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Original Article

Prevalence of Normal, Premature, Early and Late Menopause and Its Correlation with Endometrial Thickness, Associated Postmenopausal Symptoms and Comorbidities on Ultrasound in Lahore

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ABSTRACT

Background: Menopause is a major reproductive milestone with important implications for gynecological, metabolic, and overall health, and variation in menopausal timing may be associated with differing endometrial and clinical profiles. Objective: To determine the prevalence of normal, premature, early, and late menopause and to evaluate their association with endometrial thickness, postmenopausal symptoms, and selected comorbidities on pelvic ultrasonography in women from Lahore. Methods: This cross-sectional observational study included 114 women presenting to major hospitals in Lahore. Participants underwent pelvic ultrasonography using transabdominal or transvaginal approaches as clinically indicated. Menopause was categorized by age at menopause into premature, early, normal, and late groups. Endometrial thickness, postmenopausal symptoms, and comorbidities were recorded on a standardized data sheet and analyzed using descriptive statistics and chi-square testing in SPSS version 24.0. Results: Normal menopause was the most prevalent type (55.3%), followed by early menopause (28.1%), late menopause (13.2%), and premature menopause (3.5%). Endometrial thickness of 1-5 mm was observed in 64.0% of participants. Menopause type was significantly associated with endometrial thickness ($p<0.001$), with 93.3% of women with late menopause demonstrating endometrial thickness greater than 5 mm. Postmenopausal symptoms were not significantly associated with menopause type, whereas postmenopausal bleeding was significantly associated with endometrial thickness ($p<0.001$). Hypertension, polycystic ovarian syndrome, and hormonal imbalance were significantly associated with menopause type, and diabetes was significantly associated with endometrial thickness ($p=0.006$). Conclusion: Menopause type in this cohort was significantly associated with endometrial thickness and selected comorbidities, while postmenopausal bleeding emerged as the symptom most strongly linked with thicker endometrium. These findings support the value of integrated ultrasound and clinical assessment in postmenopausal women. Keywords: Menopause; postmenopause; endometrial thickness; pelvic ultrasonography; postmenopausal bleeding; comorbidities.

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INTRODUCTION

Menopause is a physiological milestone marking the permanent cessation of menstruation following depletion of ovarian follicular activity and the end of reproductive potential. Clinically, natural menopause is diagnosed retrospectively after 12 consecutive months of amenorrhea in the absence of another pathological or physiological cause. The menopausal transition is accompanied by progressive endocrine changes, including declining ovarian estrogen and progesterone production, fluctuating estradiol levels, and rising gonadotropin concentrations, which together contribute to vasomotor, psychological, sleep-related, and urogenital symptoms of variable severity (1-4). Although menopause is a universal event in women, its timing is heterogeneous and clinically important because age at menopause has implications for long-term cardiometabolic, skeletal, reproductive, and gynecological health (2,5).

The usual age at natural menopause lies between 45 and 55 years, with a global average near 51 years, but menopause may occur earlier or later than this expected range. Menopause before the age of 40 years is generally categorized as premature menopause or primary ovarian insufficiency, while menopause between 40 and 45 years is considered early menopause, and menopause after 55 years is described as late menopause (5-8). These categories are not merely chronological distinctions; they reflect differing biological exposures and risk profiles. Premature and early menopause have been associated with adverse physical and psychosocial consequences, including reduced bone mineral density, cardiovascular risk, and diminished quality of life, whereas late menopause has been linked to prolonged endogenous estrogen exposure and a potentially increased risk of endometrial hyperplasia and malignancy (5,8,9). Such variation makes the study of menopausal timing clinically relevant, particularly when combined with imaging-based assessment of the uterus and endometrium.

Pelvic ultrasonography occupies an important place in postmenopausal evaluation because it provides a noninvasive means of assessing endometrial morphology and thickness. In postmenopausal women, endometrial thickness is a clinically meaningful sonographic parameter, especially when interpreted in relation to symptoms such as postmenopausal bleeding and in the context of relevant comorbidities. A thinner endometrium is generally expected in many postmenopausal women, whereas increasing endometrial thickness may warrant closer evaluation depending on the clinical scenario (10,11). However, endometrial thickness is unlikely to exist in isolation. It may vary across menopausal categories and may also interact with symptoms and metabolic or endocrine comorbidities such as hypertension, diabetes mellitus, obesity, polycystic ovarian syndrome, and hormonal imbalance, all of which may influence gynecological health across the menopausal continuum (9-12).

Existing literature has described the epidemiology of menopausal age and the symptom burden associated with menopausal transition in diverse populations, but important gaps remain. Much of the published evidence comes from non-Pakistani cohorts, and relatively limited data are available from Lahore regarding the prevalence of normal, premature, early, and late menopause within a single clinical sample. More importantly, local evidence integrating menopausal timing with ultrasound-based endometrial thickness assessment and concurrent postmenopausal symptoms and comorbidities is sparse. Most prior work has focused either on menopausal age distributions or on endometrial thickness as an isolated sonographic finding, rather than examining how menopausal categories, imaging findings, symptoms, and comorbidity patterns intersect within a hospital-based population. This limits the availability of context-specific evidence needed for clinically meaningful interpretation in Pakistani women presenting for gynecological or radiological assessment (10-12).

Given this gap, a cross-sectional observational study was undertaken among postmenopausal women in Lahore to determine the prevalence of normal, premature, early, and late menopause and to evaluate their association with endometrial thickness on pelvic ultrasonography, as well as with common postmenopausal symptoms and selected comorbidities. It was hypothesized that menopause type would show a significant relationship with endometrial thickness and selected clinical correlates, thereby providing locally relevant evidence for improved sonographic and clinical assessment of postmenopausal women (10-12).

MATERIALS AND METHODS

This cross-sectional observational study was conducted in Lahore, Pakistan, among women presenting to the Radiology Department of Sir Ganga Ram Hospital, the Obstetrics and Gynaecology Department of Aadil Hospital, the Radiology Department of Services Hospital, and associated outpatient clinical services. The study was designed to estimate the prevalence of normal, premature, early, and late menopause in the target population and to examine the association of menopause type with endometrial thickness measured on pelvic ultrasonography, along with common postmenopausal symptoms and selected comorbidities. A hospital-based analytical cross-sectional design was selected because it allowed

simultaneous characterization of menopausal category, imaging findings, symptom profile, and comorbidity burden within a defined clinical population presenting for evaluation.

A total of 114 women were included in the study. Participants were recruited consecutively from eligible women presenting during the study period to the participating departments and hospitals. Females aged 18 to 70 years with postmenopausal status or symptoms suggestive of postmenopausal changes, including postmenopausal bleeding, hot flushes, night sweats, vaginal dryness, insomnia, mood disturbance, depression, or related complaints, were considered for inclusion. Women were excluded if they were younger than 18 years or older than 70 years, were pregnant, had a prior history of hysterectomy, or had known ovarian or uterine malignancy. These exclusion criteria were applied to reduce major structural or pathological confounding that could substantially alter uterine assessment or distort classification of menopausal status. Written informed consent was obtained from all participants before enrollment, and participation was voluntary throughout the study. Confidentiality was maintained by anonymizing recorded information and restricting data use to research purposes only. Ethical conduct was maintained in accordance with institutional research principles and respect for participant privacy and autonomy.

Eligibility assessment was performed before imaging and data recording. Menopause was operationally classified according to age at menopause into four categories: premature menopause for menopause occurring between 20 and 39 years, early menopause for menopause occurring between 40 and 45 years, normal menopause for menopause occurring between 46 and 55 years, and late menopause for menopause occurring between 56 and 70 years. The principal dependent imaging variable was endometrial thickness, categorized into 1–5 mm, 6–10 mm, and 11–15 mm for descriptive and comparative analysis. Clinical variables included the presence or absence of postmenopausal bleeding, hot flushes, night sweats, vaginal dryness, insomnia, depression, and fatigue. Comorbidity variables included hypertension, diabetes mellitus, obesity, polycystic ovarian syndrome, and hormonal imbalance. These variables were selected because of their clinical relevance to menopausal health and their recurring importance in the literature on menopausal timing, endocrine function, and gynecologic risk (10-12).

Data collection was performed using a structured recording sheet developed for uniform capture of demographic and clinical variables, menopausal age category, symptom profile, comorbidities, ultrasound approach, and endometrial thickness. All participants underwent pelvic ultrasonography by either transabdominal sonography or transvaginal sonography according to clinical indication and physician recommendation. For the transabdominal approach, participants were instructed to maintain a full urinary bladder to provide an adequate acoustic window, after which ultrasound gel was applied to the lower abdomen and the pelvis was examined through the suprapubic region using an appropriate low-frequency transducer. For the transvaginal approach, participants were instructed to empty the bladder before examination, and a high-frequency endovaginal probe covered with a sterile sheath was inserted carefully to visualize the pelvic organs in sagittal and transverse planes. Radiological findings were documented systematically, and the written reports were cross-checked against recorded observations to improve internal consistency of data entry. Standardization of variable recording and use of predefined categories were employed to reduce information bias and enhance reproducibility.

Several measures were incorporated to improve methodological rigor. Uniform operational definitions were used for menopause categories and endometrial thickness groups across all participating sites. Exclusion of women with hysterectomy and known gynecological malignancy reduced the risk of major structural confounding in endometrial assessment. Use of a standardized data collection sheet helped minimize interviewer and recording variability, while direct extraction of ultrasound findings from radiological assessment reduced dependence on participant recall for the principal imaging outcome. Because this was a cross-sectional hospital-based study, the possibility of selection bias and residual confounding could not be eliminated completely; however, consecutive recruitment of eligible

participants and consistent eligibility criteria across sites were used to improve comparability within the sample. The final sample size of 114 represented all eligible and consenting participants available during the study period and was considered adequate for descriptive frequency estimation and chi-square based exploratory association testing across the predefined clinical categories.

Data were entered, checked, and analyzed using SPSS version 24.0. Descriptive statistics were used to summarize the study variables, including frequencies and percentages for categorical data. Measures such as median, mode, and standard deviation were also generated where appropriate during initial data screening. The main analytical objective was to examine associations between categorical variables; therefore, chi-square testing was applied to assess the relationship between age at menopause, menopause type, endometrial thickness category, postmenopausal symptoms, and comorbidities. A two-sided p-value of less than 0.05 was considered statistically significant. Data cleaning was performed before formal analysis to identify incomplete entries and maintain consistency between case records and ultrasound findings. Only verified observations were included in the final dataset used for analysis. Because the study objective was prevalence estimation and exploratory association analysis, no imputation procedure was applied, and analyses were based on available complete observations. The statistical plan prioritized transparent reporting of frequencies, cross-tabulations, and significance testing to allow reproducible interpretation of the observed relationships within this clinical population.

RESULTS

A total of 114 women were included in the final analysis. Most participants experienced menopause between 46 and 55 years of age, representing 63/114 women (55.3%), followed by 40–45 years in 32/114 (28.1%), 56–70 years in 15/114 (13.2%), and 20–39 years in 4/114 (3.5%). Accordingly, normal menopause was the most frequent category, observed in 63/114 participants (55.3%), followed by early menopause in 32/114 (28.1%), late menopause in 15/114 (13.2%), and premature menopause in 4/114 (3.5%). With respect to imaging technique, transabdominal sonography was performed in 68/114 women (59.6%), while transvaginal sonography was performed in 46/114 women (40.4%). Endometrial thickness was most commonly within the 1–5 mm range, found in 73/114 participants (64.0%), whereas 27/114 (23.7%) had a thickness of 6–10 mm and 14/114 (12.3%) had a thickness of 11–15 mm. These data indicate that although most women had a thin endometrium, more than one-third of the sample had an endometrial thickness above 5 mm, supporting the clinical relevance of stratified imaging analysis in this population.

Table 1. Baseline Distribution of Menopausal Age, Menopause Type, Ultrasound Approach, and Endometrial Thickness

Variable	Category	n	%
Age at menopause (years)	20–39	4	3.5
	40–45	32	28.1
	46–55	63	55.3
	56–70	15	13.2
Menopause type	Normal	63	55.3
	Premature	4	3.5
	Early	32	28.1
	Late	15	13.2
Ultrasound approach	TAS	68	59.6
	TVS	46	40.4
Endometrial thickness (mm)	1–5	73	64.0
	6–10	27	23.7
	11–15	14	12.3

A highly significant association was observed between age at menopause and menopause type ($p<0.001$). Each menopausal age category mapped directly to its corresponding menopausal classification: all 4 women aged 20–39 years were classified as premature menopause, all 32 women aged 40–45 years as early menopause, all 63 women aged 46–55 years as normal menopause, and all 15 women aged 56–70 years as late menopause. As expected, this relationship reflects the operational definitions used for menopausal categorization and should therefore be interpreted as definitional consistency rather than

an independent biological association. Endometrial thickness also varied significantly across age-at-menopause categories (p<0.001). Among women with menopause at 46–55 years, 46/63 (73.0%) had endometrial thickness of 1–5 mm, whereas among women with menopause at 56–70 years, 13/15 (86.7%) had endometrial thickness of 6–10 mm, indicating a shift toward thicker endometrium in the late menopause group.

Table 2. Association of Age at Menopause with Menopause Type and Endometrial Thickness

Predictor	Outcome Category	20–39 years n (%)	40–45 years n (%)	46–55 years n (%)	56–70 years n (%)	Total n	p-value
Menopause type	Normal	0 (0.0)	0 (0.0)	63 (100.0)	0 (0.0)	63	<0.001
	Premature	4 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	4	
	Early	0 (0.0)	32 (100.0)	0 (0.0)	0 (0.0)	32	
	Late	0 (0.0)	0 (0.0)	0 (0.0)	15 (100.0)	15	
Endometrial thickness	1–5 mm	3 (75.0)	23 (71.9)	46 (73.0)	1 (6.7)	73	<0.001
	6–10 mm	1 (25.0)	6 (18.8)	7 (11.1)	13 (86.7)	27	
	11–15 mm	0 (0.0)	3 (9.4)	10 (15.9)	1 (6.7)	14	

A statistically significant association was also found between menopause type and endometrial thickness (p<0.001). In the normal menopause group, 46/63 women (73.0%) had an endometrial thickness of 1–5 mm, 7/63 (11.1%) had 6–10 mm, and 10/63 (15.9%) had 11–15 mm. In early menopause, the corresponding proportions were 23/32 (71.9%), 6/32 (18.8%), and 3/32 (9.4%). In premature menopause, 3/4 women (75.0%) had a thickness of 1–5 mm and 1/4 (25.0%) had 6–10 mm, with no cases in the 11–15 mm category. In contrast, the late menopause group showed a markedly different distribution: only 1/15 women (6.7%) had a thickness of 1–5 mm, while 13/15 (86.7%) had a thickness of 6–10 mm and 1/15 (6.7%) had 11–15 mm. When categories were collapsed into clinically informative thresholds, 14/15 women with late menopause (93.3%) had an endometrial thickness greater than 5 mm, compared with 17/63 (27.0%) in normal menopause, 9/32 (28.1%) in early menopause, and 1/4 (25.0%) in premature menopause. This pattern suggests that late menopause carried the highest burden of sonographically thickened endometrium in this sample.

Table 3. Association of Menopause Type with Endometrial Thickness

Menopause type	1–5 mm n (%)	6–10 mm n (%)	11–15 mm n (%)	Total n	ET >5 mm n (%)	p-value
Normal	46 (73.0)	7 (11.1)	10 (15.9)	63	17 (27.0)	<0.001
Premature	3 (75.0)	1 (25.0)	0 (0.0)	4	1 (25.0)	
Early	23 (71.9)	6 (18.8)	3 (9.4)	32	9 (28.1)	
Late	1 (6.7)	13 (86.7)	1 (6.7)	15	14 (93.3)	

Postmenopausal symptoms showed no statistically significant association with menopause type. Postmenopausal bleeding occurred in 33 participants overall and was most frequent in women with normal menopause (20/63, 31.7%), followed by late menopause (7/15, 46.7%), early menopause (5/32, 15.6%), and premature menopause (1/4, 25.0%), but the overall association was not significant (p=0.150). Hot flushes were reported in 32 women and were proportionally common in early menopause (11/32, 34.4%) and late menopause (6/15, 40.0%), although again without statistical significance (p=0.282). Insomnia was the most frequently reported symptom overall, affecting 53/114 participants (46.5%), with comparable relative distribution across menopause groups, and fatigue affected 46/114 women (40.4%), also without significant variation across menopause categories (p=0.703 and p=0.265, respectively). These findings indicate that symptom burden was broadly distributed across menopause types and did not discriminate significantly between premature, early, normal, and late menopause in this cohort.

Table 4. Association of Postmenopausal Symptoms with Menopause Type

Symptom	Normal n (%)	Premature n (%)	Early n (%)	Late n (%)	Total n	p-value
Postmenopausal bleeding	20 (31.7)	1 (25.0)	5 (15.6)	7 (46.7)	33	0.150
Hot flushes	15 (23.8)	0 (0.0)	11 (34.4)	6 (40.0)	32	0.282
Night sweats	7 (11.1)	0 (0.0)	3 (9.4)	1 (6.7)	11	0.864
Vaginal dryness	6 (9.5)	0 (0.0)	1 (3.1)	0 (0.0)	7	0.392
Insomnia	29 (46.0)	3 (75.0)	14 (43.8)	7 (46.7)	53	0.703

Symptom	Normal n (%)	Premature n (%)	Early n (%)	Late n (%)	Total n	p-value
Depression	8 (12.7)	0 (0.0)	3 (9.4)	5 (33.3)	16	0.114
Fatigue	29 (46.0)	0 (0.0)	12 (37.5)	5 (33.3)	46	0.265

Comorbidity patterns differed more clearly across menopause categories. Hypertension showed a statistically significant association with menopause type (p=0.001), occurring in 23/63 women with normal menopause (36.5%) compared with 1/32 (3.1%) in early menopause, 1/15 (6.7%) in late menopause, and none in premature menopause. PCOS was also significantly associated with menopause type (p=0.003), with the highest proportional frequency in premature menopause (3/4, 75.0%) and substantial representation in early menopause (11/32, 34.4%), compared with 8/63 (12.7%) in normal menopause and 6/15 (40.0%) in late menopause. Hormonal imbalance showed a weaker but still statistically significant association (p=0.042), although the number of affected participants was small. In contrast, diabetes (p=0.228) and obesity (p=0.761) did not differ significantly across menopause groups. These results suggest that selected endocrine and cardiovascular comorbidities may cluster differently by menopausal timing, even when common symptoms do not.

Table 5. Association of Comorbidities with Menopause Type

Comorbidity	Normal n (%)	Premature n (%)	Early n (%)	Late n (%)	Total n	p-value
Hypertension	23 (36.5)	0 (0.0)	1 (3.1)	1 (6.7)	25	0.001
Diabetes	15 (23.8)	0 (0.0)	3 (9.4)	4 (26.7)	22	0.228
Obesity	12 (19.0)	0 (0.0)	6 (18.8)	2 (13.3)	20	0.761
PCOS	8 (12.7)	3 (75.0)	11 (34.4)	6 (40.0)	28	0.003
Hormonal imbalance	1 (1.6)	1 (25.0)	1 (3.1)	2 (13.3)	5	0.042

When symptoms were analyzed against endometrial thickness, postmenopausal bleeding demonstrated a strong statistically significant association (p<0.001). Of the 33 women with postmenopausal bleeding, 14 (42.4%) had an endometrial thickness of 11–15 mm, 13 (39.4%) had 6–10 mm, and only 6 (18.2%) had 1–5 mm, indicating that 27/33 women (81.8%) with bleeding had an endometrial thickness greater than 5 mm. Fatigue was also significantly associated with endometrial thickness (p<0.001), but its distribution was concentrated in the 1–5 mm group, where 40/46 women (87.0%) were represented. In contrast, hot flushes, night sweats, vaginal dryness, insomnia, and depression were not significantly related to endometrial thickness. These data reinforce the clinical importance of postmenopausal bleeding as the symptom most strongly linked with thicker endometrium in this sample.

Table 6. Association of Postmenopausal Symptoms with Endometrial Thickness

Symptom	1–5 mm n (%)	6–10 mm n (%)	11–15 mm n (%)	Total n	p-value
Postmenopausal bleeding	6 (18.2)	13 (39.4)	14 (42.4)	33	<0.001
Hot flushes	18 (56.3)	10 (31.3)	4 (12.5)	32	0.473
Night sweats	10 (90.9)	1 (9.1)	0 (0.0)	11	0.138
Vaginal dryness	6 (85.7)	1 (14.3)	0 (0.0)	7	0.419
Insomnia	40 (75.5)	9 (17.0)	4 (7.5)	53	0.058
Depression	8 (50.0)	6 (37.5)	2 (12.5)	16	0.355
Fatigue	40 (87.0)	5 (10.9)	1 (2.2)	46	<0.001

Among comorbidities, diabetes was the only variable significantly associated with endometrial thickness (p=0.006). Diabetes was present in 22 women overall, of whom 8/22 (36.4%) had an endometrial thickness of 1–5 mm, 8/22 (36.4%) had 6–10 mm, and 6/22 (27.3%) had 11–15 mm, showing a broader spread toward thicker endometrial categories than was observed for the other comorbidities. Hypertension, obesity, PCOS, and hormonal imbalance were not significantly associated with endometrial thickness, despite their numerical presence across categories. Taken together, these findings suggest that while several comorbid conditions varied by menopause type, diabetes showed the clearest direct relationship with sonographic endometrial thickness in this study.

Table 7. Association of Comorbidities with Endometrial Thickness

Comorbidity	1–5 mm n (%)	6–10 mm n (%)	11–15 mm n (%)	Total n	p-value
Hypertension	20 (80.0)	2 (8.0)	3 (12.0)	25	0.100
Diabetes	8 (36.4)	8 (36.4)	6 (27.3)	22	0.006

Comorbidity	1–5 mm n (%)	6–10 mm n (%)	11–15 mm n (%)	Total n	p-value
Obesity	13 (65.0)	5 (25.0)	2 (10.0)	20	0.940
PCOS	17 (60.7)	10 (35.7)	1 (3.6)	28	0.099
Hormonal imbalance	3 (60.0)	2 (40.0)	0 (0.0)	5	0.537

Overall prevalence estimates confirmed that normal menopause was the dominant menopausal pattern in this Lahore-based cohort, affecting 55.3% of women, while early menopause accounted for a notable 28.1%, late menopause for 13.2%, and premature menopause for 3.5%. From a clinical standpoint, the most important inferential findings were the significant association between menopause type and endometrial thickness, the concentration of endometrial thickness greater than 5 mm in the late menopause group, the strong link between postmenopausal bleeding and thicker endometrium, and the significant association between diabetes and endometrial thickness. These findings support the relevance of combining menopausal timing with targeted ultrasound interpretation in postmenopausal assessment.

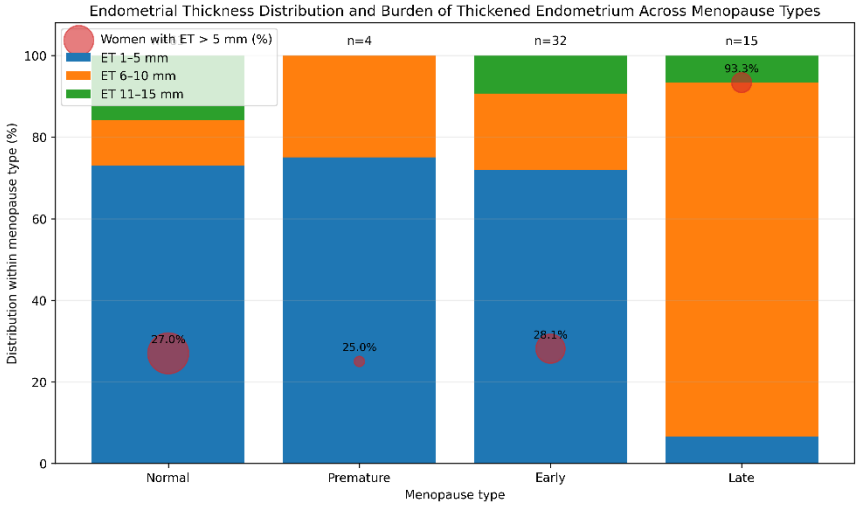

Figure 1 Endometrial Thickness Distribution and Burden of Thickened Endometrium Across Menopause Types

This figure demonstrates a marked gradient in endometrial thickness distribution across menopause types, with women experiencing late menopause showing the highest burden of endometrial thickness greater than 5 mm. Specifically, 14/15 women with late menopause (93.3%) had endometrial thickness above 5 mm, compared with 17/63 (27.0%) in normal menopause, 9/32 (28.1%) in early menopause, and 1/4 (25.0%) in premature menopause. In contrast, thin endometrium (1–5 mm) predominated in normal, early, and premature menopause, affecting 73.0%, 71.9%, and 75.0% of women in those groups, respectively, whereas only 6.7% of women with late menopause fell into this lower-thickness category. This distribution highlights a clinically important concentration of thicker endometrium among women with delayed menopausal onset, supporting closer sonographic attention in this subgroup.

DISCUSSION

The present study evaluated the prevalence of normal, premature, early, and late menopause in a hospital-based sample of women in Lahore and examined their associations with endometrial thickness, postmenopausal symptoms, and selected comorbidities using pelvic ultrasonography. The principal finding was that normal menopause constituted the largest proportion of cases, accounting for 55.3% of the study population, followed by early menopause at 28.1%, late menopause at 13.2%, and premature menopause at 3.5%. This overall pattern is broadly compatible with the established understanding that natural menopause most commonly occurs between 45 and 55 years of age, with a smaller but clinically important proportion of women experiencing menopause outside this interval (13,14). The frequency of premature menopause in the present sample was close to estimates reported in international literature, where the prevalence of menopause before 40 years has generally remained low but clinically relevant due to its adverse implications for long-term reproductive, skeletal, metabolic, and cardiovascular health

(15,16). By contrast, the proportion of early menopause observed in this study was comparatively high, suggesting that earlier menopausal transition may represent a meaningful clinical concern in the local population and warrants further investigation in broader community-based studies (17,18).

A major strength of the present work lies in its integration of menopausal timing with sonographic evaluation of endometrial thickness. A statistically significant association was observed between menopause type and endometrial thickness, with thin endometrium most commonly seen among women with normal, early, and premature menopause, whereas women with late menopause demonstrated a substantially higher proportion of endometrial thickness above 5 mm. This finding is clinically important because endometrial thickness is one of the most frequently used sonographic parameters in postmenopausal evaluation, particularly in women undergoing gynecological assessment or presenting with bleeding symptoms (19). The concentration of thicker endometrium among women with late menopause may reflect the cumulative effect of longer lifetime estrogen exposure, a concept that has been consistently linked with endometrial proliferation, hyperplasia, and increased gynecologic risk in later life (14,19). However, because the current study was cross-sectional and hospital-based, these findings should be interpreted as associations rather than evidence of temporal or causal pathways.

Another relevant observation was that postmenopausal symptoms did not differ significantly across menopause categories, despite insomnia, fatigue, postmenopausal bleeding, and hot flushes being numerically common in the cohort. This suggests that symptom burden alone may not reliably distinguish between normal, premature, early, and late menopause in this clinical sample. Previous literature has shown that menopausal symptoms are highly variable and influenced by biological, psychological, environmental, and sociocultural factors, which may explain why symptom clustering did not map clearly onto menopause type in this study (20,21). The absence of statistically significant associations across menopause groups does not imply that these symptoms are clinically unimportant; rather, it indicates that they may be broadly distributed across menopausal categories and should be interpreted alongside other demographic, endocrine, and imaging findings. This is particularly relevant in routine practice, where symptoms such as insomnia, vasomotor complaints, and mood changes frequently coexist without necessarily reflecting a specific menopausal category.

In contrast to the nonsignificant relationship between symptoms and menopause type, postmenopausal bleeding showed a strong and clinically meaningful association with endometrial thickness. More than four-fifths of women with postmenopausal bleeding had an endometrial thickness greater than 5 mm, supporting the established role of pelvic ultrasonography in the initial evaluation of bleeding after menopause. This finding aligns with prior studies indicating that increasing endometrial thickness in symptomatic postmenopausal women should prompt careful clinical attention, particularly when bleeding is persistent or recurrent (19,22). The present data therefore reinforce the practical relevance of ultrasound-based endometrial measurement in this setting and support the use of bleeding as a symptom that merits prioritized sonographic assessment. At the same time, a thin endometrium in symptomatic women should still be interpreted in full clinical context, as ultrasound findings alone do not replace histopathological evaluation when otherwise indicated.

The pattern of comorbidities in the present study further adds to the interpretation of menopausal health in this population. Hypertension, polycystic ovarian syndrome, and hormonal imbalance were significantly associated with menopause type, whereas diabetes and obesity were not. Diabetes, however, demonstrated a statistically significant association with endometrial thickness, suggesting that metabolic dysfunction may have a more direct relationship with endometrial changes than with menopause category alone. This finding is biologically plausible, given that metabolic and endocrine dysregulation can influence endometrial physiology through insulin resistance, inflammatory pathways, and altered hormonal milieu (18,23). The observed relationship between PCOS and menopause type is also noteworthy, as women with a history of chronic ovulatory dysfunction and androgen excess may experience differing reproductive aging patterns and gynecologic risk profiles. Nevertheless, caution is

warranted in interpreting these associations, since the study design does not allow control of all potential confounders and the sample size within some subgroups, particularly premature menopause and hormonal imbalance, was relatively small.

The findings should be interpreted in light of several limitations. First, the study was conducted in a hospital-based sample from Lahore, which may limit generalizability to the wider Pakistani population. Women presenting to tertiary or specialty services may differ from community populations in symptom burden, health-seeking behavior, and comorbidity profile. Second, the use of a cross-sectional design precludes inference about directionality or causation. Third, the menopausal categories were operationally based on age at menopause, which is useful for classification but also explains the definitional association observed between menopausal age groups and menopause type. Fourth, no multivariable analysis was performed to adjust for possible confounders such as parity, socioeconomic status, smoking, medication use, or body composition. Fifth, some subgroup counts were small, reducing statistical stability for certain comparisons. Despite these constraints, the study contributes meaningful local data by integrating menopausal timing, ultrasound findings, symptoms, and comorbidities within a single analytical framework.

Overall, the present study provides clinically relevant evidence that menopausal pattern in women from Lahore is not only heterogeneous but also associated with measurable differences in endometrial thickness and selected comorbidity profiles. The most clinically actionable findings were the high prevalence of normal menopause, the relatively substantial burden of early menopause, the concentration of endometrial thickness above 5 mm in late menopause, and the strong relationship between postmenopausal bleeding and thicker endometrium. These observations support a more integrated approach to postmenopausal assessment in which menopausal timing, symptom history, comorbidity status, and pelvic ultrasound findings are interpreted together rather than in isolation. Future longitudinal and multicenter studies with larger samples and adjusted analyses are needed to clarify whether these observed patterns remain consistent across broader populations and to determine their implications for screening, surveillance, and individualized gynecologic care (19,22,23).

CONCLUSION

In conclusion, normal menopause was the most prevalent menopausal pattern in this Lahore-based cohort, followed by early, late, and premature menopause, and menopause type demonstrated a significant association with endometrial thickness on pelvic ultrasonography. Women with late menopause showed the greatest burden of endometrial thickness above 5 mm, while postmenopausal bleeding was the symptom most strongly associated with thicker endometrium. Selected comorbidities, particularly hypertension, polycystic ovarian syndrome, hormonal imbalance, and diabetes in relation to endometrial thickness, also showed significant associations. These findings highlight the clinical value of combining menopausal timing with symptom review, comorbidity assessment, and ultrasound-based endometrial evaluation in postmenopausal women, while underscoring the need for larger longitudinal studies to confirm these associations and improve risk stratification in routine gynecologic practice.

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