropometric and blood-pressure parameters, allowing the lipid findings to be interpreted in a broader physiological context.

Clinical Relevance

Identification of an adverse lipid pattern during midlife may permit earlier recognition of modifiable cardiovascular risk. The present study focuses on measurable physiological and biochemical differences between reproductive-age and postmenopausal women in the study setting.

Research Question

Is menopausal status associated with differences in fasting serum lipid profile and selected cardiovascular-risk indicators among women attending the study center?

REVIEW OF LITERATURE

The literature review identified consistent observations across several studies. Inaraja et al. reported lipid-profile changes during the menopausal transition, with higher atherogenic lipids after menopause. Park et al. documented substantial lipid increases during the menopausal transition in middle-aged women. Lou et al. examined years since menopause and found progressive variation in lipid parameters with increasing duration after menopause. Li et al. synthesized evidence regarding HDL-C and menopause. Other studies, including work by Chaudhry et al., Jain et al., Berad et al., Mallick et al., and Shivwani et al., similarly described higher TC, TG, and LDL-C and lower HDL-C in postmenopausal women. The literature therefore supports the rationale that menopause is associated with an adverse lipid phenotype and potentially greater cardiovascular risk. The present study was undertaken to examine this relationship in women attending a tertiary-care center in Rewa.

Physiological Basis

Estrogen decline is discussed as an important mechanism linking menopause with altered

lipid metabolism. The observed pattern — higher TC, TG, LDL-C, and VLDL-C with lower HDL-C — provides a physiological framework for understanding the increased atherogenic burden observed in the postmenopausal group.

Evidence Summarized

- Inaraja et al. described lipid-profile changes during the menopausal transition.
- Park et al. reported substantial lipid increases during menopausal transition.
- Lou et al. reported variation in lipid parameters according to years since menopause.
- Li et al. examined the association between HDL-C levels and menopause.
- Several Indian and international studies reported higher TC, TG, and LDL-C and lower HDL-C after menopause.

Knowledge Gap

This study provides a local hospital-based assessment from Rewa, Madhya Pradesh, comparing reproductive-age and postmenopausal women using lipid profile, anthropometry, and cardiovascular risk indicators.

Aim and Objectives

To compare the lipid profile between women of reproductive age and postmenopausal women, and to assess the association of menopausal status with dyslipidemia and cardiovascular risk indicators.

1. To compare serum total cholesterol, triglycerides, HDL-C, LDL-C, and VLDL-C between the two study groups.
2. To assess the prevalence of dyslipidemia in reproductive-age and postmenopausal women.
3. To compare anthropometric and blood-pressure parameters between the groups.
4. To assess atherogenic ratios and cardiovascular-risk categories in the two groups.
5. To examine the relationship of age and BMI with selected lipid parameters.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, cross-sectional comparative observational study conducted in the Department of Physiology in collaboration with the Department of Medicine, Shyam Shah Medical College, Rewa, and associated hospitals. The study period extended from May 2024 to September 2025. Participants were

screened from outpatient and inpatient services and enrolled after written informed consent.

Study Population and Grouping

A total of 400 women were included, with 200 women in the reproductive-age group and 200 postmenopausal women. Reproductive-age participants were aged 21-45 years.

Postmenopausal participants were aged 45-65 years and had at least 12 consecutive months of amenorrhea. Women meeting relevant exclusion criteria, including major chronic disease and lipid-lowering therapy, were excluded. Hormone replacement therapy was an exclusion criterion for the postmenopausal group.

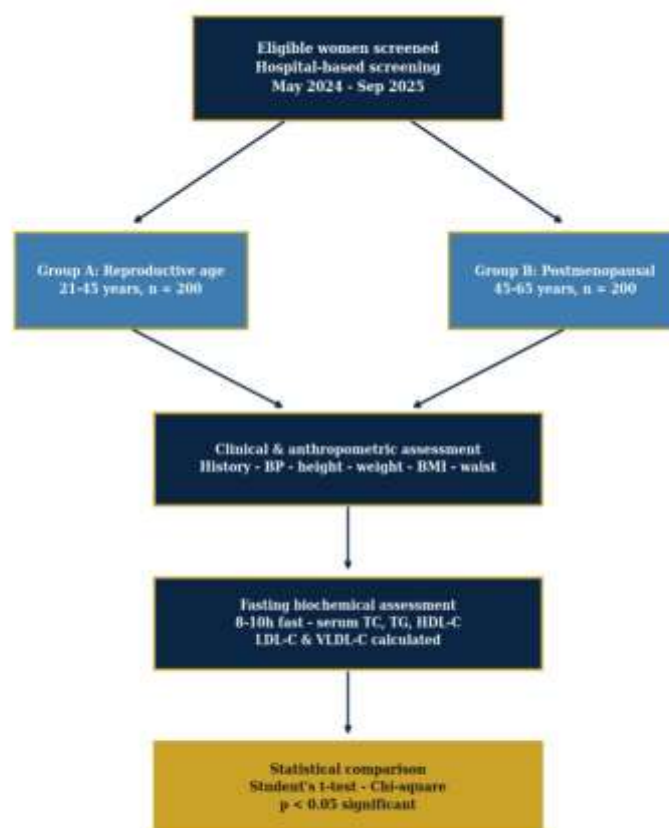


Figure 1. Study Design and Workflow

Clinical and Anthropometric Assessment

A structured proforma was used to collect demographic and clinical information, including residence, dietary habits, physical activity, and relevant medical history. Height was measured using a stadiometer and weight using a calibrated digital weighing scale. BMI was calculated as weight in kilograms divided by height in meters squared. Waist circumference was measured using a standardized anatomical landmark. Blood pressure was measured in the sitting position after at least five minutes of rest; two readings were obtained five minutes apart and averaged for analysis.

Biochemical Assessment

Participants underwent overnight fasting for 8-10 hours. Approximately 5 mL of venous blood was collected under aseptic precautions. Serum was separated after clotting and centrifugation. TC, TG, and HDL-C were analyzed by standard enzymatic methods on an automated biochemistry analyzer. LDL-C and VLDL-C were calculated using Friedewald's formula where applicable. Data were entered into a predesigned master chart and cross-checked for transcription errors.

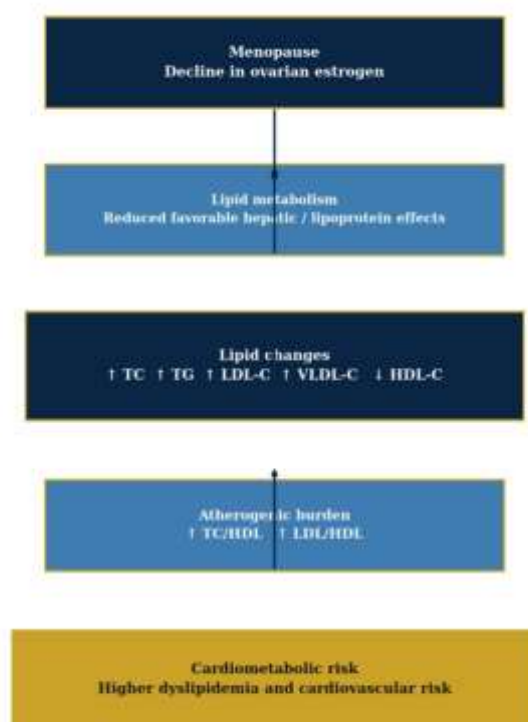


Figure 2. Conceptual Pathway Linking Menopause to an Atherogenic Lipid Profile.

Statistical Analysis and Ethics

Data were entered into Microsoft Excel and analyzed using SPSS version 20. Continuous variables were expressed as mean $\pm$ SD and categorical variables as frequency and percentage. Continuous variables were compared using the independent Student's t-test and categorical variables using the chi-square test. Correlation analysis was used for relationships between age/BMI and lipid parameters. A p-value <0.05 was considered statistically significant. Participants provided informed written consent, and confidentiality was maintained throughout the study.

Outcome Measures

Primary outcome: comparison of fasting serum TC, TG, HDL-C, LDL-C, and VLDL-C between

reproductiveage and postmenopausal women. Secondary outcomes included dyslipidemia prevalence, anthropometric measures, blood pressure, atherogenic ratios, and cardiovascular-risk categories.

RESULTS

Participant Characteristics

Four hundred women were included with equal group allocation. The reproductive-age group had a mean age of 33.41 ± 7.16 years, while the postmenopausal group had a mean age of 54.98 ± 6.16 years. Reproductive-age women were mainly represented in the 21-30 and 31-40 year categories, whereas postmenopausal participants were represented in the 45-55 and 56-65 year categories.

Table 1. Anthropometric and Blood-Pressure Comparison

Parameter	Reproductive Age	Postmenopausal	p-value
Weight (kg)	58.18 ± 7.70	65.47 ± 9.83	<0.0001
BMI (kg/m ²)	22.69 ± 2.33	28.56 ± 2.63	<0.0001
Waist circumference (cm)	78.90 ± 5.66	98.18 ± 7.90	<0.0001
SBP (mmHg)	111.95 ± 7.60	140.65 ± 11.94	<0.0001

DBP (mmHg)	72.65 ± 4.39	87.63 ± 4.96	<0.0001
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Postmenopausal women showed greater adiposity. Mean weight was 65.47 ± 9.83 kg compared with 58.18 ± 7.70 kg in reproductive-age women. Mean BMI was 28.56 ± 2.63 kg/m² versus 22.69 ± 2.33 kg/m², and waist circumference was 98.18 ± 7.90 cm versus 78.90 ± 5.66 cm. These differences were statistically highly significant. Mean SBP and DBP were also higher in postmenopausal women: 140.65 ± 11.94 and 87.63 ± 4.96 mmHg compared with 111.95 ± 7.60 and 72.65 ± 4.39 mmHg, respectively (both p<0.0001).

Dyslipidemia Prevalence

Dyslipidemia was present in 66.0% of postmenopausal women compared with 39.0% of reproductive-age women (p<0.001). Higher proportions of elevated total cholesterol, triglycerides, LDL-C, and VLDL-C, and a higher prevalence of low HDL-C, were observed in postmenopausal women. Raised triglycerides (≥150 mg/dL) were more common in postmenopausal women, while normal triglyceride values were more common in the reproductive-age group.

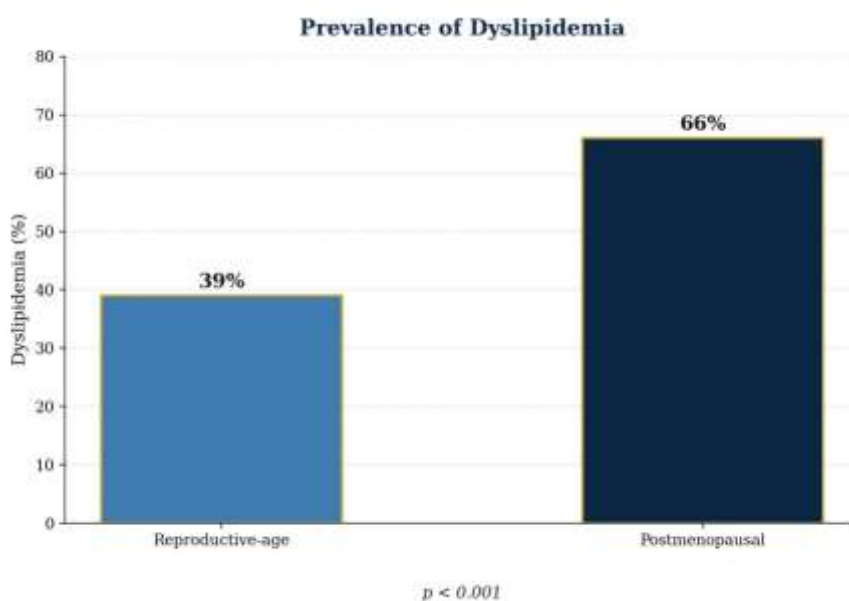


Figure 3. Prevalence of Dyslipidemia.

Mean Lipid Profile

The principal lipid comparison demonstrated a more atherogenic profile among postmenopausal women. Mean TC was 214.8 ± 36.5 mg/dL compared with 186.4 ± 32.1 mg/dL; TG was 176.9 ± 56.4 versus 142.6 ±

48.2 mg/dL; LDL-C was 136.2 ± 34.1 versus 112.8 ± 28.6 mg/dL; and VLDL-C was 35.3 ± 11.2 versus 28.5 ± 9.6 mg/dL. HDL-C was lower in postmenopausal women (46.1 ± 7.9 versus 52.3 ± 8.4 mg/dL). All differences were statistically significant at p<0.001.

Table 2. Comparative Fasting Lipid Profile (Mean ± SD, mg/dL)

Parameter	Reproductive Age	Postmenopausal	p-value
TC (mg/dL)	186.4 ± 32.1	214.8 ± 36.5	<0.001
TG (mg/dL)	142.6 ± 48.2	176.9 ± 56.4	<0.001
HDL-C (mg/dL)	52.3 ± 8.4	46.1 ± 7.9	<0.001
LDL-C (mg/dL)	112.8 ± 28.6	136.2 ± 34.1	<0.001
VLDL-C (mg/dL)	28.5 ± 9.6	35.3 ± 11.2	<0.001

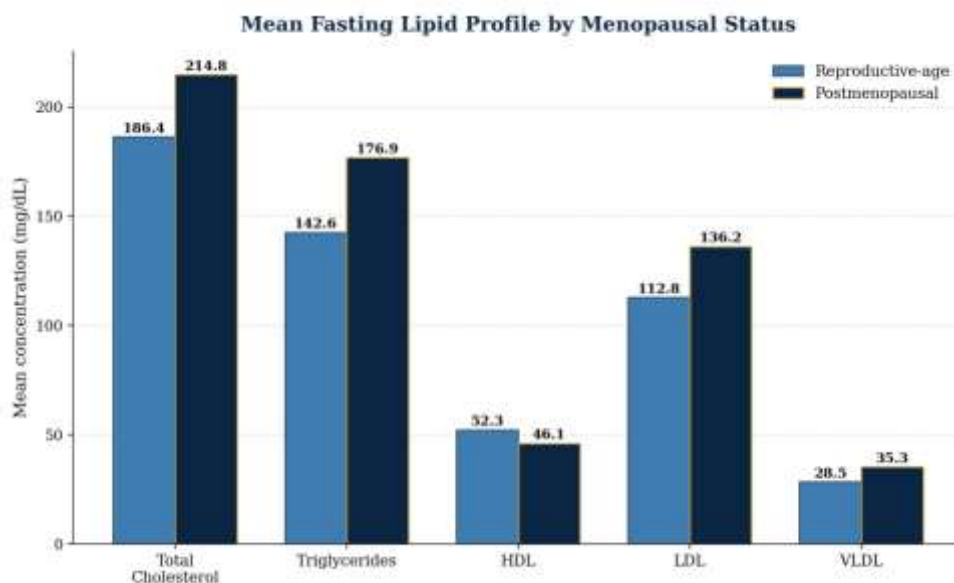


Figure 4. Mean Fasting Lipid Profile by Menopausal Status

Atherogenic Ratios and Cardiovascular Risk

Atherogenic ratios were significantly higher in postmenopausal women. TC/HDL was 4.7 ± 1.1 compared with 3.6 ± 0.8 , and LDL/HDL was 3.0 ± 0.9 compared with 2.1 ± 0.6 ($p < 0.001$).

Low cardiovascular risk accounted for 32.0% of postmenopausal women compared with 56.0% of reproductive-age women. Moderate risk accounted for 37.0% versus 28.0%, and high risk for 31.0% versus 16.0%, respectively ($p < 0.001$).

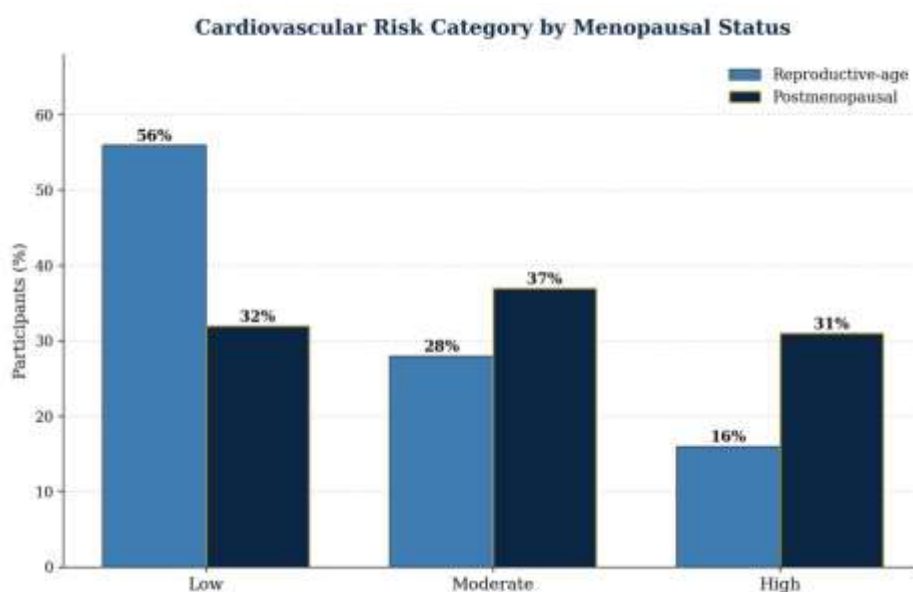


Figure 5. Cardiovascular-Risk Categories by Menopausal Status.

Correlation Analysis

Age showed positive correlations with TC ($r = 0.42$), TG ($r = 0.38$), and LDL-C ($r = 0.44$), while HDL-C showed a negative correlation ($r = -$

0.31). BMI also showed positive correlations with TC ($r = 0.46$), TG ($r = 0.41$), and LDL-C ($r = 0.48$), and a negative correlation with HDL-C ($r = -0.35$).

Table 3. Correlation of Age and BMI with Lipid Parameters

Predictor	TC	TG	LDL-C	HDL-C
Age	$r = 0.42$	$r = 0.38$	$r = 0.44$	$r = -0.31$
BMI	$r = 0.46$	$r = 0.41$	$r = 0.48$	$r = -0.35$

Duration since Menopause

Among postmenopausal women, mean TC increased progressively with duration since menopause, from 206.4 ± 32.8 mg/dL in

women with <5 years since menopause, to 218.6 ± 34.1 mg/dL at 5-10 years, and 228.2 ± 36.9 mg/dL after >10 years ($p < 0.01$).

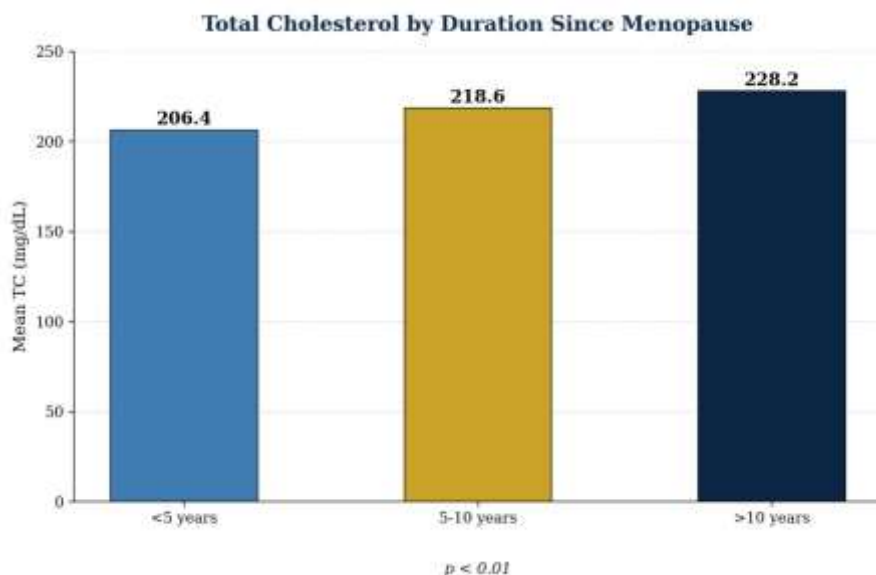


Figure 6. Progressive Increase in Mean Total Cholesterol With Duration Since Menopause.

DISCUSSION

The present study demonstrates a clear association between postmenopausal status and an adverse lipid profile. The direction and magnitude of the findings are broadly consistent with the studies summarized in the literature review. One important observation is the simultaneous presence of higher adiposity, blood pressure, and atherogenic lipids in postmenopausal women. This clustering suggests that menopause should be considered in the broader context of cardiometabolic risk rather than as an isolated lipid abnormality. The lower HDL-C and higher LDL-C, TG, and VLDL-C observed in postmenopausal women provide a physiologically coherent pattern of increased atherogenic burden. The higher TC/HDL and LDL/HDL ratios further reinforce this interpretation.

The correlation findings indicate that age and BMI were associated with the lipid changes. Because age, adiposity, and menopause are interrelated, the cross-sectional design cannot determine the independent contribution of each factor. The progressive increase in TC with increasing years since menopause is nevertheless compatible with the pattern described in the literature review. From a clinical perspective, the menopausal transition may therefore represent a useful point for systematic cardiovascular-risk assessment,

including measurement of lipid profile, blood pressure, body weight, and waist circumference. The study supports preventive attention to lifestyle and modifiable cardiovascular risk factors in midlife women.

Comparison with Previous Studies

The direction of the present findings is consistent with the evidence summarized in the literature review. Studies cited repeatedly reported higher TC, TG, and LDL-C and lower HDL-C among postmenopausal women. The present study also demonstrated higher atherogenic ratios and greater representation in moderate/high cardiovascular-risk categories.

Physiological Interpretation

The findings suggest an interaction between menopausal status, age, and adiposity. The higher BMI and waist circumference in the postmenopausal group may contribute to the lipid abnormalities, while the menopausal transition itself is physiologically relevant to the observed shift in lipid metabolism. Because the design is cross-sectional, these factors cannot be separated causally.

CONCLUSION

Postmenopausal women in this study had a significantly more atherogenic lipid profile than

reproductive-age women. Dyslipidemia was more prevalent, TC, TG, LDL-C, and VLDL-C were higher, HDL-C was lower, atherogenic ratios were increased, and moderate/high cardiovascular-risk categories were more frequent. These findings support the importance of cardiovascular risk assessment and lipid screening during and after the menopausal transition, together with appropriate lifestyle-based preventive strategies.

Limitations

The study was cross-sectional and therefore cannot establish a causal relationship between menopause and lipid abnormalities. It was conducted at a single tertiary-care center, which may limit generalizability. Serum estrogen and other reproductive hormones were not measured. Detailed dietary intake, physical activity, and genetic predisposition were not evaluated in depth. These limitations should be considered when interpreting the observed associations.

Practical Implications

- Menopausal transition may be considered an appropriate period for cardiovascular-risk assessment.
- Fasting lipid profile, blood pressure, BMI, and waist circumference can be assessed together to identify clustering of risk factors.
- Lifestyle modification and appropriate management of identified cardiovascular risk factors may be particularly relevant in midlife women.
- Longitudinal and multicentric studies with hormonal profiling are needed to clarify causal mechanisms.

Future Research

Future studies may incorporate estrogen and other hormonal measurements, detailed dietary and physical-activity assessment, insulin-resistance indices, and inflammatory markers. Longitudinal designs would help distinguish the effects of chronological aging from those associated specifically with menopause.

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