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Association of Hormonal Profiles with Menopausal Symptoms in Women Following Hysterectomy

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Abstract

Background: Hysterectomy is one of the most frequently performed surgical operations in gynecology, with a potential impact on ovarian function and an increase in hormonal changes causing menopausal symptoms. Changes in important hormones like Follicle-stimulating hormone (FSH), Luteinizing hormone (LH), and Inhibin B could be major contributors to the onset and severity of these symptoms. **Objective**: This study aimed to explore the relationship of hormonal profiles with menopausal symptoms among postmenopausal women after hysterectomy. **Methods**: We performed a case–control study at Al-Zahra Teaching Hospital, Al-Najaf, Iraq from June 2025 to December 2025. The study involved 48 women with a history of hysterectomy, compared to 62 age-matched healthy controls. A structured questionnaire was used to collect demographic and clinical data, including menopausal symptoms. FSH, LH and inhibin B serum levels were determined by enzyme-linked immunosorbent assay (ELISA). Statistical analyses: independent t-test, Chi-square test and correlation analysis, $P < 0.05$. **Results**: FSH (46.80 ± 8.75 mIU/mL) and LH (28.50 ± 6.20 mIU/mL) levels in women with hysterectomy were significantly higher than controls ($P < 0.05$), but inhibin B secretion was significantly lower at this stage (18.30 ± 5.10 pg/mL). Patients reported significantly more menopausal symptoms than the controls, such as hot flashes, vaginal dryness, sleep disturbances and night sweats ($p < 0.05$). High levels of FSH and LH were significantly associated with vasomotor and psychological symptoms, whereas low inhibin B was significantly linked to vaginal dryness and lack of libido. Conclusion: Hysterectomy is related with hormonal imbalance and increased menopausal symptoms. Hormonal profiling may prove particularly valuable in the assessment and management of post-hysterectomy.

Keywords: FSH, LH, Inhibin B, Hysterectomy, Menopausal Symptoms

Introduction

Hysterectomy ranks among the most common surgical procedures performed in gynecologic practice. Benign disease (eg, uterine fibroids; abnormal uterine bleeding; or pelvic organ prolapse) is often an indication for this procedure. While having therapeutic value, hysterectomy — particularly if performed with bilateral oophorectomy — may lead to profound destabilization of hormonal homeostasis and the condition recognized as surgical menopause. This phenomenon is also referred to as the sharp decline in ovarian hormone levels per hour, still much more gradual than natural menopause where transitioning can take decades (Chen & Min, 2025).

Menopause itself is a physiological stage of life, defined by cessation of ovulation due to ovarian follicular depletion and associated with major endocrine changes. The most significant hormonal change is reduced estrogen production due to high levels of gonadotropines (follicle-stimulating hormone [FSH], luteinizing hormone [LH]). This decline in hormone secretion causes multiple clinical conditions, including vasomotor symptoms (hot flashes and night sweats), urogenital atrophy, mood disturbances and metabolic changes (Yang & Toriola, 2024).

The impact of hormonal profiles on menopausal symptoms has been thoroughly studied, and the prevailing evidence indicates that estrogen deficiency may have a key role in initiating and exacerbating the symptoms. About 80% of women have menopausal symptoms, and nearly one in three say their manifestation is severe and seriously undermines quality of life. Beyond the effects on physical health, menopausal symptoms also have psychological and social impacts, including sleep disturbances (18), anxiety (19), and decreased work productivity (20) (Yang et al., 2024).

The ovaries need surgical removal in a hysterectomy and this results in loss of ovarian hormone production all of a sudden, compared to natural menopause by which there are more severe and immediate symptoms. Higher FSH and LH while low in estrogen were found during recent hysterectomy women group, indicating an imbalance on the endocrine. Even when ovaries are left in situ, hysterectomy can impact blood supply to and functioning of the ovaries leading to early menopause and menopausal symptoms (Chen & Min, 2025).

Antimullerian hormone levels in this population is clinically relevant as they have direct implications on patient management and treatment decisions. Studies of hormonal testing, measuring estrogen and FSH and some other related biochemical markers in this population, offer an important insight into the physiological status of women post hysterectomy. This review performed to update for recent studies on MHT, which remains concurrently with the most effective treatment for both alleviating vasomotor and urogenital symptoms. However, MHT should be only individualised according to the risk of cardiovascular events and/or hormone-sensitive neoplasms accompanying its application (Arnautu et al., 2025).

Recent literature has highlighted that the relationships between hormonal alterations and severity of menopausal manifestations are cross-dimensional. And scientists have come to understand that estrogen does more than facilitate reproduction, and is involved in modulating immune responses, bone metabolism, cardiovascular health and neurological function. Reduced estrogen levels have been associated with an elevated risk of osteoporosis and cardiovascular disease, as well as neurodegenerative changes, which underscore the importance of hormonal assessment in menopausal women (Yang et al., 2024).

In addition, recent studies have indicated that the clinical manifestation of menopausal symptoms appear to be related less to absolute levels of hormones than hormonal variability itself. Alternatively, dynamic hormonal patterns have the potential to further improve clinical outcome prediction; for example, when estradiol and FSH fluctuate during the menopausal transition, these changes can be associated with bone density and metabolic outcomes. These findings underscore the need to factor both quantitative and temporal variables of hormonal fluctuation into research and clinical usage (Santoro et al., 2015).

Although there are an increasing number of publications related to hysterectomy outcome data, the volume and focus on a demographically less common clinical population such as non-uterine cancer in women makes it essential for further research upon this area to understand these conditions better. Most of previous studies only focused on natural menopause, with less attention to surgical menopause/emergence of hormonal disturbances. Furthermore, the varying grades of symptoms expressed in women imply that the individual hormonal profile greatly affect clinical outcomes (Harvey et al., 2022).

This study is designed to assess the association between hormonal profiles and menopausal symptoms in hysterectomized women. This study aims to investigate the relationship between specific hormonal variables and clinical manifestations in order to help elucidate underlying mechanisms of symptom development for this population.

Methods

Patients and data collection

Over a period of six months this case-control study was conducted. From June 2025 to December 2025, it was carried out at Al-Zahra Teaching Hospital in Al-Najaf City, Iraq to evaluate whether hysterectomy alone could lead women to develop menopausal symptoms associated with their hormonal profiles, this study was conducted. A total of 110 women were enrolled into this study. There were 48 patients who had undergone hysterectomy and 62 women as a control group appearinl0 healthy. The subjects were selected from the gynecological clinic of Al-Zahra Teaching Hospital. The patient group consisted of women with a history of hysterectomy who had one or more menopausal symptoms including hot flushes, night sweats, genital dryness disturbing sleep patterns, changes in the mood and lack of sexual desire. Defined on age alone, the control group was comprised of healthy women of possibly similar age who did not void the medical history of those menopausal problems showing marked progress or hardly any progress. Women aged 40—60 years, who were willing to participate in the study and consented informedly, were included. Exclusion criteria included women with chronic systemic diseases (diabetes, cardiovascular disease, autoimmune diseases, malignancies-chronic inflammatory conditions), and psychiatric disorders. Women with known hormone disorders (i.e., thyroid, adrenal or pituitary diseases), those receiving hormonal replacement therapy, and those on medication that may interfere with hormonal balance were additionally excluded for 3 months prior as result-based confounding factors.

Data Collection

Demographic and clinical data were collected using a structured questionnaire. Variables such as age, marital status, body mass index (BMI), time since hysterectomy and specific evaluation of menopausal symptoms were include. Participants reported how often and how severe their menopausal symptoms were, with severity being determined from these reports. BMI is calculated by dividing body weight (kg) by height (m^2). According to criteria developed by the World Health Organization (WHO), the masses were categorized as underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9) or obese (≥30).

Collection of Blood Samples and Hormonal Assay

In order that every subject could at the same time in Ihe early morning, from 800am to 930 am, provide blood samples, we informed all the subjects before examination that they were not allowed to eat or drink anything according u the instructions from the manufacturer, blood samples an were obtained in a sterile state and left to coagulate at room temperature before they were centrifuged at 3000 r/min for 10 minutes. After the treatment, serum should be stored at -20 °C and departing tested. Genital follicle-stimulating hormone (FSH), luteinizing hormone (LH), and inhibin B concentrations were tested using commonly available enzyme-linked immunosorbent assays (ELISAs). The manufacturer's instructions were followed. Total incubation time was 2 h After interrupting incubation, Termination solution consisting of 3 mol/L sulfuric acid and 2 mmol/L sodium azide was added to each well. After incubation, each well was washed 4 times with washing solution and the plates were inverted to remove supernatants and dried using dry absorbent paper. 4Develop color intensity by adding substrate solutions and finally an stop solution which stops the reaction when added together. The corrected absorbance was read at a wavelength of 450nm in a microplate reader and concentration determined outside range of standard calibration curve on-last All samples were analysed in duplicate for the sake of accuracy. Stability and validity coefficient between assays did not surpass 10%.

Ethical consideration

The study protocol was reviewed and approved by the Ethics Committee of Al-Zahra Teaching Hospital, Al-Najaf, Iraq. All participants signed written consent forms This study conforms with the principles outlined in the Declaration of Helsinki (2013).

Statistics analysis

Statistical analysis was performed using the Statistical Package of Social Science (SPSS) for Windows Release 16.0 (SPSS Inc., Chicago, IL, USA). Normality of continuous variables was assessed by the Kolmogorov-Smirnov test. Data are presented as mean ± standard deviation (SD) for normally distributed variables or median (interquartile range) if not normally distributed. Comparisons between patients and control groups were conducted with the independent samples t-test for normally distributed variables and the Mann–Whitney U test for non-parametric data. Pearson’s or at need Spearman’s correlation coefficients were used to determine the relationship between serum hormone levels (FSH, LH and inhibin B) and menopausal symptom severity. Statistically significant differences were set at $p<0.05$.

The Results

Age and distribution of body mass index (BMI) for patients as well as control groups were described in Table 1. The greatest portion of both groups were in the 38–47 years age bracket,

followed by those older than 47 years old. The 18–27 years-old and the more mature age group, 28–37 years old were less frequent among patients and controls. No statistical difference was observed in age distribution between both groups (P = 0.58). This similarity also makes it easier to isolate age as a variable and explore its association with both hormonal changes during menopause and subsequent symptomatology. The mean BMI was within the normal weight range for most participants in both groups. Many were also overweight, and a substantial number were obese. The distribution across categories for BMI was relatively consistent between patients and controls. Patients were more obese, though marginally. But this does not reach statistical significance (P = 0.09). It implies that BMI distribution in both groups was comparable, and less likely to skew the relationship between hormone concentration—especially FSH, LH, and inhibin B—and menopausal symptom picture (Table 1).

Table 1. Categorization of age and body mass index between patients and control group

Items		Patients (N= 48)		Control (N= 62)		(P value)
		Freq.	%	Freq.	%	
Age	18-27	4	8.3	6	9.7	0.58 (NS)
	28-37	10	20.8	14	22.6	
	38-47	18	37.5	21	33.9	
	≥ 48	16	33.4	21	33.8	
BMI	Underweight	3	6.3	5	8.1	0.09 (NS)
	Normal	17	35.4	25	40.3	
	Overweight	16	33.3	20	32.3	
	Obese	12	25	12	19.3	

*** Non- Significant at P value >0.05**

Table 2 shows the variation in serum levels of the main reproductive hormones that measured in study, to comparing women who has hysterectomy with healthy controls. We found significantly higher levels of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) in the patient than in the control group. More precisely, patients 'LH concentrations (28.50 ± 6.20 mIU/mL) were above those in controls (22.10 ± 5.40 mIU/mL); and similarly, FSH concentration also rose for patients (46.80 ± 8.75 mIU/mL) as compared to controls (36.40 ± 7.60 mIU/mL), both differences being statistically significant (P < 0·05). These results are consistent with the physiological response to reduced ovarian function following hysterectomy. At this time, the ovaries do not produce as much estrogen, so there is no negative feedback on the hypothalamic–pituitary axis and secretion of gonadotropins consequently increase. By contrast, serum inhibin B levels were significantly lower in patients (18.30 ± 5.10 pg/mL) than in controls (32.60 ± 6.45 pg/mL) (P < 0.027). Inhibin B is mainly produced by ovarian granulosa cells and has an important function in keeping down FSH. Hence, the decrease in inhibin B levels seen here points to decreased ovarian reserve, failure in the tissues themselves or perhaps even its being removed during Resection salvaged patients (table 1).

Table 2. Differences in the levels of hormones between patients and control women

Hormones	Patients (N= 48)		Control (N= 62)		(P value)
	Mean	SD	Mean	SD	
LH (mIU/mL)	28.5	6.2	22.1	5.4	< 0.03 *
FSH (mIU/mL)	46.8	8.75	36.4	7.6	< 0.04 *
Inhibin B (pg/mL)	18.3	5.1	32.6	6.45	< 0.027 *

*** Significant at P value <0.05**

Table 3 illustrates the differences between menopause symptoms in women with and without a hysterectomy. Findings indicate that several symptoms are significantly more frequently present inpatients. In particular, hot flashes, vaginal dryness, disturbances in sleeping, and night sweats showed statistically significant differences (P 0.05), although a relative predominance of patients was apparent. This may be mats to the fact that these symptoms are not monocausal. Changes in hormone levels casta role both in etiology and course of illness well as an emotionally related factor (table 3).

Table 3. Comparison of symptoms between patients with hysterectomy and control

Indicators		Patients (N= 48)		Control (N= 62)		Chi Square	P value (Sig.)
		Freq.	%	Freq.	%		
Hot Flashes	Yes	30	62.5	18	29	10.85	0.001
	No	18	37.5	44	71		
Vaginal Dryness	Yes	28	58.3	15	24.2	12.4	0.001
	No	20	41.7	47	75.8		
Sleep Disturbance	Yes	26	54.2	20	32.3	5.36	0.02
	No	22	45.8	42	67.7		
Mood Disturbances	Yes	22	45.8	24	38.7	0.55	0.45
	No	26	54.2	38	61.3		
Night Sweats	Yes	27	56.3	17	27.4	9.21	0.002
	No	21	43.7	45	72.6		
Decrease in Libido	Yes	24	50	21	33.9	2.9	0.08
	No	24	50	41	66.1		

Table 4 shows the mean differences in serum luteinizing hormone (LH) levels between women with hysterectomy with and without menopausal symptoms. The results show that patients suffering from hot flash, sleep and mood disturbance had significantly increased LH levels (P 0.05), night sweats (P > 0.05), and decreased libido (P > 0.05). And even though LH levels were somewhat higher in symptomatic individuals, these differences were not enough to achieve statistical significance. This might indicate that these symptoms are driven by other factors, such as independent of gonadotropins (for vaginal dryness, local tissue alterations) and psychosocial factors (for libido) (table 4).

Table 4. Differences in LH patients with hysterectomy and control

Indicators		LH (mIU/mL)		T Test	P value (Sig.)
		Mean	SD		
Hot Flashes	Yes	30.2	5.9	2.21	0.02 S
	No	26.1	5.4		
Vaginal Dryness	Yes	29.1	6.1	0.65	0.46 NS
	No	28.2	5.8		
Sleep Disturbance	Yes	30	5.7	2.10	0.03 S
	No	26.8	5.3		
Mood Disturbances	Yes	29.8	6	1.8	0.04 S
	No	27	5.6		
Night Sweats	Yes	29.2	5.8	0.82	0.23 NS
	No	27.9	5.5		
Decrease in Libido	Yes	29	5.9	1.26	0.15 NS
	No	27.5	5.4		

Table 5 shows the difference in serum follicle-stimulating hormone (FSH) levels of hysterectomized women with and without menopausal symptoms. Patients who complained of hot flashes, sleep disturbances, and mood disturbances had significantly higher levels of FSH (P < 0.05). Women with hot flashes had the highest FSH levels, demonstrating a positive correlation between elevated gonadotropin levels and vasomotor symptoms. This is in concordance with the physiology as lower estrogen levels after hysterectomy lead to decreased negative feedback on the hypophyseal–pituitary axis and increased secretion of FSH. Along with that, the highly increased FSH levels in patients with sleep disturbances and mood disorders indicate a possible role of disturbed hormones on neuroendocrine axes involved in sleep control pathways and emotion stabilization. These results are consistent with prior evidence that contrasts higher levels of FSH with somatic and psychological manifestations during the transition to menopause (table 5).

Table 5. Differences in FSH patients with hysterectomy and control

Indicators		FSH (mIU/mL) (N= 48)		T Test	P value (Sig.)
		Mean	SD		
Hot Flashes	Yes	49.8	8.6	2.40	0.011
	No	43.1	7.9		S
Vaginal Dryness	Yes	47.2	8.4	0.76	0.29
	No	46.1	8.1		NS
Sleep Disturbance	Yes	48.9	8.2	1.81	0.04
	No	44.8	7.7		S
Mood Disturbances	Yes	49.1	8.5	2.11	0.02
	No	44.2	7.8		S
Night Sweats	Yes	47	8.3	0.81	0.42
	No	46.2	7.9		NS
Decrease in Libido	Yes	47.5	8.1	1.27	0.16
	No	45.3	7.8		NS

Table 6. Differences in serum inhibin B levels according to menopausal symptoms in women with hysterectomy in general, lower inhibin B levels were observed in symptomatic patients compared to asymptomatic individuals, suggesting reduced ovarian activity during symptom onset. In relation to vaginal dryness, a statistically significant difference (P = 0.03) was noted with lower inhibin B levels among women with this symptom. This supports the function of inhibin B as a marker for ovarian reserve and that reduced levels could play a role in urogenital atrophy given its association with estrogen deficiency. Inhibin B levels were also statistically significantly associated with libido; compared to men without sexual interest problems, they had much lower levels (P = 0.001). All these signs indicate that inhibin B as an ovarian activity marker may play a secondary role in sexual functionality based on its affiliation with the general hormonal status, especially oestradiol secretion. Patients with hot flashes, sleep disturbances, mood disturbances, and night sweats had lower levels of inhibin B as compared to patients without these indications; however, this difference was not statistically significant. This may show that while inhibin B is a marker of ovarian reserve, it plays less of a role in the pathophysiology of vasomotor and neuropsychological symptoms than gonadotropins such as FSH and LH (table 6).

Table 6. Differences in Inhibin B patients with hysterectomy and control

Indicators		Inhibin B (pg/mL)		T Test	P value (Sig.)
		Mean	SD		
Hot Flashes	Yes	16.2	4.8	2.75	0.01
	No	20.1	5.2		NS
Vaginal Dryness	Yes	15.9	4.6	2.17	0.03
	No	19.8	5		S
Sleep Disturbance	Yes	16.8	4.9	2.05	0.04
	No	19.2	5.1		NS
Mood Disturbances	Yes	16.5	4.7	2.16	0.03
	No	19	5		NS
Night Sweats	Yes	16	4.6	2.42	0.02
	No	19.5	5.1		NS
Decrease in Libido	Yes	14.8	4.2	3.55	0.001
	No	20.3	5.3		HS

Discussion

The aim of the current study was to determine the association between hormonal profiles (Follicle-stimulating hormone, Luteinizing hormone and Inhibin B) and menopausal symptoms in women following hysterectomy. The results indicated significant hormonal changes in the patient group compared to controls, and an increase of specific menopausal symptoms. These findings provide novel insight into the endocrine mechanisms that underlie these symptoms in hysterectomized women.

That FSH and LH is higher in the patients than in controls is (so-called) physiologic compensation for reduced ovarian function, a well-documented phenomenon that has been detailed at least 60 years ago. Changes in ovarian blood flow and neuroendocrine signalling that occur following hysterectomy typically suppress oestradiol production regardless of whether the ovaries are retained. This reduction relieves inhibition on the hypothalamic–pituitary axis then promoting gonadotropin secretion (Moorman et al., 2011). Farquhar et al. (not yet cited) and once again we have comparable data (2005), an observation that in hysterectomised women they experience earlier ovarian failure and raised gonadotrophins compared with non-operated controls.

Conversely, levels of inhibin B were significantly lower in the patient group, reflecting decreased ovarian reserve and activity of granulosa cells. It has promoted the effect on itself about FSH secretion, but inhibit FSH secretion; thus, when it decreases reveals with upregulation of FSH. Inhibin B and FSH levels have a known inverse relationship, elaborated particularly in studies of ovarian aging and transition to menopause. Such report is sustained by current data as it shows that inhibin B can be used as a sensitive marker of decline in ovarian function after hysterectomy (Burger et al., 2007).

However, when specifically looking for menopausal symptoms, patients reported much greater vasomotor symptoms (eg hot flashes/night sweats), vaginal dryness and sleep disturbances than controls. The results confirmed the findings reported in literature that estrogen deficiency is a main mediator of vasomotor and urogenital atrophy. Because the sudden changes in estrogen that

follow hysterectomy may trigger more symptoms than the gradual transition observed with natural menopause (Freeman et al., 2009).

Further insights into the symptom-specific endocrine axes were provided by analysis of hormone levels in relation to subjective symptoms. Significantly higher levels of both FSH and LH were found in patients with hot flashes, sleep disturbances, and mood disturbances. This indicates that increased gonadotropin levels may be strongly associated with vasomotor and neuropsychological symptoms. Previous studies have shown similar relationships, suggesting that levels of gonadotropins, particularly FSH, are associated with the frequency and severity of hot flashes. In addition, the relationship between high gonadotropins and sleep disorders might be mediated by an indirect action on thermoregulation and circadian rhythms (Randolph et al., 2004).

In a clinical trial interestingly, vaginal dryness was significantly related to inhibin B, but not FSH or LH. This result indicates that urogenital symptoms are likely to be more clinically relevant in terms of local estrogen deficiency, which is closely linked to ovarian reserve markers (like inhibin B) than systemic approach. Vaginal atrophy activating before the loss of hormonal secretion, which is in compliance with previous researches that state vaginal atrophy is more related to long term estrogen deficiency compared with short-term changes (Santoro & Randolph, 2011).

A higher prevalence of a significant association between obstructive dysmenorrhea and low inhibin B levels based on 14 studies corroborates the notion that ovarian functioning can affect sexual health. While libido has many determinants including psychological and social factors, hormones are a major driver. Additionally, low levels of inhibin B suggest reduced ovarian activity and therefore lower estrogen production, which correlates with lower sexual desire (Kingsberg et al., 2015).

Notably, not all of the symptoms had significant associations with hormonal levels. Night sweats and some psychological symptoms, by contrast, had low correlations with FSH, LH or inhibin B, highlighting how many of the facets of menopause have multiple determinants that are regulated not only by hormones but also genetic diversity, environmental context and psychosocial conditions (Lee et al., 2012). Other studies have found similar results and concluded that hormonal levels alone could not account for symptom severity (Freeman et al., 2009).

The present study bears important clinical instances. The relationships demonstrated between hormonal profiles and menopausal symptoms may inform the endocrine status of women post-hysterectomy as measured by FSH, LH and inhibin B so that high-risk individuals with more severe symptoms can be identified to optimize personalized management strategies, including whether or not hormone replacement therapy will feature.

Nonetheless, certain limitations should be recognized. Hormonal change as a causative factor for symptom development cannot be inferred from this cross-sectional design. Moreover, self-reported symptoms may have also introduced reporting bias. The relatively small sample size may yet further restrict generalizability of the findings. Longer studies in larger groups are needed to shed light on the timing of hormonal changes relative to symptom progression.

Conclusion

This study demonstrated that women diagnosed after hysterectomy have dramatically altered hormonal profiles consistent with diminished ovarian function, including high levels of Follicle-stimulating hormone and Luteinizing hormone to low Inhibin B (the latter in the range for menopause). These hormonal changes were found to mediate vasomotor symptoms (eg, hot flushes) and urogenital manifestations (eg, vaginal atrophy), such that a higher number of menopausal symptoms reported correlated with these hormonal alterations. Gonadotropins correlated significantly more with hot flush, sleep disturbance and mood changes but inhibin B was a relatively better correlation with vaginal dryness and decrease in libido. This study underscores the key role of hormonal dysregulation in the etiology of hysterectomy-induced menopause symptoms. Determination of these hormonal markers may enable the early diagnosis and correction in symptomatic women.

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