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Evaluation of Some Cardio-Inflammatory, Hepato-Renal, Reproductive Hormones and Oxidative Stress Biomarkers among Post-menopause Women in Amassoma, Bayelsa State, Nigeria

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Abstract

Menopause is a permanent menstruation cessation which results in the inability of many women to conceive children. This study was aimed on some evaluation of cardio-inflammatory, hepato-renal, reproductive hormones, and oxidative stress biomarkers among post-menopause women in Amassoma, Bayelsa State, Nigeria. Five milliliter of blood specimen were collected via venipuncture technique from each of the one hundred and seventeen women who were selected for this study and categorized into three groups: experimental group one made up of 39 post-menopause women within the age bracket of 52 and 60 who had undergone menopause for less than 5 years, experimental group two made up of 39 post-menopause women within age bracket of 52 and 60 who had undergone menopause for 5-7 years and 39 non-menopausal women within the age bracket of 31 to 42 years who served as control group. The blood specimens were dispensed into lithium heparin anti-coagulated bottles respectively and spun at 2,500 revolution/minute with the obtained plasma used for the measurement of the following biomarkers: troponin-1 (immune turbidimetric method), creatinineKinase-MB (immune inhibition method), C-reactive protein (latex turbidimetry method), interleukin-6 (elascience method), alanine aminotransferase (colorimetric method), aspartate aminotransferase(colorimetric method), urea (urease berthelot method), creatinine (Jaffe reaction method), estradiol (liquid chromatography-tandem mass spectrometry method), follicle stimulating hormone (enzyme linked immunosorbent assay), progesterone (enzyme linked immunosorbent assay), malondialdehyde (thiobarbituric acid method) and glutathione peroxidase(ultra violet method). The data obtained from these measurements were analyzed using SPSS version 23.0 as statistical package and the differences between the groups assessed using student "t" test which were considered significant at a p-value lesser than 0.05. The results in experimental group one post-menopause women revealed no statistically significant differences ($p > 0.05$) in the mean values of troponin-1, creatinineKinase, C-reactive protein, interleukin-6, alanine aminotransferase, aspartate aminotransferase, urea, creatinine, malondialdehyde and glutathione peroxidase as compared to the control group, while significant decrease ($p < 0.05$) were revealed in estradiol and progesterone as well as significant elevation in follicle stimulating hormones as compared to that of the control group. However, in the experimental group two post-menopause women, statistical significant elevations ($p < 0.05$)

were obtained in the mean values of troponin-1, creatinineKinase-MB, C-reactive protein, interleukin-6, alanine aminotransferase, aspartate aminotransferase, urea, creatinine, follicle stimulating hormone, malondialdehyde and glutathione peroxidase as compared to the control group while significant decrease ($p < 0.05$) were obtained in the mean values of estradiol and progesterone when compared to that of the control group. In conclusion, this study has found that women who had undergone post-menopause for a period of 5-7 years may be at risk of developing cardio-inflammatory, hepato-renal, reproductive hormones and oxidative stress biomarkers abnormalities while those who are lesser than 5 years may not be prone to these abnormalities.

Keywords: *Evaluation, cardio-inflammatory, hepato-renal, reproductive hormones, oxidative stress, biomarkers, post-menopause, Amassoma, Bayelsa State, Nigeria*

1. INTRODUCTION

Menopause, a permanent cessation of menstruation, typically results in the inability of many women to conceive children (Eunice, 2013). Typically, the onset of menopause occurs between the ages of 45 and 50. It can also be characterised as a decrease in the hormone production of the ovaries (Takahashi and Johnson, 2015).

During this period, the ovaries produce lower levels of estrogen and progesterone, resulting in a decreased chance of pregnancy. Furthermore, once a woman has gone through 12 consecutive months without experiencing a menstrual cycle, her levels of estrogen will significantly decrease, marking the official onset of menopause (Sievert, 2013). Before menopause, a woman's menstrual periods typically become erratic, characterised by variations in duration, intensity, hot flashes and flow. Basically, the hot flashes which last for a duration of 30 seconds to ten minutes may be accompanied by shivering, sweating, and reddening of the skin. Additional symptoms may encompass vaginal dryness, insomnia, and fluctuations in mood; the severity of these symptoms varies across women (Eunice, 2013).

Menopause is mostly an innate biological phenomenon, although it can occasionally be induced by chemotherapy or surgical procedures that result in the removal of both ovaries. Menopause is a natural process that happens when the ovaries generate less progesterone and oestrogen hormones (Harlow *et al.*, 2012). It is a process that consists of three distinct stages: premenopause, perimenopause, and postmenopause.

Perimenopause: This term refers to the period preceding the final menstrual cycle, characterised by fluctuating and declining levels of reproductive hormones, resulting in a withdrawal of these hormones. Pre-menopause refers to the period before the onset of noticeable anomalies in the timing of monthly menstrual cycles (Schneider and Naftolin, 2005).

Perimenopause, derived from the term "around the menopause," refers to the period of time before and after the final occurrence of menstrual flow. Based on research about the midpoint and ovulation of the menstrual cycle, this phase typically spans a duration of six to ten years and concludes one year following the final menstrual period (Prior, 2013). During perimenopause, estrogen levels usually increase by 20 to 30 percent compared to premenopause. These fluctuations are responsible for many of the physical changes that happen during perimenopause and

menopause (Chichester and Cirano, 2011). Some of the changes that can occur include hot flashes, night sweats, insomnia, vaginal dryness, osteoporosis, and heart disease (Prior, 2013). Fertility diminishes throughout this period but is not believed to reach zero until the onset of menopause. After the last menstrual period, the official date is determined retrospectively once a year has elapsed (Hurst, 2011).

The duration of perimenopause can extend for a maximum of eight years, and the onset of the menopausal transition often occurs between the ages of 40 and 50. Women generally initiate their perimenopause and menopausal transitions concurrently, however there may be exceptions in the same manner as their mother (Maclaran and Paney, 2015).

Menopause can evoke feelings of bereavement in certain women as a result of the cessation of their reproductive capacity. Moreover, this transition often occurs when a woman is dealing with additional pressures in her life, such as the responsibility of taking care of elderly parents, the loss of parents, the feeling of emptiness when children move out, and the arrival of grandchildren, which can make middle-aged individuals feel like they are part of the elderly population, especially in cultures that have a negative perception of ageing. An increased concentration of follicle-stimulating hormone (FSH) can be detected using a blood test as an indication of menopause or postmenopause in females who do not have a uterus (Bellipanni *et al.,* 2005).

Postmenopause is a term used to describe women who have not experienced a menstrual cycle for a minimum of one year and are not currently pregnant or breastfeeding (Harlow *et al.,* 2012). Menopause which is associated with various physiological and biochemical changes that have effects on bone minerals and their metabolism can be caused by various factors such as age, surgery, genetics, lifestyle choices, chromosomal abnormalities, autoimmune diseases, and other factors (Oluboye *et al.,* 2018). Any occurrence of vaginal bleeding in women who have already gone through menopause is concerning and should be thoroughly investigated to eliminate the possibility of malignant disorders (Hoffman, 2012). Common symptoms that might manifest during menopause and persist until postmenopause are vaginal, psychological, and physical symptoms. It has been shown that after menopause women loose an average of 3% of bone mineral density annually which leads to osteopenia and finally osteoporosis (Sorya *et al.,* 2015).

The diagnosis of menopause which is typically based on the clinical presentation, can as well be established by assessing the levels of hormones such as estrogen, thyroid stimulating hormones (TSH), and follicle stimulating hormones (FSH) in either the blood or urine. Typically, there is no requirement for a specialised treatment. The following drugs may be beneficial: menopausal hormone therapy (MHT), clonidine, gabapentin, or selective serotonin reuptake inhibitors (Lock and Vinh-Kim, 2010).

Despite some researchers claiming that investigations are generally not recommended for menopausal diagnoses in women due to the clinical nature of the majority of cases, certain individuals may nevertheless benefit from having specific biochemical markers examined. This study therefore seeks to evaluate some cardio-inflammatory, hepato-renal, reproductive hormones and oxidative stress biomarkers among postmenopausal women in Amassoma, Bayelsa State, Nigeria. It is crucial based on the fact that there is lack of literature on these parameters. Besides,

many postmenopausal women are unaware of the importance of undergoing certain laboratory testing.

2 MATERIALS AND METHODS

2.1 Study Area

This study took place at Amassoma, which is located in Bayelsa State. Amassoma is a locality in Southern Ijaw, Bayelsa State, Nigeria. It has a population of 6,970 and is located 298 miles (480 kilometres) to the south of Abuja, the capital of the country. The latitude of the location is 40 degrees, 58 minutes, and 13 seconds North while the longitude is 60 degrees, 6 minutes, and 32 seconds East (Daupamowei 2018)

2.2 Ethical Approval

The study got the ethical approval from the College of Health Research Ethics Committee, College of Health Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria and was carried out in full compliance with the fundamental principles of the World Medical Association of Helsinki Declaration of 1975, as revised in 2008. Furthermore, all the selected, apparently healthy participants provided oral informed consent after being told of the rationale behind the need for their blood specimens in this study.

2.3 Research Methodology

This study utilised blood specimens of women who are postmenopausal.

2.3.1 Criteria for Inclusion and Exclusion

The study utilised apparently healthy individuals aged between 48 and 52 years who gave their consent and were not addicted to smoking, snuffing, or drugs as well as free from health conditions such, as hypertension and diabetes mellitus. However, individuals who were addicted to smoking, snuffing or drugs and had illnesses such as hypertension and diabetes mellitus were excluded.

2.3.2 Sample Size Calculation

The sample size for this research was calculated using Taro Yamane's method with the formula $n=N / (1+N e^2)$ as earlier described by Azza and Eman, 2020

n = sample size

N = population of study

E = margin error

N = 166

e = 0.05

$n = 166 / 1 + 166 (0.05)^2$

n = 166 / 1 + 166 (0.0025)

n = 166 / 1 + 0.415

n = 117

2.3.3 Study Group

A total of one hundred and seventeen seemingly healthy participants were recruited for this study, and they were divided into three groups as indicated.

2.3.4 Control Group

This comprised 39 women who were apparently healthy and not experiencing menopause, with ages ranging from 31 to 42 years.

2.3.5 Experimental Group One.

This comprised 39 seemingly asymptomatic post-menopausal women who had experienced menopause for less than 5 years and were between the ages of 52 and 60 years.

2.3.6 Experimental Group Two.

This comprised 39 seemingly healthy post-menopausal women who were between 5 and 7 years post menopause and aged between 52 and 60 years.

2.4 Collection and Processing of Samples

Each volunteer in the control and experimental groups had five millimetres of their blood specimens with drawn using the venipuncture procedure. The blood specimens were then dispensed into lithium heparin anti-coagulated container respectively. The specimens were centrifuged at 2,500 revolutions per minute using a Gulfex macro centrifuge. The resultant plasma was then used to measure the following biochemical parameters: troponin-1, creatinineKinase-MB, C-reactive protein, interleukin-6, alanine aminotransferase, aspartate aminotransferase, urea, creatinine, estradiol, follicle stimulating hormone, progesterone, malondialdehyde and glutathione peroxidase.

2.5 Laboratory Analysis

2.5.1 Troponin-1 measurement

This was measured making use of the dual vial liquid immune turbidimatric method which was earlier described by Diazyme with catalog number DZ145A United States of America and modified subsequently by Emmanuel *et al.*, 2020.

2.5.2 Measurement of creatinineKinase-MB

This was quantified using the immune- inhibition method as described by Atlas Medical unit 4, William James House, Cowley Road, Cambridge, CB40WX and subsequently modified by Emmanuel *et al.,* 2020.

2.5.3 C-reactive protein measurement

This was estimated using the latex turbidimetry method as earlier described by Randox Laboratories Limited and subsequently modified by Emmanuel *et al.,* 2020.

2.5.4 Measurement of interleukin-6

This was done using the earlier described elascience method with catalog number E-EL-HO.102 which was subsequently modified by Egoro *et al.,* 2023

2.5.5 Quantification of alanine aminotransferase

This was quantified using a colorimetric technique which was earlier described in Randox Laboratories Limited and subsequently modified by Emmanuel, 2020.

2.5.6 Quantification of aspartate aminotransferase

This was performed using the colorimetric technique as described earlier in Randox Laboratories Limited and subsequently modified by Egoro *et al.,* 2021.

2.5.7 Measurement of urea

This was measured in alignment with the Urease-Berthelot technique as earlier described by Randox Laboratories Limited and subsequently modified by Emmanuel *et al.,* 2021.

2.5.8 Measurement of creatinine

This was estimated with reference to the procedure as described by Jaffe reaction method in Randox Laboratories Limited kit and subsequently modified by Emmanuel *et al.,* 2021.

2.5.9 Measurement of estradiol

The liquid chromatography-tandem mass spectroscopy method as described by Harriet *et al.,* 2020 was used

2.5.9.1 Measurement of follicle stimulating hormone

This was carried out using enzyme linked immunosorbent assay catalog number BC-1029, as described by Uotila *et al.,* 1981 in BioCheck Inc. 323, Vintage Park Drive, Foster City, CA 94404

2.5.9.2 Measurement of progesterone

This was carried out using enzyme linked immunosorbent assay catalog number BC-1113, as described by Shepard and Senturia, 1977 in BioCheck Inc. 323, Vintage Park Drive, Foster City, CA 94404

2.5.9.3 Measurement of malondialdehyde

This was carried out using the ultra violet technique as described by Bio-diagnostic, 29, Tahreer Street, Dokki, Giza, Egypt as further modified by Egoro *et al.,* 2024

2.5.9.4 Measurement of glutathione peroxidase

This was carried out using the ultra violet technique as described by Bio-diagnostic, 29, Tahreer Street, Dokki, Giza, Egypt as further modified by Egoro *et al.,* 2024

2.6 Statistical Analysis

The study's data were analysed using the statistical software for Social Scientists (SPSS version 23.0). The mean and standard deviation were used to express the results while student 't' test was used to analyse the differences between the control and experimental volunteers. A p-value less than 0.05 was deemed to be statistically significant.

3 RESULTS

The Tables below present the findings of the study examining various biomarkers in post-menopause women in Amassoma, Bayelsa State, Nigeria

Table 1 shows the cardio-inflammatory biomarkers in post-menopause women who had been through menopause for less than 5 years (experimental group one) compared to women who had not yet gone through menopause which served as control group.

Table 1: Cardio-inflammatory biomarkers in post-menopause women with less than 5 years (experimental group one) compared with the control group

Parameter	Control Group n= 39	Experimental Group One n = 39	p-value	Remark
Troponin-1 $^{x}10^{-2}$ (IU/L)	1.18 ± 0.27	1.21 ± 0.29	0.91	NS
CKMB (IU/L)	3.71 ± 0.77	3.75 ± 0.80	0.87	NS
CRP (mg/L)	3.82 ± 0.22	3.85 ± 0.25	0.94	NS
IL-6 (pg/ml)	6.12 ± 0.71	6.16 ± 0.73	0.89	NS

The results are expressed as mean ± SD

Keys: CKMB = CreatinineKinase-B, CRP = C-reactive protein, IL-6 = Interleukin-6, n= Number of subjects, NS = Not significant statistically

The study's findings, presented in Table 1, indicate that there were no significant statistical differences between the mean values of the measured cardio-inflammatory biomarkers: troponin-1(1.21 ± 0.29) IU/L, creatinineKinae-MB (3.75 ± 0.80) IU/L, C-reactive protein (3.85 ± 0.25) mg/L and interleukin-6 (6.16 ± 0.73) pg/ml in the experimental group one women as compared to that of the control group: troponin-1 (1.18 ± 0.27) IU/L, creatinineKinase-MB (3.71 ± 0.77) IU/L, C-reactive protein (3.82 ± 0.22) mg/L and interleukin-6 (6.12 ± 0.71) pg/ml respectively.

Table 2 shows the results of hepato-renal biomarkers in post-menopause women who had been through menopause for less than 5 years (experimental group one) compared to women who had not yet gone through menopause which served as control group.

Table 2: Hepato-renal biomarkers in post-menopause women with less than 5 years (experimental group one) compared with the control group

Parameter	Control Group n= 39	Experimental Group One n = 39	p-value	Remark
ALT (U/L)	9.71 ± 0.43	9.76 ± 0.46	0.78	NS
AST (U/L)	7.86 ± 0.31	7.90 ± 0.34	0.69	NS
Urea (mmol/L)	2.77 ± 0.28	2.79 ± 0.33	0.82	NS
Creatinine (µmol/l)	61.71 ± 1.27	61.76 ± 1.30	0.88	NS

The results are expressed as mean ± SD

Keys: ALT = Alanine aminotransferase, AST = Aspartate aminotransferase, n= Number of subjects, NS = Not significant statistically

The study's findings, presented in Table 2, indicate that there were no significant statistical differences between the mean values of the measured hepato-renal biomarkers: alanine aminotransferase (9.76 ± 0.46) U/L, aspartate aminotrasferase (7.90 ± 0.34) U/L, urea (2.79 ± 0.33) mmol/L and creatinine (61.76 ± 1.30) µmol/l in the experimental group one individuals as compared with that of the control group: alanine aminotransferase (9.71 ± 0.43) U/L, (7.86 ± 0.31) U/L, (2.77 ± 0.28) mmol/L and (61.71 ± 1.27) µmol/l respectively

Table 3 shows the results of reproductive hormones in post-menopause women who had been through menopause for less than 5 years (referred to as experimental group one) compared to women who had not yet gone through menopause which served as control group.

Table 3: Reproductive hormone biomarkers in post-menopause women with less than 5 years (experimental group one) compared with the control group

Parameter	Control Group n = 39	Experimental Group One n= 39	p – value	Remark
Estradiol (pg/ml)	5.00 ± 0.39	2.10 ± 0.15	0.01	S
Progesterone (ng/ml)	4.78 ± 0.11	3.80 ± 0.11	0.04	S
FSH (mlU/ml)	3.92 ± 0.27	5.87 ± 0.68	0.04	S

The results are expressed as mean ± SD

Keys: FSH = Follicle stimulating hormone, n = Number of subjects, S = Significant statistically

The study's findings, presented in Table 3, indicate that there were significant statistical elevation in the mean value of follicle stimulating hormone (5.87 ± 0.68) mIU/ml and decrease in the mean

values of estradiol (2.10 ± 0.15) pg/ml and progesterone (3.80 ± 0.11) ng/ml in the experimental group one individuals as compared with that of the control group: follicle stimulating hormone (3.92 ± 0.27) mIU/ml, estradiol (5.00 ± 0.39) pg/ml and progesterone (4.78 ± 0.11) ng/ml respectively

Table 4 shows the results of oxidative stress biomarkers in post-menopause women who had been through menopause for less than 5 years (referred to as experimental group one) compared to women who had not yet gone through menopause which served as control group.

Table 4: Oxidative stress biomarkers in postmenopausal women with less than 5 years (experimental group one) compared with the control group

Parameter	Control Group n = 39	Experimental Group One n= 39	p-value	Remark
MDA (µmol/l)	2.67 ± 0.07	2.68 ± 0.08	0.89	NS
GPx (µmol/l)	1.87 ± 0.04	1.89 ± 0.06	0.91	NS

The results are expressed as mean ± SD

Keys: MDA = Malondialdehyde, GPX = Glutathione peroxidase, n = Number of subjects, NS = Not significant statistically

The study's findings, presented in Table 4, indicate that there were no significant statistical differences between the mean values of the measured oxidative stress biomarkers: malondialdehyde (2.68 ± 0.08) µmol/l, and glutathione peroxidase (1.89 ± 0.06) µmol/l in the experimental group one women as compared with that of the control group: (2.67 ± 0.07) µmol/l, and glutathione peroxidase (1.87 ± 0.04) µmol/l respectively.

Table 5 shows the results of cardio-inflammatory biomarkers in post-menopause women who had been through menopause for a period of 5-7 years (referred to as experimental group two) compared to women who had not yet gone through menopause which served as control group.

Table 5: Cardio-inflammatory biomarkers in post-menopause women with 5-7 years postmenopausal experience (experimental group two) compared with the control group

Parameter	Control Group n= 39	Experimental Group Two n = 39	p-value	Remark
Troponin-1 $^{x}10^{-2}$ (IU/L)	1.18 ± 0.27	1.63 ± 0.57	0.04	S
CKMB (IU/L)	3.71 ± 0.77	3.97 ± 0.54	0.05	S
CRP (mg/L)	3.82 ± 0.22	10.20 ± 1.42	0.03	S
IL-6 (pg/ml)	6.12 ± 0.71	12.11 ± 0.71	0.03	S

The results are expressed as mean ± SD

Keys: CKMB = CreatinineKinase-B, CRP = C-reactive protein, IL-6 = Interleukin-6, n= Number of subjects, S = Significant statistically

The study's findings, presented in Table 5, indicate that there were significant statistical elevation between the mean values of the measured cardio-inflammatory biomarkers: troponin-1 (1.63 ± 0.57) IU/L, creatinineKinase –MB (3.97 ± 0.54) IU/L, C-reactive protein (10.20 ± 1.42) mg/L and interleukin-6 (12.11 ± 0.71) pg/ml in the experimental group two women as compared to that of the control group: troponin-1 (1.18 ± 0.27) IU/L, creatinineKinase –MB (3.71 ± 0.77) IU/L, C-reactive protein (3.82 ± 0.22) mg/L and interleukin-6 (6.12 ± 0.71) pg/ml respectively.

Table 6 shows the results of hepato-renal biomarkers in post-menopause women who had been through menopause for 5-7 years (referred to as experimental group two) compared to women who had not yet gone through menopause which served as control group.

Table 6: Hepato-renal biomarkers in postmenopausal women with 5-7 years' postmenopausal experience (experimental group two) compared with the control group

Parameter	Control Group n= 39	Experimental Group Two n = 39	p-value	Remark
ALT (U/L)	9.71 ± 0.43	15.92 ± 0.17	0.02	S
AST (U/L)	7.86 ± 0.31	13.16 ± 0.57	0.02	S
Urea (mmol/L)	2.77 ± 0.28	12.85 ± 1.28	0.04	S
Creatinine(µmol/l)	61.71 ± 1.27	91.20 ± 1.82	0.03	S

The results are expressed as mean ± SD

Keys: ALT = Alanine aminotransferase, AST = Aspartate aminotransferase, n= Number of subjects, S = Significant statistically

The study's findings, presented in Table 6, indicate that there were significant statistical elevations between the mean values of the measured alanine aminotransferase (15.92 ± 0.17) U/L, aspartate aminotransferase (13.16 ± 0.57) U/L, urea (12.85 ± 1.28) mmol/L and creatinine (91.20 ± 1.82) µmol/l in the experimental group two women as compared to that of the control group: alanine aminotransferase (71 ± 0.43) U/L, aspartate aminotransferase (7.86 ± 0.31) U/L, urea (2.77 ± 0.28) mmol/L and creatinine (61.71 ± 1.27) µmol/l respectively.

Table 7 shows the results of reproductive hormone biomarkers in post-menopause women who had been through menopause for 5-7 years (referred to as experimental group two) compared to women who had not yet gone through menopause which served as control group.

Table 7: Reproductive hormone biomarkers in postmenopausal women with 5-7 years' postmenopausal experience (experimental group two) compared with the control group

Parameter	Control Group n = 39	Experimental Group n = 39	p – value	Remark
Estradiol (pg/ml)	5.00 ± 0.39	1.02 ± 0.09	0.01	S
Progesterone (ng/ml)	4.78 ± 0.11	3.11 ± 0.11	0.02	S
FSH (mlU/ml)	3.92 ± 0.27	13.70 ± 1.88	0.02	S

The results are expressed as mean ± SD

Keys: FSH = Follicle stimulating hormone, n = Number of subjects, S = Significant statistically

The study's findings, presented in Table 7, indicate that there were significant statistical decrease in the mean values of the measured estradiol (1.02 ± 0.09) pg/ml and progesterone (3.11 ± 0.11) ng/ml and significant elevations in the mean values of the measured follicle stimulating hormone (13.70 ± 1.88) mlU/ml in the experimental group two post-menopause women as compared to that of the control group: estradiol (5.00 ± 0.39) pg/ml, progesterone (4.78 ± 0.11) ng/ml and follicle stimulating hormone (3.92 ± 0.27) mlU/ml respectively.

Table 8 shows the results of oxidative stress biomarkers in post-menopause women who had been through menopause for 5-7 years (referred to as experimental group two) compared to women who had not yet gone through menopause which served as control group.

Table 8: Oxidative stress biomarkers in postmenopausal women with 5-7 years postmenopausal experience (experimental group two) compared with the control group

Parameter	Control Group n = 39	Experimental Group n= 39	p-value	Remark
MDA (µmol/l)	2.67 ± 0.07	3.12 ± 0.10	0.04	S
GPx (µmol/l)	1.87 ± 0.04	2.10 ± 0.09	0.04	S

The results are expressed as mean ± SD

Keys: MDA = Malondialdehyde, GP_X = Glutathione peroxidase, n = Number of subjects, S = Significant statistically

The study's findings, presented in Table 8, indicate that there were significant statistical elevations between the mean values of the measured oxidative stress biomarkers: malondialdehyde (3.12 ± 0.10) µmol/l and glutathione peroxidase (2.10 ± 0.09) µmol/l in the experimental group two women as compared to that of the control group: malondialdehyde (2.67 ± 0.07) µmol/l and glutathione peroxidase (1.87 ± 0.04) µmol/l respectively.

DISCUSSION

The objective of this study was to assess the cardio-inflammatory, hepato-renal, reproductive hormones and oxidative stress biomarkers of women who have undergone menopause for less than 5 years as well as 5-7 years respectively. This was done by comparing the mean values of the control group with that of the corresponding experimental group respectively

The cardiac biomarkers that were considered for this study are troponin-1 and creatinineKinase-MB. As shown in Table 1 the mean values of troponin-1 (p=0.91) and creatinineKinase-MB (p=0.87) in the post-menopause women with less than 5 years post-menopause experience (experimental group one) were not significantly altered as compared to that of the control group respectively. This finding which is suggestive that post-menopause women in this category are not prone to cardiac disorder is contrary to the past work of Mariana *et al.*, 2023.

The inflammatory biomarkers used in this study are C-reactive protein and interleukin-6. The results of the mean values regarding C-reactive protein (p=0.94) and interleukin- 6 (p=0.89) as shown in Table 1 (experimental group one) revealed no significant alterations when compared to the control group. This finding which contradicts the previous research conducted by Mary *et al,* 1999 suggests that women who have undergone post-menopause for less than 5 years may not be susceptible to inflammatory disorders.

The results of the hepatic enzymes alanine aminotransferase and aspartate aminotransferase that were measured in the post-menopause women for less than 5 years (experimental group one) are as presented in Table 2. The mean values for alanine aminotransferase (p=0.78), and aspartate aminotransferase (p=0.69), in comparison to that of the control group indicated no significant alterations which is suggestive of a normal liver condition in this category of post-menopause women. This finding however disagrees with the previous study conducted by Carla, 2015.

As further revealed in Table 2, the women with postmenopausal experience of less than 5 years (experimental group one) had no significant alterations in the mean values of urea (p=0.82) and creatinine (p=0.88) as compared to the control group. This finding which indicated that postmenopausal women in this category are not prone to renal disorder is not consistent with the past work of Duo *et al.*, 2022

In this study, the mean values of estradiol (p= 0.01) and progesterone (p=0.04) revealed significant decrease while follicle stimulating hormone revealed significant elevation (p=0.04) in the post-menopause women with less than 5 years postmenopausal experience as shown in Table 3 (experimental group one) when compared to the corresponding control group respectively. This finding which is consistent with the previous work conducted by Carla, 2015 indicated that postmenopausal women within this category are prone to hormonal abnormalities

As shown in Table 4, the mean values of oxidative stress biomarkers: malondialdehyde (p=0.89) and glutathione peroxidase (p=0.91) in post-menopause women with less than 5 years post-menopause experience (experimental group one) revealed no statistical significant alterations when compared with that of the control group. There is paucity of literatures that correlates with this present finding.

As shown in Table 5, the mean values of troponin-1 (p=0.04) and creatinineKinase-MB (p=0.05) in the post-menopause women with 5-7 years post-menopause experience (experimental group two) were significantly elevated as compared to that of the control group respectively. This finding which is consistent with the previous work conducted by Matthew *et al.,* 2023 and suggestive of adverse impact on the structure and function of the heart in this category of post-menopause women may be attributed to the low level of estradiol during and after menopause.

Also, the results showing the mean values of C-reactive protein (p=0.03) and Interleukin 6 (p=0.03) as presented in Table 5 (experimental group two) revealed significant elevations when compared to the control group. This finding which is in alignment with the previous research conducted by Mary *et al*., 1999 suggests that women who have been postmenopausal for 5-7 years may be susceptible to inflammatory disorders. The mechanism underlying these elevations is not clear as information about this finding is lacking. However, it is presumed that increased

deposition of visceral fat in the post-menopause period which increases the production of inflammatory cytokines and the release of tumor necrosis factor-a (TNF-a), interleukin-6 and decrease in interleukin-10 may be responsible.

As shown in Table 6, the mean values of alanine aminotransferase (p=0.02) and aspartate aminotransferase (p=0.02) in the postmenopausal women with 5-7 years postmenopausal experience (experimental group two) revealed significant elevations as compared to that of the control group. This current finding which is in agreement with the past work of Carla, 2015 may be associated with the loss of estrogen in menopause and post-menopause women which increases the likelihood of mitochondrial dysfunction, immune response declination to injury and disarray in the balance between anti-oxidant formation and oxidative stress with the sum effect contributing to an increased susceptibility to the development of pronounced liver pathology..

Table 6, further revealed significant elevations in the mean values of urea (p=0.04) and creatinine (p=0.03) in postmenopausal women with 5-7 years postmenopausal experience (experimental group two) as compared to that of the corresponding control group respectively. This finding which suggests that postmenopausal women within this category are prone to renal disorder is in agreement with the earlier work of Duo *et al.*, 2022. The mechanism for this elevation is unknown as there is paucity of relevant information regarding this finding

In the postmenopausal women with 5-7 years postmenopausal experience (experimental group two), as indicated in Table 7, the mean values of estradiol (p=0.01) and progesterone (p=0.02) revealed significant decrease while that of follicle stimulating hormone (p=0.02) revealed significant elevation when compared to that of the corresponding control group respectively. This finding which is consistent with the previous work conducted by Carla, 2015 indicates that postmenopausal women within this category are prone to hormonal abnormalities

Table 8 shows that the mean values of malondialdehyde (p=0.04) and glutathione peroxidase (p=0.04) in post-menopause women with 5-7 years post-menopause experience (experimental group two) were significantly elevated as compared to that of the control group. This present finding which may be suggestive of the initiation of a first line defensive role of vital organs by these biomarkers due to the depletion of estrogen in post-menopause women is in agreement with the past work of Sanchez-Rodriquez *et al.*, 2012.

CONCLUSION

This study has found that post-menopause women who are 5-7 years experienced may be at risk of developing cardio-inflammatory, hepato-renal, reproductive hormones and oxidative stress biomarkers abnormalities while those who are less than 5 years experienced may not be prone to these abnormalities.

Competing Interest

No competing interest

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Recommendations

(i) Post-menopause women who are 5-7 years experienced should consider undergoing a cardio-inflammatory, hepato-renal, reproductive hormones and oxidative stress biomarkers check-up.

(ii) Post-menopause women should maintain a high standard of hygiene because of their low level of estradiol which makes them easily prone to infections.

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