

# EFFECT OF ESTROGEN ON SERUM TOTAL CHOLESTEROL AND TRIGLYCERIDE LEVELS IN POSTMENOPAUSAL WOMEN

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## Abstract

**Background:** Hyperlipidemia is a major risk factor for cardiovascular diseases in postmenopausal women. Increased incidence of cardiovascular diseases in postmenopausal women may be due to hyperlipidemia caused by lower level of estrogen hormone.

**Objectives:** The study was carried out to observe the association of serum estrogen with total cholesterol (TC) and triglyceride (TG) levels in postmenopausal women.

**Methods:** This cross sectional study was conducted in the Department of Physiology, Dhaka Medical College, Dhaka, during the period of January to December 2011. A total of 90 females were selected from different areas of Dhaka city. Among them, 60 postmenopausal women with age ranging from 50 to 60 years were taken as study group and 30 apparently healthy premenopausal women with age ranging from 20 to 30 years were included as control group for comparison. The study parameters total cholesterol and triglyceride were estimated by enzymatic method in both groups. Serum estrogen level was estimated by Radioimmunoassay (RIA) method in order to assess the hormonal level of both groups. Data was analyzed by Unpaired Student's *t*-test and Pearson's correlation co-efficient (*r*) test as applicable.

**Results:** In this study, the mean serum TC level was higher in postmenopausal women than those of premenopausal women and result was statistically significant. The level of mean serum TG was significantly ( $p < 0.001$ ) higher in postmenopausal women in comparison to those of premenopausal women. In postmenopausal women serum estrogen level was lower than premenopausal women and serum estrogen level showed negative correlation with TC level. Again serum TG level also showed negative correlation with serum estrogen level. All these correlation were statistically non-significant.

**Conclusion:** From the results of the present study it may be concluded that the serum total cholesterol and triglyceride levels are significantly higher in postmenopausal women that may be due to low level of estrogen.

**Key word;** Total cholesterol, Triglyceride, Estrogen, Postmenopausal women.

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## Introduction

Menopause is defined as the permanent cessation of menstruation resulting from the loss of follicular activity. It is recognized by the presence of amenorrhea for 12 consecutive months without any pathological and physiological factors. A new hormonal pattern is established at menopause, which is characterized by high levels of follicle

stimulating hormone (FSH), luteinizing hormone (LH) and low level of estrogen.<sup>1</sup> Menopause has a wide starting age range, but usually be expected in the range of 42-58 years<sup>2</sup> After menopause, the morbidity and mortality from cardiovascular diseases (CVD) are increased. Postmenopausal women are 4-8 times more likely to die of coronary artery disease than premenopausal women.<sup>3</sup> It has

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been suggested that the rate of morbidity from coronary artery diseases accelerate more quickly in postmenopausal women than do those of males after the age of 45 years.<sup>4</sup> It is estimated that one in every two women die of a heart related disorder, which represent more death than due to cancer, chronic lung diseases and accident combined.<sup>5</sup>

Estrogen is a steroid hormone produced primarily in the ovaries and too much lesser extent in other cells like fat tissue. Estrogen production from the ovaries declines around and after menopause. Estrogen is a cardio protective hormone for women. But in postmenopausal women due to lack of the estrogen, cardio protective function is lost and increased the coronary artery diseases.<sup>6</sup> However, several other physiological changes which develop during menopause may also influence the risk of cardiovascular disease, such as aging effect, decreasing resting metabolic rate and physical activity.<sup>7</sup> Again, following menopause due to lacking of estrogen, women have increased risk for central obesity, hyperlipidemia, glucose intolerance and hypertension. Among these factors the hyperlipidemia seems to be the major issue.<sup>8</sup> Hyperlipidemia is a term commonly used to describe individual with increased level of serum total cholesterol (TC), triglyceride (TG) and very low density lipoprotein cholesterol (VLDL-C) and low density lipoprotein (LDL).<sup>9</sup> Cholesterol is an organic molecule found in our blood that exists in two forms low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C). Low density lipoprotein is considered the bad form of cholesterol as it buildup within arteries and can lead to cardiac complication. High density lipoprotein on the other hand, has been known to reduce the risk of heart attack and is considered the good form of cholesterol. The reason being, HDL-C pulls cholesterol away from the arteries and carries it to the liver where the body can eliminate it.<sup>10</sup>

Again it has been shown that raised TG level is a key feature of the lipid disturbance that are more strongly associated with CVD risk in postmenopausal women. They suggested that

higher TG has a link for development of central obesity and insulin resistance in postmenopausal women. Insulin resistance at the adipocyte results in increased release of fatty acids in to the circulation. Then excess free fatty acid enter into liver, stimulates the assembly and secretion of VLDL, resulting in hypertriglyceridemia<sup>11</sup>

Similarly some investigators suggested that the prevalence and severity of atherosclerosis and ischemic heart diseases in postmenopausal women are related to hyperlipidemia more specifically hypercholesterolemia is a major risk factor for atherosclerosis. Hypercholesterolemia causes endothelial injury, resulting in adhesion of platelets and monocyte, release of growth factors which lead to smooth muscle cell migration and proliferation. As a result narrowing blood vessels occurs and atherosclerotic plaque develops.<sup>12</sup>

Some other study also reported that serum TC and TG level are higher in postmenopausal women than that of premenopausal women.<sup>13-16</sup> Opposite finding was reported by some investigators who did not find any significant difference in serum TC level between premenopausal and postmenopausal women.<sup>17</sup>

Increased incidence of CVD resulting from increased levels of total cholesterol and triglyceride, have been reported. But very few publication about the effect of estrogen on TC and TG levels in postmenopausal are available. Therefore, this study has been designed to observe the effect of estrogen on serum TC and TG levels in postmenopausal women.

### **Method**

This cross sectional study was conducted in the Department of Physiology, Dhaka Medical College, Dhaka, during the period of January 2011 to December 2011. A total of 90 female were selected from different areas of Dhaka city. Among them, 60 postmenopausal women with age ranging from 50 to 60 years were taken as study group and 30 apparently healthy premenopausal women with age ranging from 20 to 30 years were included as control group for comparison. Subjects having history of heart, liver, kidney diseases, endocrine

disorders and women taking hormone replacement therapy steroid, alcohol user, and smoker were excluded from the study. After selection of the subjects, the objectives, nature, purpose and benefit of the study were explained to the subjects in details. Ethical permission was taken from ethical committee of Dhaka medical College. Written informed consents were taken from the participants. Detailed medical history, menstrual history and family history of the subjects were taken and recorded in a pre-designed data collection form. Then with all aseptic precautions 5ml of venous blood was drawn from antecubital vein by disposable plastic syringe. Blood was allowed to clot and then centrifuged at a rate of 3000 rpm and supernatant clear serum was separated. Serum was taken in to eppendorf tube and was preserved in refrigerator in Department of Physiology of Dhaka Medical College, Dhaka. Then estimation of serum estrogen level was done by RIA method in the Department of Nuclear Medicine, Dhaka Medical College. Estimation of serum TC and TG level were done by enzymatic method in the department of Dhaka medical college. Statistical analysis was done by Unpaired Student's t- test. Correlation was analyzed by Pearson's correlation coefficient (r) test. P value <0.05 was taken as of significance.

## Results

The mean age was higher in postmenopausal women and it was statistically significant ( $p < 0.0001$ ). (Figure-1 & Table-I).

The value of mean total cholesterol was higher in postmenopausal women than those of premenopausal women and the result was statistically significant ( $p < 0.001$ ). (Figure-2 & Table-I).

The mean value of triglyceride level in postmenopausal women was significantly ( $p < 0.001$ ) higher than those of premenopausal women. (Figure 3, & Table-I).

Serum estrogen level was lower in postmenopausal women than that of premenopausal women and the result was statistically significant ( $p < 0.001$ )

( Table-II & Figure 4).

Distribution of parameters were observed in postmenopausal women and 45% of postmenopausal had TC level within normal level (i.e. < 200 mg/dl) whereas 55% had above normal level in same group of women. (Table-III and Figure 5) Again, 31,7% of postmenopausal had TG within normal level (i.e. > 150mg/dl) ,whereas, 68.3% had above normal level . (Table-III & Figure-6)

Moreover, serum estrogen level showed negative correlation ( $r = - 0.126$ ) with low total cholesterol (TC) level in postmenopausal women and result was statistically non-significant. In postmenopausal women the triglyceride (TG) level showed also negative correlation ( $r = -0.062$ ) with serum estrogen level and result was statistically non-significant. (Table-IV, Figure -7 & Figure-8.)

**Table I**

*Age, Total cholesterol (TC) and triglyceride (TG) levels in premenopausal and postmenopausal women*

Groups	n	Age (years)	TC (mg/dl)	TG (mg/dl)
A	30	28.77±6.66	135±45.12	125±46.77
B	60	53.90±5.75	209.65±44.03	196.62±88.60

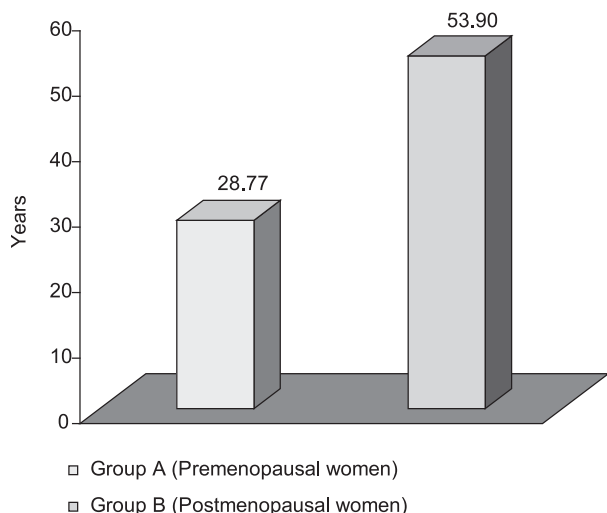
## Statistical analysis

Groups	Age	TC	TG
(p value)	(p value)	(p value)	
A vs. B	0.0001***	0.0001***	0.0001***

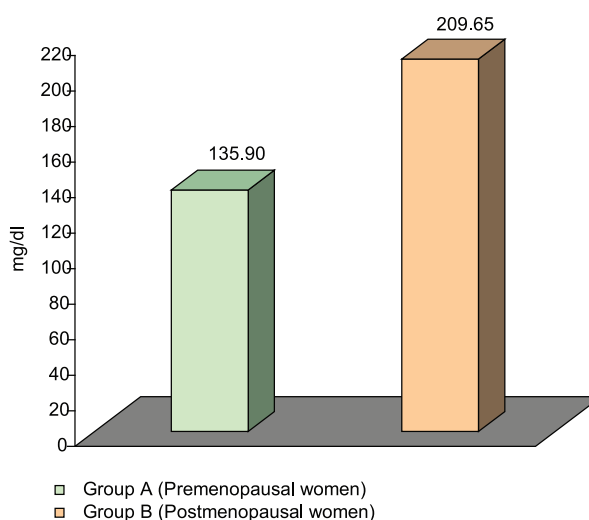
Unpaired Student's 't' test was performed to compare between groups. The test of significance was calculated and p values <0.05 was accepted as level of significance.

Group A : Premenopausal women n = Number of subject  
Group B : Postmenopausal women ns = Not significant

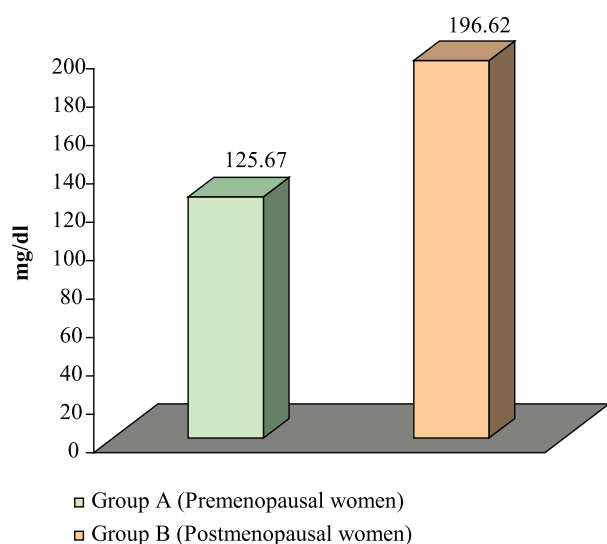
\*\*\* = Significant at  $P < 0.001$



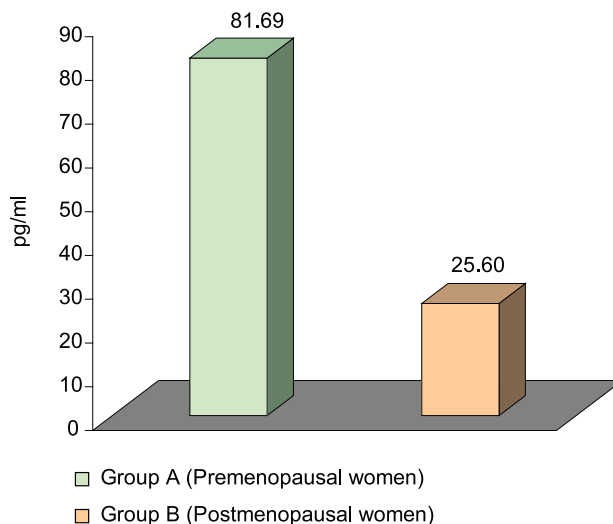
**Fig.-1:** Mean age in different groups



**Fig.-2:** Mean TC level in different groups



**Fig.-3 :** Mean TG level in different groups



**Fig.-4 :** Mean estrogen level in different groups

**Table-II**

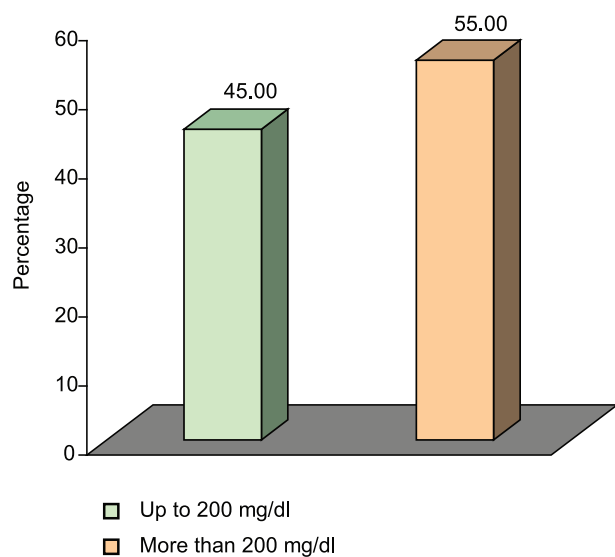
*Serum estrogen level in premenopausal and postmenopausal women*

Groups	n	Estrogen (pg/ml)
A	30	81.69±36.61
B	60	25.60±17.35
Groups A vs B		Serum estrogen (p value) 0.003**

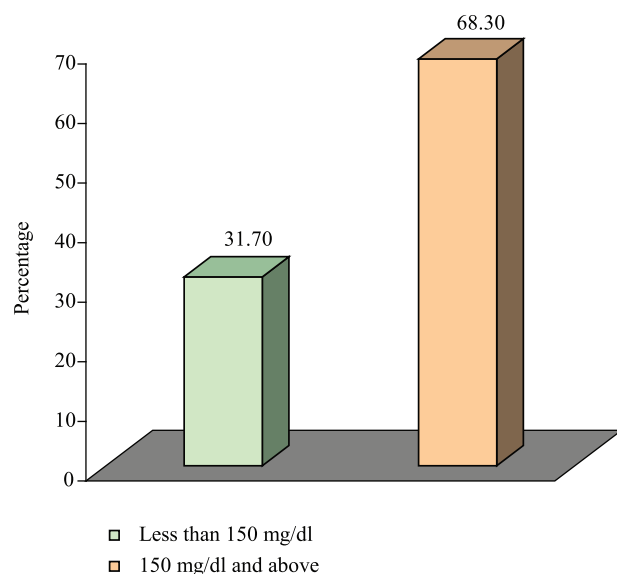
Results are expressed as mean±SD

Unpaired Student's 't' test was performed to compare between groups. The test of significance was calculated and p values <0.05 was accepted as level of significance.

Group A : Premenopausal women      n = Number of subjects  
 Group B : Postmenopausal women    \*\* = Significant at P<0.01  
 \*\*\* = Significant at P<0.0



**Fig.-5 :** Distribution of subjects by serum total cholesterol in postmenopausal women



**Fig.-6 :** Distribution of subjects by serum triglyceride in postmenopausal women

**Table-III**

*Distribution of the subjects by the study parameters in postmenopausal women*

Parameters	Group B (n=60)	
	No.	(%)
Total cholesterol (mg/dl)		
<200	27	(45.0)
>200	33	(55.0)
Triglyceride (mg/dl)		
<150	19	(31.7)
>150	41	(68.3)

**Table-IV**

*Correlation of serum estrogen level with biochemical parameters in postmenopausal women*

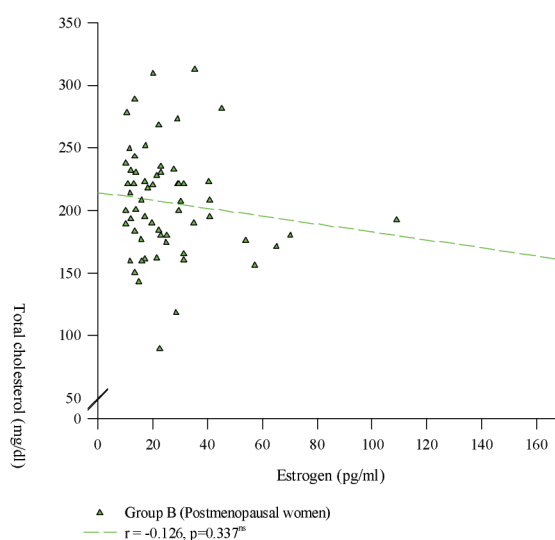
Parameters	Group B (n=60)	
	r	p
TC	0.126	0.337 <sup>ns</sup>
TG	-0.062	0.638 <sup>ns</sup>

Pearson's correlation coefficient (r) test was performed to compare relationship between parameters. The test of significance was calculated and p value <0.05 was accepted as level of significance.

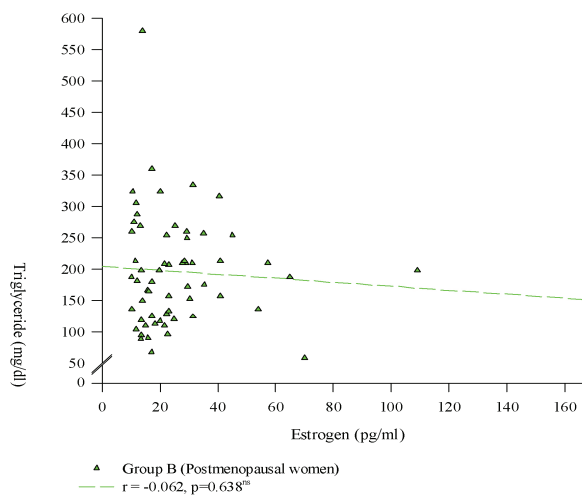
Group B : Postmenopausal women

n = Number of subjects

ns = Not significant



**Fig.-7:** Correlation of serum estrogen and total cholesterol level in postmenopausal women



**Fig.-8:** Correlation of serum estrogen and triglyceride level in postmenopausal women

## Discussion

In the present study the level of total cholesterol and triglyceride in healthy premenopausal women were almost within normal range and also similar to reported by the several investigators from abroad.<sup>12-16</sup>

The mean serum TC level in postmenopausal women was higher than that of premenopausal women and result was statistically significant. Similar types of findings were reported by different researchers of different countries<sup>8,13,15</sup>. On the contrary, similar observations were made by other researchers but they did not find any significant difference in total cholesterol level. This inconsistency of the result may be due to small sample size in their study.<sup>17</sup>

Again, in our study, serum total cholesterol showed negative correlation with serum estrogen level in postmenopausal women. The result was consistent with the result of other study.<sup>13</sup>

The serum level of triglyceride in postmenopausal was higher than those of premenopausal women and result was statistically ( $p < 0.001$ ) significant. Similar types of findings were reported by different researchers of different countries<sup>8,13,15</sup>. On the contrary, similar observations were made by other researchers but they did not find any significant difference in triglyceride value between the groups. They suggested that it may be due to different type of nutrition and life style in their study population<sup>12</sup>. Again, triglyceride showed negative correlation with serum estrogen level in postmenopausal women. The result was consistent with the result of other study.<sup>17</sup>

Estrogen has a major beneficial effect on TC metabolism. Estrogen hastens turn over or catabolism of cholesterol. Serum TC level is high in postmenopausal women due to estrogen deficiency.<sup>18</sup>

Estrogen also decreases the serum TG level by promoting the use of lipid as fuel and increase the oxidation of free fatty acids. TG level in serum is higher in postmenopausal women due to estrogen deficiency.<sup>19,20</sup>

Again, it has been suggested from research review that estrogen deficiency in postmenopausal women increased released of free fatty acid into portal circulation and excessive free fatty acid decrease the sensitivity of insulin. Thus insulin resistance is developed in postmenopausal women. Insulin resistance in adipose tissue causes increased activity of hormone sensitive lipase resulting in increased level of circulating fatty acids. These fatty acids are carried to the liver where they are converted to triacylglycerol and cholesterol.<sup>21,22</sup>

Estrogen also has anti-inflammatory properties. In postmenopausal women due to lacking of estrogen there is increased cytokines level including tumor necrosis factor alpha, and IL-6, It has been reported that cholesterol elimination through bile acid synthesis and export is strongly inhibited by increased serum levels of tumor necrosis factor alpha, which also favors fatty acid synthesis rather than fatty acid oxidation.<sup>23</sup>

In the present study, both total cholesterol and triglyceride levels are higher in postmenopausal women than premenopausal women. This is most likely due to lower level of estrogen, as the measured value of estrogen was lower in postmenopausal women than premenopausal women. Furthermore, in the present study, total cholesterol and triglyceride levels, showed negative correlation with serum estrogen level in postmenopausal women. These correlations further support these findings. But exact mechanism is not elucidated by this type of study due to time and financial constraints.

## Conclusion

From this study, it can be concluded that higher values of total cholesterol and triglyceride may present in postmenopausal women may be due to their lower level of estrogen hormone.

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