

Effect of diet and body mass index on the serum lipid profile in healthy premenopausal, perimenopausal, and postmenopausal tribal women of India

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ABSTRACT


Background: The serum lipid profile in premenopausal and perimenopausal/postmenopausal women gets deranged not only due to hormonal changes in different patterns of menstrual cycle but also due to body mass index (BMI) and dietary influence. **Objective:** The objective of this study was to determine the effect of BMI and dietary influence in serum lipid profile in among groups of premenopausal and perimenopausal/postmenopausal women. **Materials and Methods:** A hospital-based study was carried out on total ($n = 161$) healthy women in different phases of menstrual cycle. **Results:** Dietary factor has not any influence on the lipid profile in these women and BMI has got an effect to a lesser extent on lipid profile in postmenopausal group. **Conclusions:** Dietary habits and BMI status do not influence the serum lipid levels as most of the women belonged to low socioeconomic status, subsiding on fiber-rich diet and being more physically active.

KEY WORDS: Body Mass Index; Diet; Perimenopausal; Postmenopausal; Tribal Women

INTRODUCTION

Menopause is a natural event in the aging process of a woman and signifies the end of reproductive years with cessation of cyclic ovarian functions as manifested by cyclic menstruation. It is heralded by the menopausal transition, a period when the endocrine, biological, and clinical features of approaching menopause begin.^[1] The average age of menopause is 51 years and <1% of women experience it before the age of 40 years with some women undergoing premature menopause at a very early age, affecting their ability to have children.^[2] Menopause is an estrogen-deficient state, but unlike another hormone deficient state, it is not a disease.^[3]

The studies have shown an association between body mass index (BMI) and triglycerides (TGs) and the association between lipid profile and body fat distribution had been much discussed during the past decades. Both lipid profile and body fat have been shown to be the important predictors for metabolic disturbances including dyslipidemia, hypertension, diabetes, cardiovascular diseases, and hyperinsulinemia.^[4,5] A meta-analysis study has shown that low-fat diet was efficacious in reducing total cholesterol (TC), high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL) in premenopausal women but did not significantly reduce the same outcome in postmenopausal women.^[6] There are variations in lipid levels obtained in different individual women based on race, age, obesity, exercise, smoking, alcohol, diet diseases like hypertension, chronic liver and renal diseases.^[7,8] Furthermore, researchers do not agree whether greater adiposity and adverse metabolic changes should be explained to a greater extent by menopausal status and changes in the hormone balance related to it, or perhaps, they are rather an independent effect of age.^[9,10] However, in the

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present study, the above confounding variables have been excluded, and thus, the effect of diet and BMI on serum lipid levels in healthy women of age 19–50 years has been studied.

Despite the extensive research on the effects of estrogens and progestagens on lipid and lipoprotein metabolism, it is not yet clear whether changes in sex steroid concentration are related to changes in lipid concentration which are associated with menopausal status.^[11,12] Our study aimed to establish the differences in lipid status in healthy women who were in perimenopause/postmenopausal and in women who underwent regular menstruation with reference to BMI status and dietary influence.

As life expectancy is increasing in terms of age in women and menopause remains relatively unchanged, so women are now spending more of their life in the postmenopause period. 60 million women in India are above the age of 55 years.^[13] It is, therefore, important to know all menopause-related diseases including lipid derangements of the women so necessary action can be taken for their healthy life in or after menopause.

The tribal population constitutes 8.6% of the total population of India.^[14] These tribal groups reside in varying ecological and geoclimatic conditions with different socioeconomic and occupational background which can influence their health and nutritional status.^[15] According to census 2011, Jharkhand is a state in Eastern India, carved out of the southern part of Bihar on November 15, 2000, and it is the homeland of the tribals who had dreamed of a separate state for a long time. Our study is an effort to reveal the effects of diet and BMI on lipid profile and also to find the predictors of hypertriglyceridemia in a small sample of women in the various patterns of a menstrual cycle.

Objectives

The objectives of this study were as follows:

- a. To see the association of dietary pattern and BMI on serum lipid profile in premenopausal and perimenopausal/postmenopausal women.
- b. To know about the predictors of hypertriglyceridemia in these women.

MATERIALS AND METHODS

Study Design

This was a hospital-based cross-sectional study.

Study Area

Females are attending indoor and outdoor outpatient department (OPD) of Medicine and Gynaecology Department of Rajendra Institute of Medical Sciences (RIMS), Jharkhand, India.

Sampling Technique

Every healthy female attendant in the age group of 19–50 years accompanying with the patients attending indoor and outdoor OPD has been taken for the study purpose.

Study Subjects

Healthy female attendants in the age group of 19–50 years accompanying with the patients attending indoor and outdoor OPD of Medicine and Gynaecology Department of RIMS were included in the study.

Study Period

The study duration was 12 months.

Study Tools

Lipid profile determination was done using enzymatic methods in the department of physiology of the same institute. Information on sociodemographic characteristics such as age, anthropometric such as height, weight, and BMI, menstrual pattern, dietary habits, and addiction were obtained on the pretested questionnaire. Weight was measured to the nearest 0.1 kg in light clothing and standing barefoot using a well-calibrated balance scale. Height was measured to the nearest using a wooden meter fixed on the wall while the subject was standing relaxed, barefoot and heels together touching the wall. BMI was calculated as weight in kg divided by height in meters squared as indicated by the World Health Organization.^[16]

Statistical Analysis

The data were collected, tabulated and analyzed using percentages. Data were described using the mean and standard deviation for the significant differences between groups. Student's *t*-test was used to compare the differences of lipid profile between normal and overweight and vegetarian and non-vegetarian groups of premenopausal and perimenopausal/postmenopausal women. Binary logistic regression was used to evaluate the predictors of hypertriglyceridemia using forward likelihood ratio (LR) method. All statistical tests were considered statistically significant in $P < 0.05$. The results were analyzed using the Statistical Package for the Social Sciences (version 21).

RESULTS

There is no significant difference found in the mean values of serum lipid profile in vegetarian versus non-vegetarian groups of premenopausal and perimenopausal/postmenopausal women [Table 1].

The significant difference is not observed in the mean values of lipid fractions in normal versus overweight groups of perimenopausal/postmenopausal women. To see the

quantitative association of BMI and lipid profile, there were $n = 3$ women in the premenopausal group and $n = 1$ in the perimenopausal group who were underweight, and these have been excluded at the time of analysis [Table 2].

Taking normal weight groups of women, it was found higher significant mean values of varied lipid fractions in postmenopausal women [Table 3].

Taking overweight groups of women, the significant higher mean values of varied lipid fractions of LDL, HDL, and aromatase inhibitor (AI) are seen in postmenopausal women [Table 4].

On using forward LR method, the predictors not included in the model are a dietary pattern, addiction habit, age, and BMI. The

R^2 value of the model is 0.335. The model is not good as only 33.5% variation in the dependent variable (hypertriglyceridemia) is explained by the predictor variable that is menstrual cycle pattern. Rest predictors are removed on running forward LR method. Only total $n = 12$ women in the study were addicted to tobacco smoking [Table 5].

DISCUSSION

To remove the effect of hormonal changes on lipid profile, we have stratified the premenopausal and perimenopausal/postmenopausal groups of women at the level of dietary intake and also as per their BMI status. On stratification, it was revealed that the dietary factor and

Table 1: Comparison of serum lipid profile in vegetarian/non-vegetarian groups of premenopausal versus perimenopausal/postmenopausal women

Phase	Diet type	TC	TG	VLDL	LDL	HDL	AI (TC/HDL)
		Mean (SD)	mean (SD)	mean (SD)	mean (SD)	mean (SD)	mean (SD)
Premenopausal	Vegetarian - 40	134.3 (30.3)	98.6 (28.4)	19.6 (5.6)	66.7 (24.2)	47.9 (8.8)	2.8 (0.6)
	Non-vegetarian - 58	145.6 (28.6)	109.4 (32.7)	22.3 (7.2)	74.9 (20.4)	50.9 (8.0)	2.9 (0.5)
	<i>P</i> value	0.063	0.094	0.054	0.073	0.073	0.265
Perimenopausal/ postmenopausal	Vegetarian - 14	33.9 (9.1)	151.9 (68.1)	30.4 (13.6)	90.5 (29.4)	37.6 (5.3)	4.2 (0.8)
	Non-vegetarian - 49	63.9 (9.1)	144.5 (52.6)	29.2 (10.7)	119.6 (63.1)	40.3 (6.7)	4.7 (1.6)
	<i>P</i> value	0.084	0.669	0.731	0.100	0.174	0.304

HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, SD: Standard deviation, TC: Total cholesterol, VLDL: Very low-density lipoprotein, TGs: Triglycerides

Table 2: Comparison of serum lipid profile in normal/overweight groups of premenopausal versus perimenopausal/postmenopausal women

Phase	BMI (kg/m ²)	TC	TG	VLDL	LDL	HDL	AI
		mean (SD)	mean (SD)	mean (SD)	mean (SD)	mean (SD)	mean (SD)
Premenopausal	Normal - 93	142.3 (27.7)	105.5 (25.0)	21.2 (5.0)	72.7 (21.1)	49.8 (7.9)	2.8 (0.5)
	Overweight - 2	160 (36.7)	177.0 (115.9)	39.0 (28.2)	71.0 (26.8)	57.5 (13.4)	3.2 (0.9)
	<i>P</i> value	0.279	0.544	0.537	0.910	0.183	0.361
Perimenopausal/ postmenopausal	Normal - 36	175.4 (75.7)	141.5 (59.4)	28.2 (11.8)	108.8 (73.2)	38.6 (6.5)	4.5 (1.8)
	Overweight - 26	194.8 (20.5)	155.6 (49.4)	31.7 (10.1)	121.0 (27.6)	41.4 (6.0)	4.6 (0.7)
	<i>P</i> value	0.207	0.326	0.234	0.422	0.088	0.712

BMI: Body mass index, HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, TC: Total cholesterol, VLDL: Very low-density lipoprotein, TGs: Triglycerides

Table 3: Lipid levels in premenopausal and perimenopausal/postmenopausal women in normal weight groups of women ($n=129$)

Lipid fractions	Premenopausal ($n=93$) mean (SD)	Perimenopausal/postmenopausal ($n=36$) mean (SD)	<i>P</i> value
TC	144.2 (23.5)	175.4 (75.7)	0.020
TG	105.5 (25.0)	141.5 (59.4)	0.001
VLDL	21.2 (5.1)	28.2 (11.8)	0.001
LDL	72.7 (21.1)	108.8 (73.2)	0.001
HDL	49.8 (7.9)	38.6 (6.5)	0.001
AI (TC/HDL)	2.8 (0.5)	4.5 (1.8)	0.001

TC: Total cholesterol, HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, VLDL: Very low-density lipoprotein, TGs: Triglycerides

Table 4: Lipid levels in premenopausal and perimenopausal/postmenopausal women in overweight groups of women ($n=28$)

Lipid fractions	Premenopausal ($n=2$) mean (SD)	Perimenopausal/postmenopausal ($n=26$) mean (SD)	<i>P</i> value
TC	164.0 (36.7)	194.8 (20.6)	0.061
TG	177.0 (115.9)	155.6 (49.4)	0.591
VLDL	39.0 (28.2)	31.7 (10.1)	0.392
LDL	71.0 (26.8)	121.0 (27.6)	0.021
HDL	57.5 (13.4)	41.4 (6.0)	0.002
AI (TC/HDL)	3.2 (0.9)	4.6 (0.7)	0.021

TC: Total cholesterol, HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, VLDL: Very low-density lipoprotein, TGs: Triglycerides

Table 5: Assessment of predictors of hypertriglyceridemia among the women in the study

Predictor	Phase	Hypertriglyceridemia		Unadjusted odds ratio	<i>P</i> value
		Present (≥ 150 mg/dl)	Absent (< 150 mg/dl)		
Women in different menstrual cycle pattern	Premenopausal	6	92	1	
	Perimenopausal	2	14	2.190	0.365
	Postmenopausal	24	23	16.0	0.001

BMI status have no influence on the mean values of varied lipid fractions in premenopausal as well as perimenopausal/postmenopausal groups of women. It means as the women advance toward peri/postmenopausal, the established fact of deranged lipid profile is observed.

Dietary composition seems to affect the lipid profile in women. More than 50% of postmenopausal women in a study in Nigeria found that were observed to consume a lot of calorie-rich food and high cholesterol diets, and this may contribute to their abnormal lipid profile.^[17] In the present study, the almost similar pattern of lipid profile in both vegetarian and non-vegetarian of healthy women was found. In non-vegetarian population, all components of the lipid profile and an even atherogenic index are slightly increased, but the increase is not statistically significant. This is because the study population belonged to the low socioeconomic group and they take mostly complex carbohydrate and fiber, which has a friendly effect on lipid profile. Even the non-vegetarian women take non-vegetarian only occasionally. They also spend a physically active life. The findings of the present study are similar to the findings of Goswami and Bandyopadhyay,^[18] and Durgawale *et al.*,^[19] who found no difference or a minor difference in lipid profile with dietary pattern, respectively.

In the current study, no significant association of diet and lipid profile was observed in premenopausal and perimenopausal/postmenopausal women. This finding is in contrast to the meta-analysis study of randomized controlled trials which concluded that a low-fat diet is efficacious in lowering the concentrations of TC, HDL, and LDL and while similar finding was seen for TGs and AI in the same meta-analysis

study.^[6] The same disagreement finding is also seen in another study which reported that healthy postmenopausal female vegetarians, not on hormone therapy, had lower TC, LDL, and TG.^[20] Furthermore, a study by Huang *et al.*^[21] inclusive of 2397 premenopausal and 1195 postmenopausal women, significant associations were found between vegetarian diets and lipid profiles in premenopausal than postmenopausal women. However, our study has recruited few women in various phases of menstrual cycle pattern, and hence, no significant association of diet and lipid profile was seen neither in premenopausal and nor in premenopausal/postmenopausal women.

Regarding the effect of BMI on serum lipid levels in young healthy women, BMI does not have a significant role in the lipid profile since in the present study women were within normal range of BMI, that is, 18.5–24.99 kg/sqmt. This finding is in disagreement with the study which reported an association of lipid profiles with obesity and BMI.^[5,22] In the current study, the prevalence of overweight in these tribal women was found to be 24.8% (40/161). While in a survey carried out by the National Nutrition Monitoring Bureau in tribal areas, the prevalence of overweight and obesity among tribal women was 3.2%.^[23]

The changes in the hormone status after menopause such as low estrogen and increase luteinizing hormone and follicular-stimulating hormone exert significant effect on plasma lipids lipoprotein metabolism in postmenopausal women. This finding is in accordance with the study where the authors have shown significantly high serum levels of TC, LDL, very LDL (VLDL), and TG and significantly low levels of serum HDL in postmenopausal women group in comparison

to their premenopausal counterparts irrespective of their BMI levels.^[24]

In the current study, an addiction was not found to be the important predictor for hypertriglyceridemia. Contrary to this, previous research workers have reported that tobacco smoking is associated with increased levels of TC, TG, LDL, VLDL and decreased the level of HDL.^[25-27] However, other studies were reported with conflicting results.^[28,29] Studies by Swapnali *et al.*^[30] and Kalavati *et al.*^[31] have shown altered lipid profile in postmenopausal women. Furthermore, a study done on the premenopausal and perimenopausal/postmenopausal women about the association of various patterns of menstrual cycle and serum lipid profile has shown that as the women approach menopause, the serum lipid profile gets abnormal.^[32]

Strengths and Limitation

Only healthy tribal women in the reproductive age group free from disorders such as diabetes, renal, and heart diseases affecting the lipid profile were included in the study. The strongest predictor for hypertriglyceridemia in these women was found to be changed hormone status due to different patterns of menstrual cycle. Furthermore, another study done on these women which is cited in this study has revealed the role of hormone changes and deranged lipid profile. The study has tried to assess the effect of diet and BMI on various lipid fractions separately in premenopausal and perimenopausal/postmenopausal groups of women controlling the influence of menstrual/hormone status on lipid profile.

Assessment of the level of estrogen hormone in relation to serum lipid level is not done while the menopausal status is used as a proxy marker for estrogen hormone level. Estimation of apolipoproteins is also not done. The study has enrolled few tribal women and very few ($n = 4$) were underweight. The data values of some of the lipid fractions are more spreading in nature due to high standard deviations.

CONCLUSIONS

The serum lipid levels in young healthy women in the age group of 19–50 years of Jharkhand state are found to be within normal range. Dietary habits and BMI status do not influence the serum lipid levels as most of the women belonged to low socioeconomic status, subsiding on fiber-rich diet and being more physically active. The non-significant difference is observed in the mean values of varied lipid fractions in normal versus overweight groups of perimenopausal/postmenopausal women.

As the women approach toward the perimenopause and postmenopausal status, the lipid profile gets deranged. In the present study, the individual effect of diet and BMI on serum lipid profile in women is not revealed as perimenopause

and menopause being normal physiological phenomenon is associated with deranged lipid profile. Hence, there is a need to carry out further studies on tribal women to know the individual effect of diet and BMI on lipid profile as the current study has included few tribal women.

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