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ORIGINAL ARTICLE

PREVALENCE AND MENSTRUAL CORRELATES OF ULTRASOUND-DETECTED UTERINE PATHOLOGIES AMONG REPRODUCTIVE-AGED UNIVERSITY STUDENTS

PREVALENCIA Y CORRELATOS MENSTRUALES DE LAS PATOLOGÍAS UTERINAS DETECTADAS POR ECOGRAFÍA EN ESTUDIANTES UNIVERSITARIAS EN EDAD REPRODUCTIVA

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ABSTRACT

Objective: Uterine pathologies contribute to gynecological morbidity but remain understudied in young populations in sub-Saharan Africa. This study investigated the prevalence of uterine pathologies and examined their associations with menstrual characteristics, lifestyle factors, and uterine morphometry among reproductive-aged students. **Material and Methods:** This cross-sectional study included 236 female students aged 15–49 years from Nnamdi Azikiwe University. Data on menstrual history and lifestyle factors were collected using a questionnaire, while pelvic ultrasonography was used to assess uterine pathologies and morphometry. Associations were evaluated using Fisher's exact test and Mann–Whitney U test, with statistical significance set at $p<0.05$. **Results:** The prevalence of any uterine pathology was 9.3%, with fibroids being the most common (5.1%) and adenomyosis rare (1.3%). No significant associations were observed between uterine pathology and menstrual cycle regularity, cycle length, menstrual pain, or overall symptom burden ($p>0.05$). Among lifestyle factors, low physical activity was significantly associated with higher prevalence of uterine pathology (13.7% vs 3.9%, $p=0.012$). Participants with uterine pathology demonstrated significantly greater uterine volume ($p=0.027$) and cervical anteroposterior diameter ($p=0.014$), while other morphometric parameters showed no significant differences. **Conclusions:** Uterine pathologies were relatively uncommon and not associated with menstrual characteristics in this young population, suggesting that such conditions may remain clinically silent in early reproductive life. The association with low physical activity highlights a potential modifiable factor, while morphometric differences indicate early structural changes detectable by ultrasound. Further longitudinal studies are needed to clarify the natural history and determinants of uterine pathology in young women.

Keywords: Leiomyoma, Adenomyosis, Menstrual cycle, Exercise, Ultrasonography *(Source: MeSH, NLM)*

INTRODUCTION

Structural uterine pathologies, including uterine fibroids (leiomyomas), endometrial polyps, and adenomyosis, account for a substantial share of gynecological morbidity among women of reproductive age. These conditions are frequently associated with abnormal uterine bleeding, dysmenorrhea, pelvic pain, and adverse reproductive outcomes, and they often have considerable effects on quality of life and psychosocial well-being (1-3). Uterine fibroids are the most common benign tumors in women and a leading cause of heavy menstrual bleeding and healthcare utilization worldwide (4,5). Adenomyosis and endometrial polyps, although diagnosed less frequently, also contribute to menstrual disturbances and reproductive dysfunction, and they are increasingly recognized in younger women (6,7).

The reported epidemiology of these conditions varies widely across populations and diagnostic approaches. Ultrasound-based studies have reported fibroid prevalence ranging from 20% to 70% across the reproductive lifespan, with a disproportionately higher burden among women of African descent (5,8). Adenomyosis, traditionally regarded as a condition of older multiparous women, is now being identified more often in younger cohorts, although prevalence estimates remain inconsistent because of diagnostic limitations and heterogeneous study populations (9,10). Endometrial polyps are often asymptomatic but may coexist with other uterine abnormalities and contribute to abnormal bleeding (6). Importantly, most of the available evidence comes from hospital-based or infertile populations, which limits its generalizability to asymptomatic or community-based groups.

Menstrual health offers an important clinical window into underlying reproductive pathology. Alterations in cycle regularity, cycle length, and menstrual symptoms have been associated with both structural and functional gynecological conditions (11,12). However, menstrual experience is shaped by a complex interplay of biological, behavioral, and psychosocial factors. Lifestyle determinants such as obesity, physical inactivity, alcohol consumption, and stress have been implicated in the development and progression of uterine fibroids, although findings have been inconsistent across settings (13-15). These discrepancies underscore the need for context-specific studies that examine clinical and lifestyle correlates of uterine health together.

Despite growing global attention, data on uterine pathologies in sub-Saharan Africa remain scarce, particularly among young and apparently healthy populations such as university students. Studies in African settings have focused mainly on symptomatic or hospital-based cohorts, which may underestimate the burden of subclinical disease (5). Moreover, the relationships between uterine morphology, menstrual characteristics, and modifiable lifestyle factors have not been adequately explored in this group.

Therefore, using ultrasound assessment combined with self-reported menstrual and lifestyle data, this study aimed to: (1) determine the prevalence of uterine fibroids, endometrial polyps, and adenomyosis among reproductive-aged university students; (2) examine their association with menstrual cycle characteristics and symptom patterns; (3) assess their relationship with lifestyle factors, including smoking, alcohol consumption, physical activity, and stress; and (4) compare uterine morphometry between participants with and without uterine pathology.

By focusing on an understudied population of young women in a Nigerian academic setting, this study contributes evidence on early uterine pathology, its clinical correlates, and potentially modifiable risk factors, with implications for early detection and prevention in resource-limited settings.

MATERIAL AND METHODS

Study Design and Setting

This is an exploratory cross-sectional study conducted among female students at the College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, Nigeria. The study was designed and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies to ensure methodological rigor and transparency in reporting (16).

Study Population and Eligibility Criteria

The study population comprised reproductive-aged female students (15–49 years) who had attained

menarche and were enrolled within the College of Health Sciences. Participants were recruited across multiple faculties and provided written informed consent prior to participation. Eligibility was restricted to individuals with a history of menstruation and willingness to undergo ultrasound assessment. Participants were further excluded if they were pregnant or lactating, had not experienced menstruation within the preceding 12 months. This study utilized a population-based analytical framework rather than a clinical-cohort design in the inclusion of participants. Hence, participants were not excluded based on self-reported lifestyle factors, contraceptive use, or prior diagnoses of gynecological conditions, as these variables were considered part of the natural variability within the study population and were retained to enhance external validity. A total of 347 participants were initially enrolled in the study (17); following application of eligibility criteria and exclusion of participants with incomplete ultrasound data, 236 participants were included in the final analysis.

Data Collection and Study Variables

Data were collected using a structured, pretested online questionnaire administered via Google Forms (https://forms.gle/cgmumPbWtmNdxmjk9). The survey instrument captured information on sociodemographic characteristics, menstrual history, lifestyle behaviors, and reproductive health status. Menstrual variables included cycle regularity, cycle length, duration of menstrual flow, and the presence of associated symptoms such as pain, fatigue, mood disturbances, and other systemic or pelvic complaints. Cycle regularity was determined based on participants' self-reported consistency of menstrual cycles over the preceding 12 months and categorized as regular or irregular. Cycle length was classified into normal (24–38 days) and abnormal (<24 or >38 days) in accordance with standard clinical definitions. Lifestyle variables assessed included smoking status, alcohol consumption, level of physical activity, and perceived stress levels, each categorized for analytical purposes. Menstrual symptoms were also explored as composite measures to capture overall symptom burden and patterns. The full dataset of this study is accessible through an open repository (17).

Anthropometric Measurements

Anthropometric measurements were obtained using standardized procedures. Height was measured to the nearest 0.1 cm using a stadiometer, with participants standing upright without footwear, while weight was measured to the nearest 0.1 kg using a calibrated digital scale. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m²) and treated as a continuous variable in subsequent analyses.

Pelvic Ultrasonography and Outcome Assessment

Pelvic ultrasonography was performed using a transabdominal approach with a 3.5–5.0 MHz curvilinear transducer (GE Logiq V2). All examinations were conducted by a trained and experienced sonographer in a standardized clinical setting to ensure consistency and minimize inter-observer variability. Participants were examined in the supine position with a full bladder to optimize visualization of pelvic structures. Both sagittal and transverse uterine images were obtained for each participant. Uterine measurements included uterine length, width, and anteroposterior diameter, from which uterine volume was calculated using the ellipsoid formula (length × width × anteroposterior diameter × 0.523). Additional parameters assessed included cervical length, anteroposterior diameter of the cervix, and endometrial thickness. Ultrasound findings were used to determine the presence or absence of uterine fibroids, endometrial polyps, and adenomyosis. For analytical purposes, a composite outcome variable, defined as the presence of any uterine pathology, was created to enable statistically robust comparisons.

Statistical Analysis

All statistical analyses were conducted using Python (version 3.10, Python Software Foundation, USA). with relevant libraries including pandas, numpy, scipy, and matplotlib. Descriptive statistics were used to summarize participant characteristics, with continuous variables presented as mean ± standard deviation or median with interquartile range as appropriate, and categorical variables summarized as frequencies and percentages. The prevalence of uterine fibroids, polyps, adenomyosis, and composite uterine pathology was calculated as proportions. Given the low frequency of individual uterine

pathologies, inferential analyses were conducted using the composite outcome of any uterine pathology versus none. Associations between uterine pathology and categorical variables, including menstrual characteristics and lifestyle factors, were evaluated using Fisher's exact test due to small, expected cell counts. Differences in continuous variables, particularly uterine morphometric parameters, were assessed using the Mann–Whitney U test, given the non-normal distribution of these measures. Multivariable regression analyses were not performed due to the limited number of outcome events, which could compromise model stability and increase the risk of overfitting. Consequently, analyses were restricted to bivariate comparisons, and findings were interpreted as exploratory. A two-sided p-value of less than 0.05 was considered statistically significant, although emphasis was placed on the magnitude and direction of associations rather than statistical significance alone.

Ethical Considerations

Ethical approval for the parent study was obtained from the Nnamdi Azikiwe University Teaching Hospital Health Research Ethics Committee (protocol number: NAUTH/CS/66/VOL.17/VER.3/117/2024/262). All procedures were conducted in accordance with institutional ethical standards and the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection.

RESULTS

Participant Characteristics and Prevalence of Uterine Pathologies

A total of 236 participants were included in the primary analysis. The majority were aged 16–25 years, with 48.3% aged 16–20 years and 43.6% aged 21–25 years. The participants' mean body mass index (BMI) was 23.1 ± 4.5 kg/m² with slightly more than half reporting regular menstrual cycles (56.8%). Alcohol use was reported by 22.0% of participants, and 5.1% reported smoking. Over half of the cohort (55.1%) engaged in low levels of physical activity, and most participants reported moderate stress levels (67.8%). A history of contraceptive use within the preceding year was reported by 23.3%, prior polycystic ovary syndrome (PCOS) diagnosis by 10.2%, and a family history of uterine fibroids by 9.3% (**Table 1**). Overall, ultrasound-detected uterine pathology was uncommon, as illustrated in **Figure 1**, with a prevalence of 9.3% in the study population. Uterine fibroids were the most frequently identified pathology (5.1%), whereas adenomyosis was rare (1.3%).

Table 1. Baseline characteristics of study participants

	n (%)
Age group	
16 - 20 years	114 (48.3)
21 - 25 years	103 (43.6)
26 - 30 years	18 (7.6)
46 - 50 years	1 (0.4)
BMI (kg/m²)	23.1 ± 4.5*
Menstrual characteristics	
Regular cycle	134 (56.8)
Irregular cycle	102 (43.2)
Lifestyle factors	
Alcohol use	52 (22.0)
Smoking	12 (5.1)
Exercise level	
Low (never/rarely)	130 (55.1)
Higher (occasional/regular)	106 (44.9)
Stress level	
Low	23 (9.7)
Moderate	160 (67.8)
High	53 (22.5)
Reproductive/clinical factors	
Contraceptive use in last year	55 (23.3)
Prior PCOS diagnosis	24 (10.2)
Family history of uterine fibroids	22 (9.3)

*value given as mean ± SD; N=236

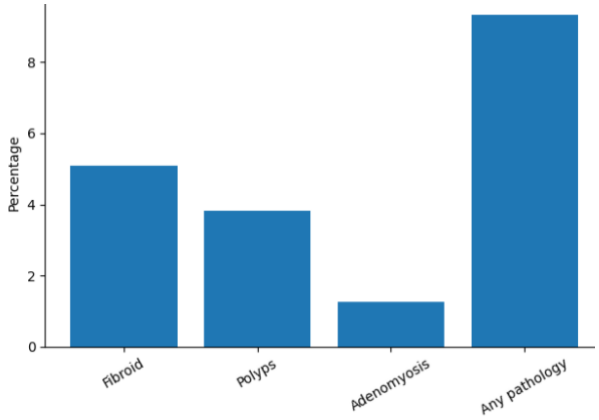


Figure 1. Prevalence of ultrasound-detected uterine pathologies among participants (n=236)

Table 2. Association between uterine pathology and menstrual characteristics

Variable	No pathology	Any pathology	p-value
	n (%)	n (%)	
Cycle regularity			
Regular	116 (89.2)	14 (10.8)	0.488#
Irregular	89 (92.7)	7 (7.3)	
Cycle length			
Normal (24–38 days)	196 (90.7)	20 (9.3)	1.000#
Abnormal (<24 or >38 days)	9 (90.0)	1 (10.0)	
Menstrual pain			
None/mild	74 (92.5)	6 (7.5)	0.634#
Moderate/severe	131 (89.7)	15 (10.3)	
Menstrual symptom burden*	8 [6–11]	9 [7–10]	0.623@

*median [IQR] symptom count using the 16 symptom items, @Mann–Whitney U test; #Fisher's exact test; n= 226

Uterine pathology and menstrual characteristics

As shown in Table 2, there were no statistically significant associations between the presence of uterine pathology and menstrual cycle characteristics, including cycle regularity, cycle length and menstrual pain severity (p>0.05). Similarly, the median menstrual symptom burden, assessed using a 16-item symptom inventory, was similar between participants with uterine pathology (p=0.623; **Table 2**).

Lifestyle factors and uterine pathology

Among lifestyle factors examined, exercise level was the only variable significantly associated with uterine pathology. Participants reporting low levels of physical activity had a significantly higher prevalence of uterine pathology compared with those engaging in higher levels of exercise (13.7% vs 3.9%, p = 0.012) (**Table 3**).

Table 3. Association between lifestyle factors and uterine pathologies

Variable	No pathology	Any pathology	p-value*
	n (%)	n (%)	
Smoking			
No	193 (90.2)	21 (9.8)	0.609
Yes	12 (100.0)	0 (0.0)	
Alcohol consumption			
No	162 (91.5)	15 (8.5)	0.412
Yes	43 (87.8)	6 (12.2)	
Exercise level			
Higher exercise	98 (96.1)	4 (3.9)	**0.012**
Low exercise	107 (86.3)	17 (13.7)	
Stress level			
Not high	160 (90.9)	16 (9.1)	0.788
High	45 (90.0)	5 (10.0)	

*Fisher's exact test

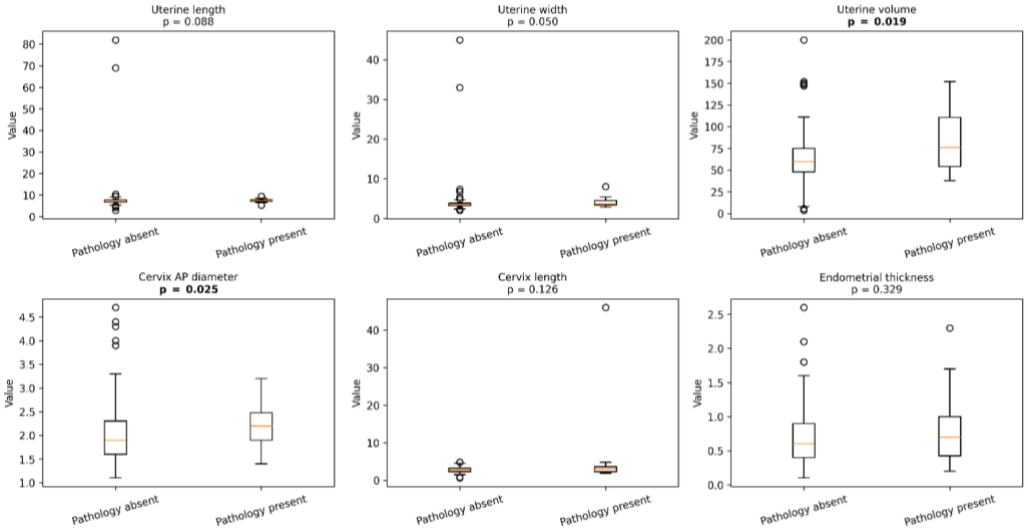


Figure 2. Comparing uterine morphometry by uterine pathology status

Uterine Morphometry and Pathology Status

As illustrated in **Figure 2**, participants with uterine pathology demonstrated significantly greater uterine volume [80.0 (54.0–112.0) vs 60.0 (48.0–75.0); p=0.027] and larger anteroposterior cervical diameter [1.9 (1.6–2.3) vs 2.2 (1.9–2.5); p=0.014] compared with participants without uterine pathology. In contrast, no statistically significant differences were observed between groups with respect to uterine length, uterine width, cervical length, or endometrial thickness (p>0.05).

DISCUSSION

This study provides insights into the prevalence, menstrual correlates, lifestyle associations, and morphometric characteristics of ultrasound-detected uterine pathologies among reproductive-aged female students in Nigeria. In this relatively young cohort, uterine pathologies were uncommon, with an overall prevalence of 9.3%, and uterine fibroids representing the most frequently identified condition. These findings reflect the demographic profile of the study population, which was predominantly composed of younger women, among whom structural uterine abnormalities are less prevalent compared to older or clinically symptomatic populations.

The observed prevalence is lower than estimates reported in clinical and population-based studies, where uterine fibroids have been documented in up to 20–70% of women of reproductive age (5,8).

This difference is likely attributable to age distribution, study setting, and the inclusion of largely asymptomatic participants. The low frequency of adenomyosis observed in this study is consistent with its well-documented association with older and multiparous women, a demographic profile not represented in this predominantly young student population. In addition, the use of transabdominal ultrasonography may have limited sensitivity for detecting early or subtle adenomyotic changes, suggesting that the true prevalence in this cohort may be underestimated (9,10). Taken together, these findings suggest that, in young community-based populations, ultrasound-detected uterine pathologies may be less prevalent than estimates derived from hospital-based cohorts and may remain clinically silent in early reproductive life.

Contrary to expectations, no statistically significant associations were observed between uterine pathology and menstrual characteristics, including cycle regularity, cycle length, menstrual pain, and overall symptom burden. While prior studies have reported strong associations between uterine fibroids and menstrual disturbances such as heavy bleeding and dysmenorrhea (1,3), the absence of such associations in this study may reflect several factors. First, the relatively small number of pathology cases may have limited statistical power to detect subtle differences. Second, lesions identified in this cohort are likely to be small or early-stage and may not yet

produce clinically significant symptoms. Third, menstrual experiences are influenced by a complex interplay of hormonal, psychosocial, and behavioral factors, which may obscure direct relationships with structural abnormalities in a young and otherwise healthy population. These findings highlight the need for caution when interpreting menstrual symptoms as proxies for underlying uterine pathology in community-based populations.

Among the lifestyle factors examined, physical activity emerged as the only variable associated with uterine pathology, with a higher prevalence observed among participants reporting low levels of exercise. This finding is consistent with previous studies suggesting a protective effect of physical activity against uterine fibroid development, potentially mediated through hormonal regulation and improved metabolic profiles (13,14). However, given the cross-sectional design, causality cannot be established, and reverse causation remains possible. No significant associations were observed for smoking, alcohol consumption, or stress levels, in line with the heterogeneous and often inconsistent findings reported in the literature (15).

The morphometric analysis revealed that participants with uterine pathology had significantly greater uterine volume and cervical anteroposterior diameter compared to those without pathology. These findings are biologically plausible, as structural abnormalities such as fibroids contribute to increased uterine size (18,19). The lack of significant differences in other parameters, including uterine length, width, and endometrial thickness, suggests that volumetric measures may be more sensitive indicators of early structural changes. These results underscore the value of ultrasound-based morphometry in identifying subclinical uterine alterations that may not yet manifest clinically.

This study has several strengths. It utilizes ultrasound-based assessment in a relatively understudied population, providing objective measures of uterine pathology rather than relying on self-reported diagnoses. The integration of menstrual, lifestyle, and morphometric data allows for a multidimensional evaluation of uterine health. Additionally, the use of a community-based student population enhances the relevance of findings for early detection and prevention strategies.

However, certain limitations should be acknowledged. The cross-sectional design limits causal inference, particularly in relation to lifestyle factors. The relatively small number of pathology cases necessitated the use of a composite outcome and limited the ability to perform pathology-specific analyses or multivariable modeling. Self-reported data on menstrual and lifestyle variables may also be subject to recall and reporting bias. Furthermore, the use of transabdominal ultrasound, while appropriate for this setting, may have lower sensitivity compared to transvaginal imaging, potentially leading to underestimation of small lesions (13,20). The study population, drawn from a single academic institution, may also limit generalizability.

In summary, uterine pathologies were identified at a low prevalence in this cohort of young Nigerian women and were not significantly associated with menstrual characteristics, suggesting that such conditions may remain clinically silent in early reproductive life. The association observed with low physical activity highlights a potentially modifiable factor, while differences in uterine morphometry indicate measurable structural variation even in the absence of overt symptoms. These findings contribute to the limited evidence on uterine health in young, community-based populations in sub-Saharan Africa and underscore the need for longitudinal studies to clarify the natural history, determinants, and clinical implications of early uterine pathology.

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Data availability:
All data generated for this study are available in an online data repository (https://doi.org/10.5281/zenodo.19008084)

Contributions:
IAO designed the study with contributions from ACE and IKC. IAO, ACE, IKC, KOA, ECN and KMU collected the data while IAO, IKC, KMC and FCA performed the data analysis. All the authors reviewed the analysis, interpreted the data, and contributed to the writing of the first draft. All the authors contributed to the revision of the first draft and approved the submitted draft