

## Original Article

## Association of obesity with serum estrogen level in postmenopausal women

Yeasmin N<sup>1</sup>, Hossain MJ<sup>2</sup>, Hossain I<sup>3</sup>, Akhter QS<sup>4</sup>**Abstract:**

*Incidence of obesity among postmenopausal women is increasing throughout the world, leading to life threatening medical problem like cardiovascular diseases, type 2 diabetes mellitus. Estrogen deficiency that develops during menopause is likely the etiological factors for development of abdominal obesity. Increased incidence of cardiovascular diseases in postmenopausal women may be due to abdominal obesity caused by lower level of estrogen hormone. The study was carried out to observe the association of obesity with serum estrogen level in postmenopausal women. 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 number of 90 female subjects 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. Waist circumference was measured and body mass index (BMI) was calculated in both groups. Serum estrogen level was estimated in order to assess the hormonal level of postmenopausal women. The value of waist circumference was higher in postmenopausal women than those of premenopausal women and result was statistically non significant. Body mass index value 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 waist circumference and body mass index values. All these correlations were statistically non significant. Present study revealed that there is association of obesity with serum estrogen level in postmenopausal women.*

**Keywords:** Obesity, estrogen, postmenopausal women

**Introduction**

Obesity results from abnormal accumulation of fat deposits, which consists of an excessive storage of triacylglycerol within adipocytes located in subcutaneous tissue and intra-abdominal viscera. However, fat also surrounds nerves and blood vessels and exists as lipid droplets that accumulate within the cells of the liver, heart, and the skeletal muscle. This occurs when there is persistent discordance between energy intake and energy expenditure and result is chronic excessive fat storage without adequate energy utilization.

The prevalence of obesity has become the largest worldwide chronic disease burden due to its comorbidities within the metabolic syndrome.<sup>1</sup> In the United States, the lifetime risk of becoming overweight or obese is approximately 50% and 25%, respectively.<sup>2</sup>

The anatomic distribution of body fat has a major influence on associated health risks. Excess fat located in the central abdominal area of the body is called android, "apple-shaped," or upper body obesity and is associated with a greater risk for hypertension, insulin resistance, diabetes mellitus, dyslipidemia, and coronary heart diseases. In contrast fat distributed in the lower extremities around the hips or gluteal region is called gynoid, "pear-shaped," or lower body obesity. The pear shape is relatively safe condition and is commonly found in women.<sup>2</sup>

Obesity is one of the most common disorders in postmenopausal women and occurs in 65% of them. It is associated with premature atherosclerosis, as well as with many metabolic alteration including insulin resistance, dyslipidemia and hypertension.<sup>3</sup> There is a progressive increase in weight in postmenopausal women. It is represented by central redistribution fat with decrease in gluteofemoral fat and increase in intra-abdominal fat. These factors increase the cardiovascular mortality and morbidity in postmenopausal women.<sup>4</sup> Estrogen deficiency during menopause has a detrimental effect on metabolism. It brings

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the changes in body fat distribution from gynoid to an android pattern. This increases the rate of hypertension, diabetes mellitus in postmenopausal women.<sup>5,6</sup> For assessment of obesity, the body mass index which has been shown to correlate with the amount of body fat in most individuals. Measuring waist size with a tape measure is also used to screen for obesity. This measurement reflects the amount of fat in the central abdominal area of the body. The presence of excess central fat is associated with an increased risk for morbidity and mortality.<sup>2</sup>

Some investigators reported that the morbidity and mortality of cardiovascular disease in post menopausal women are more common than pre menopausal women, where obesity and estrogen deficiency have been supposed to be the major reasons.

However, several physiological changes such as ageing effect, decreased physical activity also develop during menopause which may influence the risk of cardiovascular disease.<sup>7</sup> Again, studies have observed that postmenopausal women had android pattern of fat distribution liked men and increased the risk of cardiovascular disease in both postmenopausal and men than the premenopausal women with gynoid pattern of fat distribution.<sup>8</sup>

Moreover, some studies found that postmenopausal women had greater visceral adiposity compared with premenopausal women. They also noticed that adipokines secreted from adipose tissue were associated with increased insulin resistance, atherosclerosis and other risk factors of coronary heart disease.<sup>9</sup> It has been suggested that adipose tissue produces and releases hormones and other biologically active molecules-adipokines. Among these adipokines, adiponectin has been shown to affect directly or indirectly in glucose and lipid metabolism.

Plasma concentration adiponectin inversely related to visceral fat. Adiponectin improves glucose tolerance via increasing insulin sensitivity. Adiponectin enhances fatty acid oxidation in liver and muscle and thus reduces triglyceride content in these tissues. As a result it decreases blood glucose level. Its deficiency contributes to the development of insulin resistance and diabetes mellitus.<sup>3</sup>

Some other study reported that greater increased in waist-to-hip ratio and waist circumference, body mass index in postmenopausal women than that of premenopausal women.<sup>10-12</sup> Opposite finding was reported by some investigators who did not find any significant difference in BMI value in premenopausal and postmenopausal women. Some studies have been done on this regard in abroad but

no published data has yet been available on this aspect in our country. Therefore, the present study has been designed to observe the association of obesity with estrogen level in postmenopausal women. Better understanding of these metabolic changes with obesity in menopause will help in the detection of women at risk for future cardiovascular diseases. Treatment and preventive measure can reduce the risk of developing cardiovascular diseases and thus reduce burden on our health budget.

## Methods

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 number of 90 female subjects 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 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.

Waist circumference was measured and height and weight of the subjects were measured for calculation of body mass index (BMI) in both groups to observe their status of obesity.

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.

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.

Statistical analysis was done by Unpaired Student's 't' test. Correlation was analyzed by Pearson's correlation co-efficient (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 ( $p < 0.001$ ). (Figure-1 & Table-I)

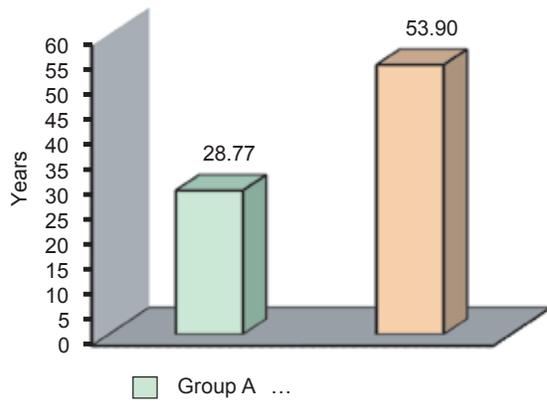
**Table-I:** Age, waist circumference (WC) and body mass index (BMI) in premenopausal and postmenopausal women

Groups	n	Age (years) (Mean±SD)	WC (cm) (Mean±SD)	BMI (kg/m <sup>2</sup> ) (Mean±SD)
A	30	28.77±6.66	82.03±7.15	22.62±3.10
B	60	53.90±5.75	85.13±9.21	26.72±4.35

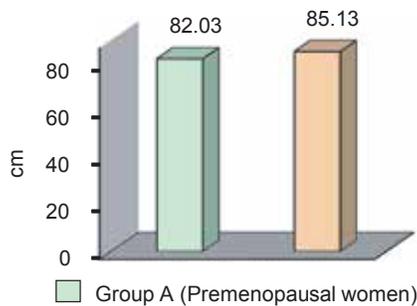
Groups	Age (p value)	WC (p value)	BMI (p value)
A vs B	0.0001***	0.110 ns	0.0001***

WC = Waist circumference, BMI = Body mass index, Unpaired Student's 't' test was performed to compare between groups. p values <0.05 was accepted as level of significance, Group A: Premenopausal women, Group B : Postmenopausal women, n=Number of subjects, ns=Not significant. \*\*\*=Significant at P<0.001



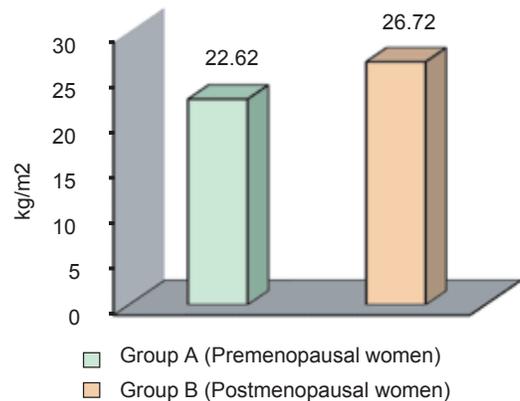
**Figure-1:** Mean age in premenopausal and postmenopausal women

The value of mean waist circumference of the postmenopausal women was not significantly higher than those of premenopausal women. (Figure-2 & Table-I)



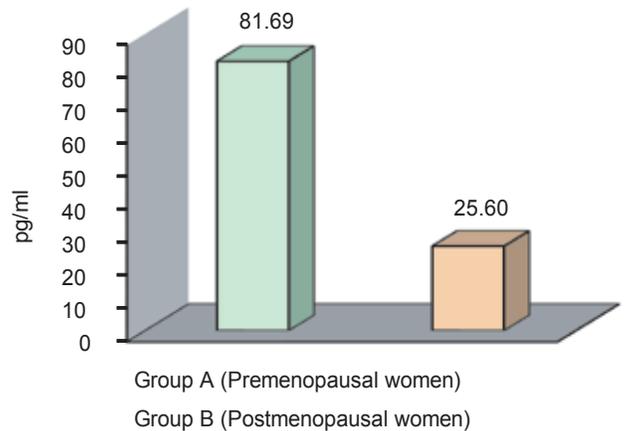
**Figure 2:** Mean waist circumference in premenopausal and postmenopausal women

The mean body mass index in postmenopausal women was also higher in postmenopausal women and result was statistically significant ( $p < 0.001$ ). (Figure-3 & Table-I)



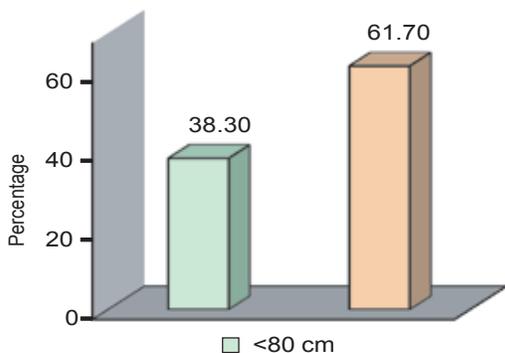
**Figure-3:** Mean body mass index in premenopausal and postmenopausal women

Serum estrogen level was lower in postmenopausal women than that of premenopausal women and the result was statistically significant ( $p < 0.001$ ). (Figure-4)



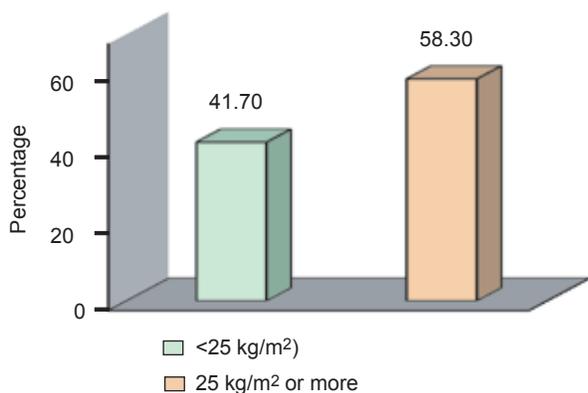
**Figure- 4:** Mean serum estrogen level in premenopausal and postmenopausal women

Distribution of parameters were observed in postmenopausal women and 38.3% of postmenopausal women had waist circumference within normal level whereas 61.7% had above normal level (i.e >80 cm). (Table-II and Figure-5)



**Figure-5:** Distribution of subjects by waist circumference in postmenopausal women

Again, 41.7 % of postmenopausal had body mass index within normal level whereas, 58.3% had above normal level (i.e >25kg/m<sup>2</sup>). (Table-II and Figure-6)



**Figure 6:** Distribution of subjects by body mass index in postmenopausal women

**Table-II:** Distribution of the subjects by the study parameters in postmenopausal women

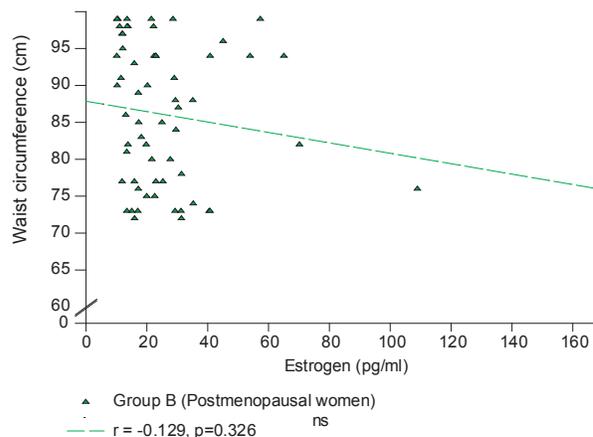
Parameters	Group B (n=60)	
	No.	(%)
Waist circumference (cm)		
<80	23	(38.3)
≥80	37	(61.7)
Body mass index (kg/m <sup>2</sup> )		
<25	25	(41.7)
≥25	35	(58.3)

Serum estrogen level showed negative correlation with waist circumference and body mass index in postmenopausal women and both results were statistically non significant. (Table-III, Figure-7and Figure- 8)

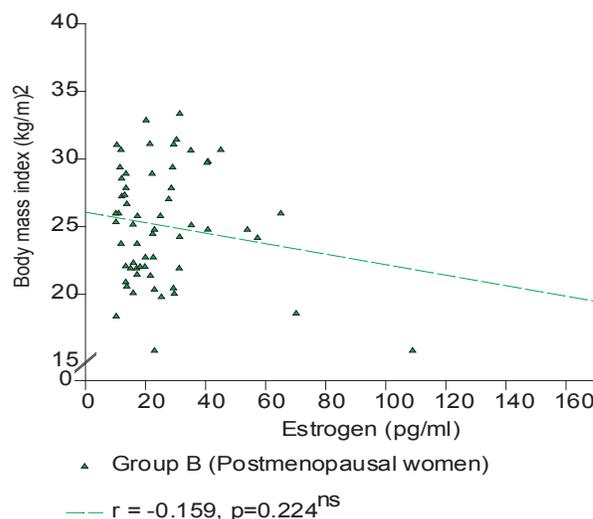
**Table-III:** Correlation of serum estrogen level with waist circumference & body mass index

Parameters	Group B (n=60)	
	r	p
Waist circumference	-0.129	0.326 <sup>ns</sup>
Body mass index	-0.159	0.224 <sup>ns</sup>

Pearson's correlation coefficient (r) test was performed to compare relationship between parameters. p value <0.05 was accepted as level of significance. Group B:Postmenopausal women,n=Number of subjects, ns=Not significant



**Figure - 7:** Correlation of serum estrogen level and waist circumference in postmenopausal women



**Figure-8:** Correlation of serum estrogen level and body mass index in postmenopausal women

## Discussion

In the present study, the values of waist circumference and body mass index in healthy premenopausal women were almost within normal range and also similar to reported by the several investigators from abroad.<sup>13-18</sup>

In this study, the waist circumference in postmenopausal women was higher than that of premenopausal women and result was statistically non significant. Similar types of observations were found by other workers. They suggested that declined in ovarian function and physical activity may be related to an accelerated accumulation of total and central fatness. Again, waist circumference showed negative correlation with serum estrogen level in postmenopausal women.<sup>13,15</sup>

The body mass index 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 body mass index value between the groups. They suggested that it may be due to different type of nutrition and life style in their study population.<sup>12,19</sup> Again, body mass index showed negative correlation with serum estrogen level in postmenopausal women.

Many explanations are suggested by different investigators regarding the development of abdominal obesity in postmenopausal women. It has been suggested that estrogen has regulatory influence on maintenance of typical fat distribution (gynoid pattern fat), glucose and lipid metabolism in women.<sup>20,21</sup> Again, estrogen regulates the function of adipose hormone such as leptin. Leptin acts through its receptor (Ob-R) in the hypothalamus and helps in the homeostatic control of adipose mass by changing in energy intake and expenditure.<sup>21</sup> However, some investigators suggested that, estrogen deficiency in postmenopausal women enhances adipose tissue deposition by increasing lipogenesis. This action happens through increased activity of lipoprotein lipase, an enzyme that regulates lipid uptake by adipocytes thus increases lipogenesis. Again, estrogen deficiency inhibits lipolytic enzyme, hormone sensitive lipase and by decreasing the lipolytic effects of epinephrine, thus increased adipose tissue deposition. In addition, estrogen deficiency in postmenopausal women decreases fatty acid oxidation, which may contribute to the increase in deposition of adipose tissue.<sup>21</sup>

In the present study, both waist circumference and body mass index values 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, waist circumference, body mass index, 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 constrains.

From this study, it can be concluded that central obesity, which is characterized by higher values of waist circumference and body mass index may present in postmenopausal women may be due to their lower level of estrogen hormone.

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