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Original Research Article

# Anthropometric and Blood Pressure Measurements, Lipids and Lipoproteins Levels and Total Antioxidant Status of Pre and Postmenopausal School Teachers in Osogbo, South-West Nigeria

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**Abstract:** This study measured the blood pressure, lipid, lipoproteins and total antioxidant status in physically active premenopausal and postmenopausal school teachers in selected secondary schools in Osogbo, Osun State, Nigeria. Thirty six premenopausal (group I) and forty postmenopausal (group II) participated in the study. Body weight, height, waist-hip circumference, Systolic blood pressure (SBP) and diastolic blood pressure (DBP) of the teachers were measured. Body mass index (BMI), waist-hip ratio (WHR), pulse pressure (PP) and mean arterial blood pressure (MAP) were calculated using standard formulae. Total Cholesterol (TC), Triglycerides (TG), high density lipoprotein cholesterol (HDL-C) were measured by enzymatic methods. Low Density Lipoprotein Cholesterol (LDL-C) and Very Low Density Lipoproteins Cholesterol (VLDLC) were calculated using Friedewald's equation. Total Antioxidant Status (TAS) was measured by spectrophotometric method. Results showed that the means of BMI (30.98 ± 4.86), WHR (0.87 ± 0.10), TG (1.74 ± 0.50) and VLDL (0.79 ± 0.23) in group II were increased ($p<0.05$) when compared with corresponding means of BMI (28.19± 4.81), WHR (0.85± 0.06), TG (0.89 ± 0.80) and VLDL (0.40 ± 0.36) in group I. A decrease in mean TAS (1.16 ± 0.07) in group II was observed when compared with corresponding mean TAS (1.24 ± 0.03) of group I. A negative association ($r = -0.371$, $p<0.01$) was observed between age and TAS. No difference was seen in mean SBP, DBP and levels of TC, HDL-C, and LDL-C in group II when compared with values of group I. Changes in TAS, lipids and lipoproteins observed in post menopausal women could be associated with oxidative stress, aging process and hormonal changes in menopause and could lead to an increased risk in developing CVD despite absence of a sedentary lifestyle.

**Keywords:** Blood pressure, lipids, lipoproteins, total antioxidant status, menopause

## INTRODUCTION

In many developed countries, more women die from cardiovascular diseases (CVD) each year than men [1, 2, 3]. Traditional risk factors for CVD include age, gender, obesity, sedentary lifestyle, cigarette smoking, genetic predisposition and hypertension. Gender and age related risks show that at <40yrs men have a higher risk than women. However, this difference is eliminated in both sexes with increasing age. As menopause sets in women, inter gender differences close up while intra gender differences widen with post menopausal women having a higher risk. This increased incidence is only partially explained by ageing, especially with regards to the hormone estrogen. Decreasing estrogen concentration is associated with menopause and has been established in numerous studies [4]. Previous studies showed that a combination of oxidative stress [5], dyslipidemia [4], menopause [6], dietary habits and lack of physical exercise and type of occupation [7] could predispose women to a higher risk for CVD. It has been suggested that key risk factors that need to be controlled in the post-menopausal women are dyslipidemia, obesity, hypertension and other components of the metabolic syndrome such as a carefully controlled Diabetes Mellitus [2].

Changes in lipid and lipoproteins associated with decreasing estrogen level may be manifested by elevation of Total Cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-C) and Triglycerides (TG) concentrations and a decrease in the High Density Lipoprotein Cholesterol (HDL-C) concentration in blood [8, 9]. Furthermore, estrogen has been suggested to have antioxidant properties and its deficiency after menopause could predisposes the body to increased free radical load, decreased total antioxidant status,

oxidative stress and free radical mediated oxidative modification such as lipid peroxidation [10].

Hypertension is a particularly powerful risk factor and lowering of blood pressure is pivotal [3]. Hypertension is one of the main CV risk factors, which might explain the increase of CV morbidity and mortality seen in postmenopausal females [11]. It has been long known that blood pressure is typically lower in premenopausal women than in age-matched men and arterial blood pressure increases after the cessation of menses and in addition, that after menopause, women develop arterial hypertension often together with changes in lipid and glucose metabolism[12].

This study is designed to determine the likely difference in the blood pressure, plasma lipids, lipoproteins and total antioxidant status in premenopausal and postmenopausal school teachers in Osogbo metropolis.

## MATERIALS AND METHODS

Thirty six (36) premenopausal (group I) and forty (40) postmenopausal (group II) participated in the study. The study was carried out in selected secondary schools in Osogbo metropolis, Osun state, South-Western Nigeria. Consent was obtained from the participants before the commencement of the study.

Height and body weight of participants were measured with participants standing without shoes. The height of all the subjects were recorded by measuring scale and the weight in kg was recorded by weighing scale. The body mass index was calculated as weight (kg) /height ($m^2$). The waist circumference was measured at the level of the umbilicus, while the hip circumference was measured at the iliac crest in standing position. The ratio between the two was calculated to provide the Waist-Hip Ratio. The Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were measured using an arm cuff and mercury sphygmomanometer. Two readings were obtained from each participant at the commencement of the study. The means of the readings were calculated and recorded. Pulse Pressure (PP) and
Mean Arterial pressure (MAP) were calculated based on the following formulae [13]:

*Pulse pressure (mmHg) = SBP (mmHg) – DBP (mmHg) … (1)*

MAP was approximated by the arithmetic mean of systolic and diastolic pressure:

$$MAP\ (mmHg) = \frac{SBP\ (mmHg) + DBP\ (mmHg)}{\ldots\ldots\ldots\ldots} \quad (2)$$

5.0 ml overnight fasting blood samples were collected from participants into test tubes containing lithium heparin as anticoagulant and plasma was separated into plain bottles immediately after collection and stored at – $20^0$C and were used for the determination of total cholesterol by the enzymatic colorimetric method of Allain *et al.* [14], triglycerides by the method described by Bucolo and David [15] , high density lipoprotein cholesterol was also determined using enzymatic colorimetric method after separation from other lipoproteins using a mixture of phosphotungstic acid and magnesium chloride, while low density lipoprotein cholesterol and very low density lipoprotein cholesterol were calculated using equation described by Friedewald *et al.* [16]. Total antioxidant status was measured using the spectrophotometric method described by Koracevic [17].

**Statistical analysis**

Results obtained from the study were expressed as mean (± standard deviation). Means were compared using the Student's t – test, while the *relationship between variables* was determined using the *Pearson's correlation coefficient (r). Results were regarded as significant at p<0.05.*

## RESULTS

Results from the present study showed that the mean age of groups I and II differed significantly ($p<0.01$) (table 1). A percentage mean age difference of 23.8% was observed between pre and post menopausal teachers (table 2) and a significant negative association ($r=-0.371$, $p<0.01$) between age and TAS was seen as shown in table 3.

Mean BMI of group II (post menopausal = 30±4.86) was higher than corresponding mean (28± 4.81) of group I (premenopausal) the percentage mean difference between the two groups was 9.89% as seen in tables 1 and 2 respectively. However, no significant difference was not seen in mean values of waist hip ratio (WHR) in groups I and II.
Significant differences in means of blood pressure measurements (SBP, DBP, MAP and PP) were not observed in the two groups when corresponding means were compared. However, a significant negative association between DBP and HDLC ($r = -0.273$, $p<0.05$) was observed (table 3)

Means of TG and VLDLC (1.74±0.50 mmol/l, 0.79±0.23 mmol/l respectively) of post menopausal teachers were higher than corresponding values (0.89± 0.80 mmol/l, 0.40± 0.36 mmol/l) pre menopausal teachers as shown in table 1. Percentage difference in means was 95.5% for TG and 97.5% for VLDLC (table 2).

On the other hand, mean TAS (1.24±0.03 mmol/l) of premenopausal teachers was higher ($p<0.01$) than corresponding value (1.16±0.07 mmol/l) of postmenopausal teachers as shown in table 1. The percentage difference in means of TAS was 6.45% (table2)

Means of TC, HDLC and LDLC did not differ significantly in groups I and II despite mean differences of 2.56%, 5% and 3.025 respectively as shown in table 2

**Table-1: Mean (±SD), p-value of anthropometric and blood pressure measurements, plasma lipid, lipoproteins and total antioxidant status (TAS) of premenopausal and post menopausal school teachers**

| Parameters | Group I (Premenopausal, n=36) | Group II (Post Menopausal, n=40) | t-value | p- value |
|---|---|---|---|---|
| Age (yrs) | 42.74 ± 7.69 | 52.92 ± 2.79 | 7.808 | p<0.001 |
| BMI(Kg/m$^2$) | 28.19± 4.81 | 30.98 ± 4.86 | 2.509 | p<0.014 |
| WHR | 0.85± 0.06 | 0.87 ± 0.10 | 0.731 | ns |
| SBP(mmHg) | 114.58 ±11.42 | 115.69 ± 15.99 | 0.339 | ns |
| DBP(mmHg) | 74.86 ± 11.11 | 75.69 ± 12.48 | 0.299 | ns |
| PP(mmHg) | 39.72± 7.83 | 40.00 ± 9.33 | 0.137 | ns |
| MAP(mmHg) | 87.72 ± 10.59 | 88.91 ± 13.07 | 0.426 | ns |
| TC (mmol/l) | 5.85 ± 1.65 | 6.00± 0.98 | 0.494 | ns |
| TG (mmol/l) | 0.89 ± 0.80 | 1.74 ± 0.50 | 5.580 | p<0.001 |
| HDL-C (mmol/l) | 1.46 ± 0.51 | 1.24 ± 0.98 | 1.165 | ns |
| LDL-C (mmol/l) | 3.97 ± 1.56 | 4.09 ± 0.95 | 0.405 | ns |
| VLDL-C (mmol/l) | 0.40 ± 0.36 | 0.79 ± 0.23 | 5.544 | p<0.001 |
| TAS (mmol/l) | 1.24 ± 0.03 | 1.16 ± 0.07 | 5.798 | p<0.001 |

BMI = body mass index; WHR = waist- hip circumference ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure; PP = pulse pressure; MAP = mean arterial blood pressure, TC = total cholesterol; TG = triglyceride; HDL-C = high density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; VLDLC = very low density lipoprotein; TAS = total antioxidant status and ns = not significant

**Table-2: Means and percentage mean differences of anthropometric and blood pressure measurements, lipid, lipoproteins and total antioxidant status (TAS) of pre and post menopausal school teachers**

| Parameter | Mean difference | % mean difference |
|---|---|---|
| Age (yrs) | -10.18 | 23.80 |
| BMI (Kg/m$^2$) | -2.79 | 9.89 |
| WHR | -0.02 | 2.00 |
| SBP (mmHg) | -1.00 | 0.87 |
| DBP (mmHg) | -1.00 | 1.35 |
| PP (mmHg) | -1.00 | 2.56 |
| MAP (mmHg) | -1.00 | 1.14 |
| TC (mmol/l) | -0.15 | 2.56 |
| TG (mmol/l) | -0.85 | 95.50 |
| HDL-C (mmol/l) | 0.22 | 15.00 |
| LDL-C (mmol/l) | -0.12 | 3.02 |
| VLDL-C (mmol/l) | -0.39 | 0.39 |
| TAS (mmol/l) | 0.08 | 6.45 |

BMI = body mass index; WHR = waist- hip circumference ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure; PP = pulse pressure; MAP = mean arterial blood pressure, TC = total cholesterol; TG = triglyceride; HDL-C = high density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; VLDLC = very low density lipoprotein; TAS = total antioxidant status and ns = not significant

**Table-3: Significant Pearson's correlation coefficient (r) in post menopausal school teachers**

| **Parameters** | **Pearson's correlation coefficient (r)** | **p-value** |
|---|---|---|
| Age and TAS | -0.371** | <0.01 |
| Age and BMI | 0.364** | <0.01 |
| Age and VLDL-C | 0.265* | <0.05 |
| HDL-C and DBP | -0.273* | <0.05 |

BMI = body mass index; DBP = diastolic blood pressure HDL-C = high density lipoprotein cholesterol; VLDL-C = very low density lipoprotein; TAS = total antioxidant status.

## DISCUSSION

In the present study, mean total antioxidant status (TAS) in postmenopausal teachers was lower than that of the premenopausal teachers and was inversely correlated with age. This decrease in the TAS is in contrast with the findings of Betrand and colleagues [18] but similar to the report by Vincent and Allison [19] which showed that TAS was lowered in postmenopausal women when compared with premenopausal women and suggested that this could be due to estrogen deficiency. Structurally, estrogen has a phenol-hydroxyl group at position 3. The presence of this phenol group gives oestrogen its antioxidant property which acts by directly neutralizing oxygen free radicals. A decrease in estrogen concentration could result in decreased TAS and accumulation of free radicals. Oxidative stress could then result when the balance between the rate of free radical production and the mop up by the body's antioxidant defense system is altered in favour of the former. Oxidative stress has been implicated in the aetiology of over 100 diseases including aging process, hypertension, CVD, Diabetes Mellitus (DM) and many forms of cancer [20]. Menopause is a natural step in the process of aging hence; postmenopausal women are likely to develop oxidative stress because of estrogen deficiency and an advancing age, accompanied with age related changes [21, 22]. Mean age was also positively associated with blood pressure measurements in this study. Positive associations between age and blood pressure measurements were reported in some studies [12, 23, 24]. On the contrary, reports from Badaruddoza and Manmeet [25] showed that variables such as age, BMI and WHR were not significantly associated with increase in blood pressure among postmenopausal women.

The BMI in postmenopausal teachers in this study was significantly higher than that of corresponding premenopausal teacher. The BMI of postmenopausal women was positively correlated with the waist circumference and this association has been observed in other studies. This could be in part due to increased accumulation of visceral and subcutaneous fat in menopause [26].

The mean TC concentration in post menopausal teachers in this current study did not differ when compared with premenopausal teachers. This is similar to the study by Otolorin et al., carried out in Ibadan, Southwest Nigeria [27] and report by Igweh and coworkers [28] who examined the effects of menopause on the serum lipid profile of normal females of South East Nigeria. In contrast, a study of post menopausal women in Calabar, South Eastern Nigeria by Usoro *et al*. [29] showed significant difference in mean TC concentration between post and pre menopausal women.

TG concentration in the postmenopausal group was higher than corresponding premenopausal teachers. This finding is in consonance with the report of Berg and colleagues [30] who showed higher a mean TG value in postmenopausal women in comparison with premenopausal women. In another previous study among Caucasian women [31], the authors also observed that TG value was higher in the post menopausal than premenopausal group.

## CONCLUSION

The present study showed that despite the equal activity level of pre and post menopausal women, post menopausal women could be at a higher risk of developing oxidative stress and probably CVD despite living an active life. Post menopausal women may require a higher intake of antioxidants in foods or supplements to prevent oxidative stress and accompanying detrimental effects.

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