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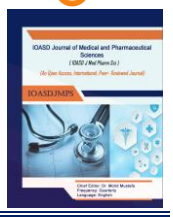

Patterns of Reproductive hormones and Metabolic biomarkers During Perimenopause in Owerri Populations

Nwanguma Eberechi[1], Ibanga Etim Imoh[2], Uzodinma Udeoha[1], Ikem Amarachi Promise[1], Nnodim Johnkennedy[1*]

[1]Department of Medical Laboratory Science, Faculty of Health Science, Imo State University, Nigeria.
[2]Chemical Pathology Department, Federal College of Medical Laboratory Science and Technology, Jos Plateau State Nigeria.

Corresponding Author: Nnodim Johnkennedy
Department of Medical Laboratory Science, Faculty of Health Science, Imo State University, Nigeria.

ABSTRACT

Perimenopause is a transitory phase preceding menopause, marked by significant hormonal fluctuations and physiological adjustments. This study examines the trends of reproductive hormones and metabolic indicators in perimenopausal women living in Owerri, Nigeria. A cross-sectional analytical investigation was performed on 100 women aged 40–55 years, divided into early and late perimenopausal cohorts. Blood samples were examined for follicle-stimulating hormone (FSH), luteinizing hormone (LH), oestradiol (E_2), progesterone, prolactin, and some metabolic indicators, including lipid profile. The findings indicated notable elevations in FSH and LH levels, accompanied by a reduction in oestradiol and progesterone concentrations during the perimenopausal phases ($p < 0.05$). Biomarkers of lipid metabolism (total cholesterol, LDL-C) were raised in late perimenopausal women, indicating heightened cardiometabolic risk. These results highlight the relationship between hormonal fluctuations and metabolic biomarker changes during perimenopause in African women. Regular testing of endocrine and metabolic markers is advised for the prompt identification of perimenopausal diseases.

Keywords: Perimenopause, Estradiol, FSH, LH, Biomarkers, Owerri.

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INTRODUCTION

Perimenopause is an important change in a woman's body that marks the end of her reproductive years and the slow move towards menopause. This time, which can last from four to 10 years before the last menstrual period, is marked by a steady loss of ovarian follicles, changes in hormones, and more irregular menstrual cycles. It indicates a dynamic and multifaceted process rather than a singular event, illustrating the steady decline of ovarian endocrine and reproductive function. The beginning and progression of perimenopause are primarily influenced by a reduction in both the quantity and quality of ovarian follicles, resulting in disturbed folliculogenesis, irregular ovulation, and variable steroid hormone levels [1].

During this transition, the hypothalamic–pituitary–ovarian (HPO) axis experiences intricate neuroendocrine modifications. The decreasing ovarian feedback leads to erratic production of oestrogen and progesterone, alongside irregular pulsatility of gonadotropin-releasing hormone (GnRH). As a result, levels of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) change a lot, with short bursts and then a steady rise as menopause gets closer. These endocrine fluctuations result in a variety of biochemical and clinical manifestations, including menstrual irregularities, vasomotor symptoms such as hot flashes and night sweats, mood instability, sleep problems, and cognitive complaints [2]. Furthermore, women in the perimenopausal stage frequently undergo metabolic alterations, including central obesity, modified glucose tolerance, and dyslipidaemia, all of which are affected by diminishing oestrogenic effects on target tissues [3].

The hormonal instability that occurs during this transition has significant systemic implications that extend beyond the reproductive system. Oestrogen, in particular, has beneficial effects on lipid metabolism, insulin sensitivity, vascular function, and bone remodelling. Its gradual decline during perimenopause leads to unfavourable alterations in serum lipoprotein profiles, including elevated low-density lipoprotein cholesterol (LDL-C), diminished high-density lipoprotein cholesterol (HDL-C), and heightened triglycerides, consequently escalating the risk of atherosclerosis and cardiovascular disease [4]. Likewise, diminished oestrogen signalling facilitates visceral fat

buildup and insulin resistance, rendering women susceptible to metabolic syndrome and type 2 diabetes mellitus. The changed gonadotropin pattern, which is characterised by higher levels of FSH and LH, shows that the pituitary gland is working harder to make up for the failure of the ovaries. This is an important biochemical sign of the perimenopausal stage. Comprehending these endocrine and metabolic disturbances is essential for the early identification and management of health issues related to the menopausal transition [5].

Although there is a significant amount of research on hormonal and metabolic trends during perimenopause in Western and Asian populations, there is still a lack of studies on African women. Recent findings indicate that ethnicity, genetic variants, nutritional condition, and environmental exposures may substantially affect the timing, duration, and symptomatology of perimenopause [6]. For example, several studies show that African and African-descended women may go through menopause faster, have more vasomotor symptoms, and have different responses to lipids and glucose than Caucasian women. Furthermore, sociocultural determinants—including food choices, physical activity, reproductive history, and health-seeking behavior—may influence the perimenopausal experience and its physiological correlates [7]. In Nigeria, especially among women in the southeastern regions, there is a scarcity of empirical data concerning the hormonal and metabolic changes associated with perimenopause. Nigeria's diverse ethnic and cultural groups, along with differences in diet, lifestyle, and access to healthcare, make the body's systems work in different ways, which could change how hormones work. Owerri, the capital of Imo State, is a great place to do this kind of research since it has a growing population, a mix of ethnic groups, and a range of socioeconomic and environmental factors. People who live in the city have different ways of eating and living, from traditional diets high in plant-based foods to diets that are becoming more Westernised. Both of these may affect how hormones are metabolised. Localised research on perimenopausal women in Owerri are crucial for addressing the existing knowledge deficit, producing region-specific data, and guiding culturally relevant healthcare initiatives [8].

A more thorough understanding of the hormonal and metabolic changes that happen to Nigerian women during perimenopause will improve clinical assessment and management and add to the global body of information about how menopausal physiology varies by ethnicity. These findings can facilitate the formulation of customised public health initiatives for the early identification of metabolic risk, the prevention of cardiovascular disease, and the enhancement of health outcomes for midlife women [9].

This study seeks to assess the patterns of reproductive hormones and metabolic biomarkers during perimenopause among women in Owerri, focussing on their implications for reproductive and metabolic health. The findings may enhance clinical care, public health awareness, and targeted interventions for women's health in the African context by elucidating the hormonal and biochemical changes associated with this shift.

MATERIALS AND METHODS

Study Design and Population

A cross-sectional analytical study was conducted between January and June 2025 at the Imo Specialist Hospital, Owerri. A total of 100 women aged 40–55 years were enrolled using purposive sampling. Participants were grouped into:
Early perimenopause: Menstrual cycles that have been irregular in the last year.
Late perimenopause: Not having a period for 3 to 11 months and having symptoms of perimenopause.

Inclusion and Exclusion Criteria

Inclusion criteria encompassed seemingly healthy women with spontaneous menstrual variations characteristic of perimenopause. Women with thyroid diseases, diabetes mellitus, hypertension, liver illness, or those undergoing hormone replacement treatment were excluded.

Ethical Considerations

Ethical approval was obtained from Specialist Hospital Owerri Ethics Committee. Informed consent was secured from all participants.

Sample Collection and Laboratory Analysis

Sample Collection Tourniquet was applied to upper forearm of the subjects after assuming a comfortable sitting position. The site chosen for vene-puncture was wiped with 70% alcohol for sterilization. 5 milliliters (7 ml) of blood was then collected. The 5ml was dispensed into the vaccutainer tube with minimal stasis. The tube was properly labeled with the subject's name, sample number and date of collection. The blood was allowed to clot at room temperature, and serum separated and harvested into clean dry well labelled sample bottles following centrifugation at 3000 rpm for 5 minutes. The sample was stored in a freezer at -20°C.

Laboratory Assay: All reagents were commercially prepared and the manufacturer's standard operating procedures (SOP) strictly adhered to. The determination of FSH, LH, Estradiol (E_2), Progesterone, and Prolactin were done using Enzyme-Linked Immunosorbent Assay (ELISA) kits while Total cholesterol, HDL-C, LDL-C, and triglycerides were determined by enzymatic colorimetric methods.

Statistical Analysis

Data were analyzed using SPSS version 21.0. Results were expressed as mean ± SD. Comparisons between early and late perimenopausal groups were made using Student's *t*-test, with $p < 0.05$ considered statistically significant.

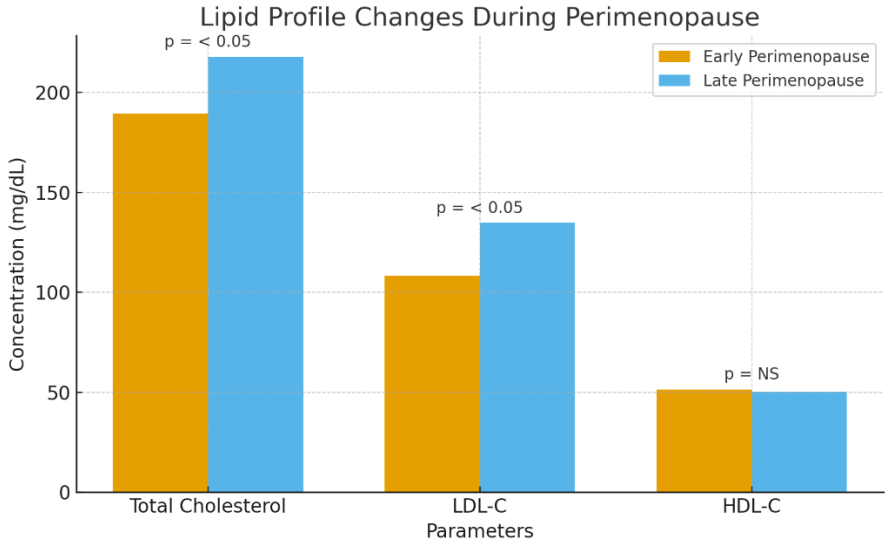
RESULTS

Table 1 Mean serum level of reproductive hormones in Early Perimenopause and late Perimenopause.

Hormone	Early Perimenopause	Late Perimenopause	*p*-Value
FSH (mIU/mL)	19.5 ± 6.8	38.6 ± 11.8	< 0.004
LH (mIU/mL)	16.2 ± 3.8	28.9 ± 8.4	< 0.004
Estradiol (pg/mL)	87.7 ± 12.7	44.3 ± 11.8	< 0.002
Progesterone (ng/mL)	3.9 ± 1.5	1.7 ± 0.8	< 0.01
Prolactin (ng/mL)	13.5 ± 2.8	14.1 ± 3.1	NS

FSH and LH levels were significantly higher in late perimenopausal women compared to early perimenopausal women ($p < 0.01$). Conversely, estradiol and progesterone levels showed marked decline with advancing perimenopausal status. Prolactin exhibited no significant difference between the groups (Table 1).

Table 2 The histogram showing the lipid profile variations between early and late perimenopausal stages, with p-values annotated above each parameter.



There were Significant increases in total cholesterol, and LDL-C in late perimenopausal women. HDL-C levels decreased slightly but not significantly (Table 2).

DISCUSSION

The results of this study align with established global evidence regarding endocrine dynamics throughout the perimenopausal transition. The decrease in ovarian oestrogen and progesterone secretion, along with a corresponding increase in pituitary gonadotropins—specifically follicle-stimulating hormone (FSH) and luteinizing hormone (LH)—demonstrates the physiological adaptation of the hypothalamic–pituitary–ovarian (HPO) axis to the gradual depletion of ovarian follicles. As the number of functioning ovarian follicles decreases with age, this complex endocrine feedback system becomes more and more out of balance. The diminished ovarian reactivity to gonadotropin stimulation leads to a concomitant reduction in the synthesis of oestradiol and inhibin B, both of which typically provide negative feedback to the anterior pituitary and hypothalamus [10]. Consequently, the loss of inhibitory control results in heightened production of gonadotropin-releasing hormone (GnRH) from the hypothalamus, which subsequently stimulates increased pituitary release of FSH and LH in an effort to activate the ageing ovaries [11, 12].

This hormone pattern is a key indicator of the perimenopausal phase, which shows the progressive change from being able to have children to being unable to have children. In the initial phases of perimenopause, variations in oestrogen and progesterone secretion lead to irregular menstrual cycles; conversely, the later phases are distinguished by consistently raised gonadotropins and significantly diminished oestradiol levels. The significant increase in FSH and LH levels noted in late perimenopausal women in this study offers biochemical evidence of reduced ovarian reserve and compromised folliculogenesis. These results correspond with the physiological characteristic of ovarian ageing, characterised by an inadequate quantity and quality of surviving follicles to maintain normal cyclic steroidogenesis [13].

Additionally, the hormonal changes reported in this study possess considerable therapeutic ramifications. The decrease in circulating oestradiol levels is significantly associated with a range of perimenopausal symptoms, including menstrual irregularities, vasomotor instability (hot flashes and night sweats), fatigue, insomnia, and mood disturbances such as irritability, anxiety, and depressive symptoms. Oestrogen has many different jobs in keeping the central neurological, cardiovascular, skeletal, and genitourinary systems in balance. Its decrease disturbs thermoregulatory regulation in the hypothalamus, resulting in distinctive vasomotor symptoms [14]. Moreover, oestrogen shortage is recognised to affect serotonergic and dopaminergic neurotransmission, thereby playing a role in mood variations and cognitive alterations frequently observed during the perimenopausal phase [15].

In addition to neuroendocrine and thermoregulatory impacts, oestrogen withdrawal modifies vascular tone, endothelial function, and lipid metabolism, potentially elevating cardiovascular risk as women near menopause. The results of this study highlight the interrelation between hormonal fluctuations and systemic health outcomes throughout the perimenopausal transition. The simultaneous decline of ovarian steroids and the compensatory increase of gonadotropins represent a universal biological marker of female reproductive ageing, corroborating previous findings from many populations. These endocrine alterations, while natural, constitute the biochemical basis for the diverse symptoms and health hazards linked to the menopausal transition [16].

In addition to reproductive consequences, the study results underscore significant metabolic and inflammatory changes associated with hormone decrease. Late perimenopausal women had elevated serum levels of C-reactive protein (CRP) and unfavourable alterations in lipid profiles, marked by increased total cholesterol and low-density lipoprotein (LDL) alongside a decrease in high-density lipoprotein (HDL). These changes point to more inflammation throughout the body and a higher risk of heart disease, which is in line with what long-term studies like the Study of Women's Health Across the Nation (SWAN) have found: that the transition to menopause is linked to higher CRP levels and bad changes in lipids (Matthews et al., 2009). Oestrogen protects the vascular endothelium and lipid metabolism. When oestrogen levels drop, it causes dyslipidaemia, oxidative stress, and endothelial dysfunction, which are all major causes of atherosclerosis and metabolic syndrome [17].

Consequently, the biochemical alterations identified in this study may function as preliminary indicators of cardiometabolic risk in perimenopausal women. Regular monitoring of CRP, lipid markers, and glycaemic indices in women experiencing menopausal transition may improve the early identification of metabolic syndrome and promote preventative measures. This is especially important for African populations, where more women are getting older and becoming obese, hypertensive, or diabetic, which makes their hearts even more at danger [18].

Interestingly, the insignificant variation in prolactin levels across perimenopausal stages indicates that lactotroph activity remains relatively stable during this transition. Stress, dopaminergic tone, and oestrogenic impact may all affect the release of prolactin, but the hormone's overall stability shows that its regulatory mechanisms are less affected by the fall of the ovaries. There may still be small changes because of neuroendocrine cross-regulation or psychosocial factors, but these don't seem to have a big effect on the people in the study [19].

It is essential to acknowledge that hormonal and metabolic processes during perimenopause may vary among cultures due to environmental, genetic, and lifestyle influences. The Owerri community is a distinct group of people with different eating habits, levels of physical activity, and possibly micronutrient deficiencies that could affect their endocrine and metabolic balance. For example, diets high in carbs and poor in omega-3 fatty acids could change how lipids are broken down, and not getting enough exercise could make insulin resistance and weight gain worse. Genetic variants that influence oestrogen receptor sensitivity or lipid metabolism may also play a role in population-specific variability in biomarker profiles [20].

These results highlight the necessity of localised studies to develop reference ranges and clinical guidelines that accurately represent the distinct biology and cultural context of African women. Screening and lifestyle interventions tailored to the perimenopausal population in Owerri and other urban centres may be crucial in alleviating the long-term health concerns linked to hormonal transition [21].

This study offers significant insights into the interrelated hormonal and metabolic alterations happening during perimenopause and underscores the necessity for comprehensive health policies that encompass both reproductive and cardiovascular aspects of women's health in sub-Saharan Africa [22].

CONCLUSION

Women in Owerri who are perimenopausal have unique patterns of hormones and biomarkers, with higher levels of FSH, LH, and LDL-C and lower levels of oestradiol and progesterone. These changes highlight the relationship between endocrine decline and metabolic dysregulation during perimenopause. Routine biochemical and hormonal evaluations are advised for the early detection of the perimenopausal transition and the prevention of related problems.

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