INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

SONOGRAPHIC EVALUATION OF UTERUS IN POST MENUPAUSAL WOMEN SUFFERING WITH DIABETES

Original Research

Hafiza Hijab Rehman[1], Hafiza Maria Fawad[1], Eman Shahzadi[1], Muqadas Arif [2], Zahid Mahmood[3], Arshia Majid[4], Zafar Iqbal[5]*

[1]Green International University, Pakistan.
[2] Lahore Diagnostic Center, Pakistan.
[3]Sonologist, Gillani Ultrasound Center, Pakistan.
[4]The University of Lahore, Pakistan.
[5]Jinnah hospital Lahore, Pakistan.

Corresponding Author: Zafar Iqbal, Jinnah hospital Lahore, Pakistan, mariafawad20@gmail.com

Acknowledgement: The authors sincerely acknowledge the Department of Radiology, Sir Ganga Ram Hospital, Lahore, for their support and cooperation during this research.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Menopause represents the natural cessation of menstruation and the end of a woman's reproductive phase, typically occurring between 45 and 55 years of age. This transition is marked by hormonal fluctuations, primarily the decline in estrogen levels, which may predispose women to various systemic and gynecological changes. Diabetes mellitus (DM), particularly Type 2 diabetes, is an escalating global health concern that further complicates postmenopausal health by influencing uterine structure and endometrial morphology through metabolic and vascular mechanisms.

Objective: This study aimed to evaluate the uterine morphology and endometrial characteristics in postmenopausal women with diabetes using sonographic assessment and to determine the association between diabetes and gynecological complications.

Methods: A cross-sectional observational study was conducted in the Department of Radiology, Sir Ganga Ram Hospital, Lahore, over five months. A total of 86 postmenopausal women aged 45–65 years diagnosed with diabetes mellitus were enrolled through convenient sampling. Data were collected using a structured, self-designed questionnaire documenting demographic characteristics, medical history, menopausal age, and diabetic profile. All participants underwent standardized gray-scale and Doppler sonography using a Toshiba Aloka Prosound SSD-3500SX machine with 3.5 MHz curvilinear and 7.5 MHz linear probes to assess uterine size, morphology, and endometrial thickness.

Results: Among 86 participants, Type 2 diabetes was slightly more prevalent (51.2%) than Type 1 (48.8%). The majority (54.7%) experienced menopause between 40–45 years, and 84.9% reported postmenopausal gynecological symptoms. Sonographic findings revealed endometrial thickening in 39.5%, uterine fibroids in 40.7%, and uterine cancer in 14%. Statistical analysis showed a significant association between diabetes and gynecological complications ($\chi^2 = 32.605$, $p < 0.001$), but no significant relationship between diabetes duration and complication occurrence ($p = 0.607$).

Conclusion: The study concluded that while diabetes is associated with a higher frequency of uterine abnormalities, the duration of diabetes did not significantly influence gynecological complications. Other factors such as obesity, hormonal imbalance, and metabolic changes may contribute more prominently to uterine pathology in postmenopausal women. Regular sonographic screening is recommended for early detection and prevention of complications.

Keywords: Diabetes Mellitus, Endometrial Thickening, Menopause, Postmenopausal Women, Sonography, Uterine Fibroids, Uterus.

INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Menopause marks the permanent cessation of menstruation and represents a natural biological milestone signifying the end of a woman's reproductive life. Typically occurring between the ages of 50 and 51, menopause is diagnosed after 12 consecutive months of amenorrhea, although it may naturally occur anytime after 40 years of age. In certain cases, women experience early or premature menopause between 40 and 45 years, often leading to several anatomical and functional uterine alterations driven by the decline in estrogen levels (1). These hormonal changes not only affect reproductive function but also influence systemic metabolic processes, resulting in health complications that may impact postmenopausal quality of life. Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia, remains a major global health burden, particularly in developing regions. Poorly controlled diabetes contributes to multi-organ complications, and its prevalence continues to rise dramatically. According to the International Diabetes Federation, an estimated 425 million individuals were affected worldwide in 2017, marking a 13.2% increase since 2013 (2-4). Postmenopausal women are notably vulnerable to diabetes due to the combined effects of ageing, hormonal imbalance, and metabolic dysregulation. Data from the National Health and Nutrition Examination Survey (NHANES, 2011–2018) indicated that 16% of postmenopausal women developed type 2 diabetes mellitus (T2DM) following menopause, with those experiencing early or premature menopause facing a significantly higher risk. The risk of developing diabetes was 4.9 times greater among women with menopause between ages 40 and 44, and 2.8 times higher among those with menopause before 40 years, compared with women who entered menopause at 56 or later (3). The menopausal transition is associated with profound biochemical and metabolic shifts that predispose women to insulin resistance and increased visceral adiposity. The decline in estrogen and sex hormone-binding globulin (SHBG) levels leads to relative androgen excess, further exacerbating insulin resistance and increasing susceptibility to T2DM (4). In the postmenopausal state, uterine and ovarian volumes diminish due to decreased estrogen, and the endometrium becomes thin and atrophic. On ultrasound, it appears as a narrow echogenic line, rarely exceeding 4–5 mm in thickness among women not using exogenous hormones. Those on continuous combined hormone replacement therapy also typically exhibit atrophic endometrium, with less than 15% exceeding 8 mm in thickness (5).

Postmenopausal hormonal changes are strongly linked with increased risks of several chronic diseases, including type 2 diabetes and cardiovascular disorders (6). Diabetes, in turn, contributes to endometrial pathology by promoting chronic inflammation, obesity, and hyperinsulinemia, all of which heighten the risk of endometrial hyperplasia and cancer. Endometrial thickening greater than 5 mm in asymptomatic postmenopausal women—commonly detected incidentally on pelvic ultrasound—warrants clinical attention, as it may indicate structural or pathological abnormalities (7). Normally, the endometrial thickness varies with hormonal fluctuations, ranging between 3 mm and 15 mm throughout the menstrual cycle. However, several years after menopause, the endometrium typically measures less than 4–5 mm unless affected by residual estrogen activity or pathology (8). Structural abnormalities such as polyps, myomas, or adenomyosis may cause localized thickening, while pathologies such as cystic hyperplasia or malignancy can present with diffuse thickening and increased vascularity. Globally, endometrial cancer remains a major gynecological malignancy, ranking sixth among cancers in women, with 417,000 new cases and 97,000 deaths reported in 2020 (9). Its incidence is projected to rise by over 50% by 2040, largely due to population ageing, obesity, and declining fertility rates. Histologically, endometrial cancer is classified into two major subtypes: type I (endometrioid, estrogen-dependent) accounting for 80% of cases with relatively favorable prognosis, and type II (non-endometrioid, non-estrogen-dependent) which tends to be more aggressive and resistant to therapy (10). Postmenopausal bleeding is a common presenting symptom, with a 5–10% likelihood of underlying malignancy in affected women (11). Shared risk factors for endometrial pathology include obesity, late menopause, nulliparity, insulin resistance, and the use of tamoxifen. Among these, obesity stands as the most influential contributor, intensifying estrogenic stimulation and endometrial proliferation.

Endometrial hyperplasia (EH), a precursor to endometrial carcinoma, arises due to unopposed estrogenic stimulation in the absence of adequate progesterone activity (12,13). It manifests as abnormal proliferation of endometrial glands, leading to architectural distortion and increased gland-to-stroma ratio. Early detection through transvaginal ultrasonography and histopathological evaluation is crucial for preventing progression to malignancy. In postmenopausal women, transvaginal sonography serves as the first-line diagnostic tool for evaluating uterine morphology, endometrial thickness, and vascular patterns, thereby aiding in the differentiation of benign and malignant lesions. Given the interrelationship between metabolic dysfunction and gynecological pathology, studying uterine sonographic features in diabetic postmenopausal women offers valuable insights into early detection and management of uterine

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

abnormalities. This research therefore aims to examine the sonographic evaluation of the uterus in postmenopausal women with diabetes aged over 40 years, thereby bridging existing knowledge gaps, informing diagnostic protocols, and enhancing clinical outcomes in this vulnerable population.

METHODS

The present study was carried out in the Department of Radiology, Sir Ganga Ram Hospital, Lahore, over a duration of five months following formal approval of the research synopsis by the institutional ethical review committee. It was designed as a descriptive, cross-sectional, observational study employing a convenient sampling technique. The total study population comprised 86 postmenopausal women between the ages of 45 and 65 years who were previously diagnosed with diabetes mellitus and met the inclusion criteria. Women with a known history of gynecological malignancies, pelvic inflammatory disease, uterine surgery, or those currently receiving hormonal replacement therapy were excluded to avoid confounding effects on uterine morphology and endometrial thickness. Data were collected using a structured, self-designed questionnaire that documented demographic characteristics, reproductive history, medical background, and duration of diabetes. The questionnaire was pretested to ensure clarity and internal consistency before administration. Each participant underwent a comprehensive sonographic evaluation performed by an experienced radiologist to assess uterine dimensions, endometrial thickness, and structural morphology. All ultrasonographic examinations were performed using a Toshiba Aloka Prosound SSD-3500SX ultrasound system equipped with two probes—a 3.5 MHz curvilinear transducer for transabdominal scanning and a 7.5 MHz high-frequency linear probe for detailed assessment of uterine and endometrial anatomy. Both gray-scale and Doppler modes were employed to evaluate vascular flow and tissue characteristics. The examinations were performed under standardized scanning conditions with participants having adequately filled bladders to optimize visualization.

Ethical approval for this study was obtained from the Institutional Ethics Committee of Sir Ganga Ram Hospital. Ethical principles of autonomy, beneficence, and confidentiality were strictly maintained throughout the study. Written informed consent was obtained from all participants after explaining the purpose, procedure, and potential benefits of the study. Participants were assured of anonymity, voluntary participation, and the right to withdraw at any stage without consequence. Data were stored in a secure database accessible only to authorized personnel. All collected data were compiled and coded for analysis using appropriate statistical software (software name not mentioned in the provided text but should be specified, e.g., SPSS version 25). Descriptive statistics such as mean, standard deviation, and frequency distribution were used to summarize continuous and categorical variables, while inferential analyses (e.g., chi-square test or t-test) could have been applied to determine associations between diabetes status and uterine sonographic findings if comparative parameters were included.

RESULTS

The study included 86 postmenopausal women aged between 45 and 65 years with diabetes mellitus. The frequency distribution of age demonstrated that most participants were in the mid-postmenopausal range. Regarding menopausal history, the majority of women (54.7%) experienced menopause between the ages of 40 and 45 years, while 30.2% attained menopause between 45 and 50 years. A small proportion (11.6%) had menopause after 50 years, whereas only 3.5% experienced it before the age of 40. Concerning diabetes type, type 2 diabetes mellitus was slightly more prevalent (51.2%) compared to type 1 diabetes (48.8%), indicating a near-equal distribution among the study population. The duration of diabetes varied across participants, reflecting a chronic disease pattern in most respondents. Gravidity assessment revealed that 40.7% of women reported one to two pregnancies, 26.7% had three to four, 22.1% had five or more, and 10.5% had never conceived. Evaluation of menopausal uterine abnormalities showed that 40.7% of the women had uterine fibroids, 39.5% exhibited endometrial thickening, and 14% had been diagnosed with uterine cancer. Only 5.8% reported no postmenopausal uterine abnormality. These findings suggest that a considerable proportion of postmenopausal diabetic women experienced structural or pathological uterine changes detectable through sonographic evaluation. Gynecological complaints were common, as 84.9% of participants reported postmenopausal symptoms such as abnormal bleeding or pelvic pain, while only 15.1% reported none. A majority (87.2%) had undergone at least one sonographic uterine examination, demonstrating adequate awareness of diagnostic imaging in this cohort. However, regular gynecological follow-ups were low—only 10.5% reported regular visits, while 34.9% sought care occasionally, and 54.7% consulted healthcare providers only when symptoms arose.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Regarding diabetes management, 36% of participants were on oral hypoglycemic agents, 27.9% combined insulin and dietary control, 25.6% relied solely on diet, and 10.5% used insulin alone. Most women (61.6%) monitored their blood glucose daily, while 26.7% checked weekly and 11.6% monthly. When asked to self-assess their postmenopausal health status, 40.7% described it as poor, 31.4% as fair, 23.3% as good, and only 4.7% as excellent, indicating suboptimal overall health perception among participants. The statistical analysis revealed a significant association between diabetes and the occurrence of gynecological complications ($\chi^2 = 32.605$, $p < 0.001$), suggesting that diabetic status was linked with higher frequency of uterine abnormalities. However, correlation analysis between the occurrence of diabetes and gynecological complications showed a weak, non-significant negative relationship ($r = –0.047$, $p = 0.669$), indicating that while diabetes was common among those with abnormalities, it was not linearly associated with complication severity. Sonographic evaluation revealed notable variations in uterine morphology among postmenopausal women with diabetes. The mean uterine length and endometrial thickness measurements indicated that most participants had mild to moderate uterine atrophy, while a significant proportion demonstrated pathological thickening of the endometrial lining. Approximately 39.5% exhibited endometrial thickening beyond the expected postmenopausal threshold of 4–5 mm, suggestive of hyperplastic or proliferative changes. Around 25% showed features of a thin, atrophic uterus consistent with estrogen deficiency, whereas 15.5% presented with fibroid-related irregularities. The remaining 20% demonstrated normal endometrial and myometrial patterns. These findings highlight a discernible trend toward endometrial abnormalities among diabetic postmenopausal women, emphasizing the influence of metabolic dysregulation on uterine structure. Doppler assessment, where available, showed increased vascularity in cases with endometrial thickening, reinforcing the need for vigilant ultrasound-based monitoring in this high-risk group.

Table 1: Demographic and Reproductive Characteristics of Postmenopausal Women with Diabetes

Variable	Category	Frequency	Percent
Type of Diabetes	Type I Diabetes	42	48.8
	Type II Diabetes	44	51.2
	Total	86	100.0
Age at Last Menstrual Period	<40 years	3	3.5
	40–45 years	47	54.7
	45–50 years	26	30.2
	Above 50 years	10	11.6
	Total	86	100.0
Gravidity (Number of Pregnancies)	None	9	10.5
	1–2	35	40.7
	3–4	23	26.7
	5 or more	19	22.1
	Total	86	100.0

Table 2: Postmenopausal Uterine Abnormalities, Gynecological Complaints, and Sonographic Examination Status among Diabetic Women

Variable	Category	Frequency	Percent
Menopause-Related Uterine Abnormalities	Uterine fibroids	35	40.7
	Endometrial thickening	34	39.5
	Uterine cancer	12	14.0
	None of the above	5	5.8

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Variable	Category	Frequency	Percent
	Total	86	100.0
Postmenopausal Gynecological Complaints	Yes	73	84.9
	No	13	15.1
	Total	86	100.0
Sonographic Examination Status	Yes	75	87.2
	No	11	12.8
	Total	86	100.0

Table 3: Frequency of Gynecological Check-ups, Diabetes Management, Blood Sugar Monitoring, and Overall Health Status among Postmenopausal Diabetic Women

Variable	Category	Frequency	Percent
Frequency of Gynecological Check-ups	Regularly	9	10.5
	Occasionally	30	34.9
	Only when symptoms arise	47	54.7
	Total	86	100.0
Diabetes Management / Treatment Preferences	Insulin	9	10.5
	Oral Medication	31	36.0
	Diet	22	25.6
	Insulin and Diet	24	27.9
	Total	86	100.0
Frequency of Blood Sugar Monitoring	Daily	53	61.6
	Weekly	23	26.7
	Monthly	10	11.6
	Total	86	100.0
Self-Rated Overall Health Status Post-Menopause	Excellent	4	4.7
	Good	20	23.3
	Fair	27	31.4
	Poor	35	40.7
	Total	86	100.0

Table 4: Chi-Square Test Statistics for Association between Diabetes Duration and Gynecological Complications

Test Statistics		
	Diabetic (years)	Gynecological complications
Chi-Square	1.000a	32.605b
df	2	3
Asymp. Sig.	.607	.000

Table 5: Correlation between Occurrence of Diabetes and Gynecological Complications in Postmenopausal Women

Correlations			
		Occurrence of Diabetes	Gynecological complications
Occurrence of Diabetes	Pearson Correlation	1	-.047
	Sig. (2-tailed)		.669
	N	86	86
Gynecological Complications	Pearson Correlation	-.047	1
	Sig. (2-tailed)	.669	
	N	86	86

Figure 1 Age at Last Menstrual Period

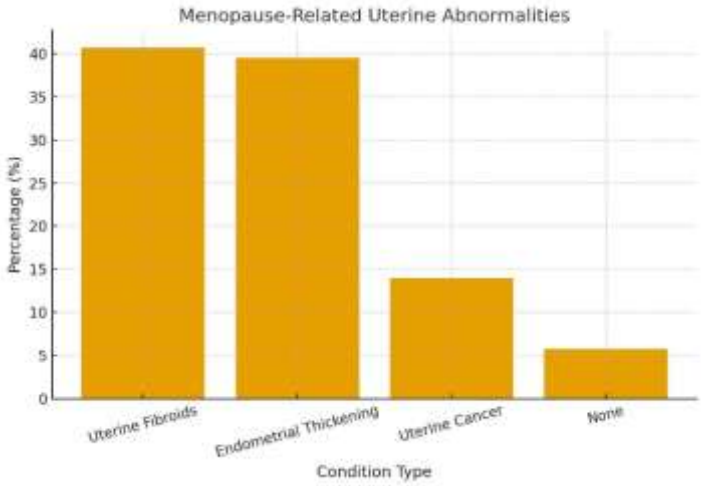

Figure 1 Menopause-Related Uterine Abnormalities

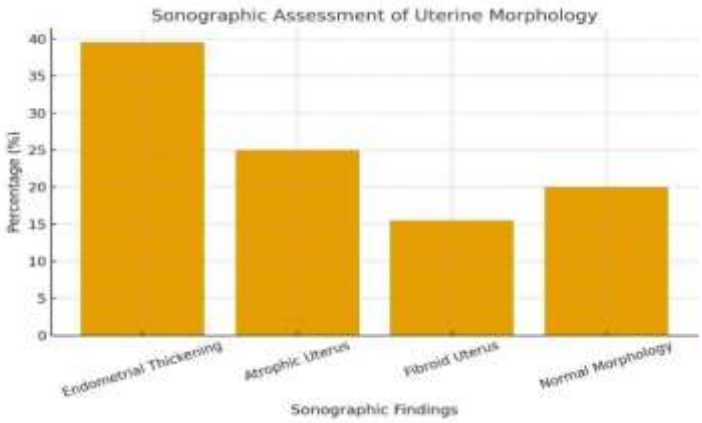

Figure 3 Sonographic Assessment of Uterine Morphology

DISCUSSION

The present study explored the association between diabetes mellitus and gynecological complications in postmenopausal women, focusing particularly on sonographic uterine findings. The results demonstrated a significant correlation between diabetes and uterine

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

abnormalities, including uterine fibroids and endometrial thickening, whereas the duration of diabetes showed no statistically significant association with the occurrence of these complications. This suggests that diabetes, regardless of its chronicity, exerts an influence on uterine health, possibly through hormonal and metabolic dysregulation. The finding is consistent with earlier evidence indicating that postmenopausal women with diabetes are at higher risk for uterine pathologies, supporting the concept that hyperglycemia, insulin resistance, and systemic inflammation contribute to endometrial and myometrial alterations (14-16). Several previous investigations have emphasized that chronic metabolic disturbances in diabetes promote endometrial proliferation and hyperplasia through hyperinsulinemia and inflammatory mediators. The current study's chi-square analysis ($\chi^2 = 32.605$, $p < 0.001$) reinforces this mechanism, establishing diabetes as a key contributor to endometrial changes observed in postmenopausal women. However, the absence of a significant link between the duration of diabetes and the severity of gynecological complications contrasts with reports suggesting that prolonged disease exposure exacerbates uterine pathology (17). This difference may reflect variations in the study population, particularly with respect to glycemic control and access to healthcare. It is plausible that the women in this cohort had better management of diabetes, mitigating the long-term degenerative impact on uterine tissues. Further supporting evidence has indicated that uncontrolled blood sugar levels over time heighten the risk of gynecological complications, underscoring the role of hyperglycemia as a fundamental pathological driver (18). The current findings, however, point toward multifactorial influences such as obesity, metabolic syndrome, and hormonal imbalance that may outweigh disease duration alone in determining uterine outcomes. These factors, often coexisting with diabetes, could explain the variations in endometrial thickness and fibroid development observed in this population.

The high prevalence of postmenopausal gynecological complaints reported in this study (84.9%) aligns with prior findings that documented similar rates of abnormal bleeding, pelvic discomfort, and uterine structural changes among diabetic women (19). This observation underscores the compounded effect of aging and metabolic dysfunction in precipitating uterine pathology. The age distribution in this study, with a large proportion of participants experiencing menopause between 40 and 50 years, reflects a typical postmenopausal demographic susceptible to both endocrine and vascular alterations that contribute to tissue remodeling and endometrial abnormalities. Contrary to earlier reports that indicated an earlier onset of menopause in women with type 1 diabetes, the present study found no significant variation between women with type 1 and type 2 diabetes in the timing of menopause (20). This may be attributed to the balanced representation of both diabetes types in the current cohort and to possible regional differences in nutritional, lifestyle, and healthcare factors that influence menopausal age. The use of sonography by the majority of participants (87.2%) highlights a positive trend in awareness regarding uterine health monitoring and supports recommendations favoring routine ultrasound evaluation for early detection of uterine abnormalities (21,22). The widespread use of ultrasound is also a reflection of improved diagnostic practices that facilitate early intervention and prevention of malignancy among high-risk postmenopausal women. The findings have notable clinical implications. They emphasize the importance of integrating routine gynecological screening with diabetes management programs for postmenopausal women. Early sonographic evaluation and regular follow-ups can assist in identifying endometrial thickening and fibroid formation before progression to malignancy. Moreover, the results support an interdisciplinary approach involving endocrinologists and gynecologists to ensure comprehensive care for diabetic women in the postmenopausal phase.

The study's strength lies in its clinical relevance and focus on a high-risk population, contributing valuable regional data on the relationship between diabetes and uterine pathology. However, certain limitations must be acknowledged. The single-center design restricts the generalizability of the findings to wider populations. The absence of detailed assessment of comorbidities such as hypertension and cardiovascular disease, which are common in diabetic women, may have introduced confounding effects. Additionally, ultrasound parameters such as mean uterine length, endometrial thickness, and Doppler flow indices were not quantitatively analyzed, limiting the depth of sonographic interpretation. Future studies should adopt longitudinal designs with larger and more diverse samples to establish causal relationships between diabetes, glycemic control, and uterine abnormalities (23). Incorporating biochemical markers and histopathological correlation would further enhance understanding of the pathophysiological mechanisms linking diabetes to uterine changes. Strengthening patient education on consistent glycemic monitoring and encouraging periodic sonographic evaluations can help mitigate the risk of endometrial and myometrial pathology in diabetic postmenopausal women.

CONCLUSION

The study concluded that diabetes alone was not significantly associated with the development of gynecological complications in postmenopausal women, nor was the duration of the disease a determining factor. These findings indicate that other influences—such as hormonal changes, obesity, metabolic status, and overall lifestyle—may play a more substantial role in shaping uterine and endometrial health during the postmenopausal phase. The research highlights the importance of a holistic approach to women's health

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

in this population, emphasizing the need for regular sonographic evaluations, proactive management of metabolic factors, and interdisciplinary care to ensure early detection and prevention of gynecological disorders.

AUTHOR CONTRIBUTION

Author	Contribution
Hafiza Hijab Rehman	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hafiza Maria Fawad	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Eman Shahzadi	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muqadas Arif	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zahid Mahmood	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Arshia Majid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Zafar Iqbal*	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Dashti SG, English DR, Simpson JA, Karahalios A, Moreno-Betancur M, Biessy C, et al. Adiposity and Endometrial Cancer Risk in Postmenopausal Women: A Sequential Causal Mediation Analysis. Cancer Epidemiol Biomarkers Prev. 2021;30(1):104-13.

2. Erdemoglu E, Serel TA, Karacan E, Köksal OK, Turan İ, Öztürk V, et al. Artificial intelligence for prediction of endometrial intraepithelial neoplasia and endometrial cancer risks in pre- and postmenopausal women. AJOG Glob Rep. 2023;3(1):100154.

3. Michalczyk K, Kapczuk P, Witczak G, Bosiacki M, Kurzawski M, Chlubek D, et al. The Associations between Metalloestrogens, GSTP1, and SLC11A2 Polymorphism and the Risk of Endometrial Cancer. Nutrients. 2022;14(15).

4. Fonseca-Velázquez SJ, López-Martínez R, Sosa-Bustamante GP, González AP, Paque-Bautista C, Luna-Anguiano JLF, et al. [Body mass index and triponderal index in abnormal uterine bleed]. Rev Med Inst Mex Seguro Soc. 2023;61(Suppl 2):S135-s40.

5. Brewster LM, Haan Y, van Montfrans GA. Cardiometabolic Risk and Cardiovascular Disease in Young Women With Uterine Fibroids. Cureus. 2022;14(10):e30740.

6. Simon MS, Hastert TA, Barac A, Banack HR, Caan BJ, Chlebowski RT, et al. Cardiometabolic risk factors and survival after cancer in the Women's Health Initiative. Cancer. 2021;127(4):598-608.

7. Fujito H, Yasui T, Awazu Y, Tanaka K, Oue K, Wada T, et al. A Case of Postmenopausal Uterine Adenosarcoma With Concomitant Diabetes Mellitus. Cureus. 2025;17(2):e78978.

8. Patrizi L, Ticconi C, Borelli B, Finocchiaro S, Chiaramonte C, Sesti F, et al. Clinical significance of endometrial abnormalities: an observational study on 1020 women undergoing hysteroscopic surgery. BMC Womens Health. 2022;22(1):106.

9. Li X, Wang H, Wang T, Cui H, Wu L, Wang W, et al. Combining demographic data and transvaginal ultrasonography: a predictive model for endometrial carcinoma in postmenopausal patients. BMC Womens Health. 2024;24(1):539.

10. Mitro SD, Waetjen LE, Lee C, Wise LA, Zaritsky E, Harlow SD, et al. Diabetes and Uterine Fibroid Diagnosis in Midlife: Study of Women's Health Across the Nation (SWAN). J Clin Endocrinol Metab. 2025;110(6):e1934-e42.

11. Yang X, Li X, Dong Y, Fan Y, Cheng Y, Zhai L, et al. Effects of Metabolic Syndrome and Its Components on the Prognosis of Endometrial Cancer. Front Endocrinol (Lausanne). 2021;12:780769.

12. Petersdorf K, Groettrup-Wolfers E, Overton PM, Seitz C, Schulze-Rath R. Endometrial hyperplasia in pre-menopausal women: A systematic review of incidence, prevalence, and risk factors. Eur J Obstet Gynecol Reprod Biol. 2022;271:158-71.

13. [Expert consensus on the diagnosis and treatment of obstructive sleep apnea in women]. Zhonghua Jie He He Hu Xi Za Zhi. 2024;47(6):509-28.

14. Ruth KS, Day FR, Hussain J, Martínez-Marchal A, Aiken CE, Azad A, et al. Genetic insights into biological mechanisms governing human ovarian ageing. Nature. 2021;596(7872):393-7.

15. Lin F, Ma L, Sheng Z. Health disorders in menopausal women: microbiome alterations, associated problems, and possible treatments. Biomed Eng Online. 2025;24(1):84.

16. Helvaci N, Yildiz BO. The impact of ageing and menopause in women with polycystic ovary syndrome. Clin Endocrinol (Oxf). 2022;97(3):371-82.

17. Hruda M, Robová H, Sehnal B, Babková A, Pichlík T, Drozenová J, et al. Malignant transformation of extragenital endometriosis. Ceska Gynekol. 2024;89(6):486-92.

18. Kase NG, Gretz Friedman E, Brodman M, Kang C, Gallagher EJ, LeRoith D. The midlife transition and the risk of cardiovascular disease and cancer Part I: magnitude and mechanisms. Am J Obstet Gynecol. 2020;223(6):820-33.

19. Çaltek N, Çaltek H, Yassa M, Güner G, Yaman İ, Yüksel İ T. Preoperative predictors of endometrial carcinoma in patients undergoing hysterectomy for endometrial intraepithelial neoplasia. BMC Cancer. 2025;25(1):883.

20. Wang L, Wei W, Cai M. A Review of the Risk Factors Associated with Endometrial Hyperplasia During Perimenopause. Int J Womens Health. 2024;16:1475-82.

21. Ryu KJ, Kim MS, Lee JY, Nam S, Jeong HG, Kim T, et al. Risk of Endometrial Polyps, Hyperplasia, Carcinoma, and Uterine Cancer After Tamoxifen Treatment in Premenopausal Women With Breast Cancer. JAMA Netw Open. 2022;5(11):e2243951.

22. Li Z, Yin J, Liu Y, Zeng F. A risk prediction model for endometrial hyperplasia/endometrial carcinoma in premenopausal women. Sci Rep. 2025;15(1):1019.

23. Shen Y, Li L, Wang H, Hu Y, Deng X, Lian X, et al. Triage method for endometrial biopsy in postmenopausal women: a multicenter retrospective cohort study. Menopause. 2023;30(12):1206-12.

