Vol. 4 No. 4 (2025)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Mahrukh et al - 2025

SONOGRAPHIC ASSESSMENT OF UTERINE DIMENSIONS IN NULLIPAROUS PAKISTANI WOMEN AND THEIR CORRELATION WITH AGE AND BODY MASS INDEX

Fatima Mahrukh*
School of Allied Health Sciences,CMH Lahore Medical College & Insitute of Dentistry Lahore. Corresponding Author Email: Fatimamahrukh1996@gmail.com
Nimra Nadeem
Green International Univeristy, Lahore. nimranadeem693@gmail.com
Rehmeen Asif
Green International Univeristy, Lahore. rehmeen.asif123@gmail.com
Uttroba Shahid
University of Lahore. rehmeen.asif123@gmail.com
Asma Waheed
Green International Univeristy, Lahore. waheedasma03@gmail.com
Missal Fatima
Green International Univeristy, Lahore. missalfatima752@gmail.com

Author Details

Keywords:
Uterus, Ultrasonography, Nulliparous Women, Uterine Volume, Age, Body Mass Index, Pakistan

Received on 11 Sept, 2025
Accepted on 17 Oct, 2025
Published on 20 Oct, 2025

Corresponding E-mails & Authors*:
Fatima Mahrukh
Fatimamahrukh1996@gmail.com

Abstract

Background: The uterus is a vital female reproductive organ, and its size is influenced by age, body mass index (BMI), and parity. Establishing normative uterine dimensions in nulliparous women is essential for accurate clinical assessment and early detection of pathology. Objective: To determine the average sonographic measurements of the uterus in nulliparous Pakistani women and to evaluate their correlation with age and BMI. Methods: This observational cross-sectional study included 50 nulliparous women aged 15–45 years without uterine or ovarian pathology, conducted at the Department of Radiology, Mayo Hospital/King

Edward Medical University, Lahore. Pelvic ultrasonography was performed using transabdominal or transvaginal approaches. Uterine dimensions (longitudinal length, transverse width, anteroposterior diameter) were measured, and uterine volume was calculated. Correlations between uterine volume, age, and BMI were analyzed using Pearson's correlation coefficient, with $p < 0.05$ considered statistically significant. Results: The study included 50 nulliparous women aged 16–42 years (mean 27.3 ± 5.6 years), with most participants (70%) aged 20–30 years. The mean height and weight were 158.8 ± 7.2 cm and 61.5 ± 12.1 kg, yielding a mean BMI of 24.4 ± 4.3 kg/m^2. Sonographic assessment showed mean uterine dimensions of 7.5 ± 1.13 cm (longitudinal length), 4.0 ± 0.74 cm (transverse width), and 3.3 ± 0.66 cm (anteroposterior diameter), with a mean uterine volume of 100.9 ± 53.6 cm^3. No uterine or ovarian abnormalities were detected. Correlation analysis revealed a significant positive relationship between uterine volume and BMI ($r = 0.236$, $p = 0.01$) and between uterine volume and age ($r = 0.352$, $p = 0.01$), indicating that uterine size increases with both age and BMI in nulliparous women. Conclusion: This study establishes baseline sonographic measurements of the uterus in nulliparous Pakistani women and demonstrates that uterine size increases with age and BMI. These normative data provide population-specific reference values that enhance diagnostic accuracy in gynecological imaging.

INTRODUCTION

The uterus is a vital female reproductive organ responsible for menstruation, implantation, gestation, and childbirth. Its size and morphology play a significant role in assessing gynecological health, as variations in uterine dimensions may indicate underlying pathologies such as fibroids, adenomyosis, or congenital anomalies (1,2).

Accurate measurement of the uterus, therefore, holds great diagnostic value in differentiating normal from abnormal findings (3).

Among the various imaging modalities, ultrasonography has become the preferred technique for evaluating uterine size. It is a safe, non-invasive, cost-effective, and readily available method that provides real-time visualization of pelvic organs without the risks associated with ionizing radiation (4,5). Determining the normal uterine size through ultrasound helps establish reference standards for clinical and research purposes (6).

The dimensions of the uterus are known to vary with factors such as age, body mass index (BMI), parity, hormonal status, and ethnicity (7,8). In nulliparous women those who have never given birth—the uterine size represents a baseline physiological state that can be used as a standard for comparison (9). Previous international studies have shown considerable variation in uterine size among different populations, suggesting that genetic, nutritional, and environmental influences may play important roles (10–12).

However, there is limited data available regarding the normal uterine dimensions in Pakistani women, particularly among nulliparous individuals (13). Establishing local reference values is essential for accurate clinical interpretation and for distinguishing pathological enlargement from physiological variation (14). Therefore, this study aims to determine the average sonographic measurements of the uterus in nulliparous Pakistani women and to explore the correlation between uterine size, age, and BMI. The findings of this study will contribute to the creation of standard normograms for uterine size in the local population and enhance diagnostic accuracy in gynecological imaging (15).

METHODOLOGY

This observational cross-sectional study was designed to determine the average sonographic measurements of uterine size in nulliparous women and to evaluate their correlation with age and body mass index (BMI). The study was conducted in the Department of Radiology, Mayo Hospital Lahore, a major tertiary care and teaching hospital equipped with modern diagnostic imaging facilities.

A total of 50 nulliparous women were included in the study. The sample size was determined based on feasibility and the availability of participants who met the inclusion criteria during the study period. A non-probability consecutive sampling technique was employed, whereby all eligible subjects presenting during the study period were selected until the desired sample size was achieved. Women were eligible for inclusion if they were nulliparous, within the reproductive age range of 15 to 45 years, and free from any uterine or ovarian pathology. Marital status was not considered a limiting factor for inclusion. Exclusion criteria included multiparous women, postmenopausal women, women outside the reproductive age range, and those with uterine or ovarian abnormalities such as fibroids, cysts, or ovarian masses.

All participants referred for pelvic ultrasonography were informed about the nature and purpose of the study, and written informed consent was obtained before examination. Demographic and anthropometric data including name, age, height, weight, and marital status were recorded using a structured pro forma designed for the study. The BMI of each participant was calculated using the standard formula:

$$BMI = \frac{\text{Weight (kg)}}{[\text{Height (m)}]^2}$$

Ultrasound examinations were carried out with the patients lying in the supine position using either a transabdominal or transvaginal approach depending on the case. A low-

frequency convex transducer (3–5 MHz) was used for imaging. Three uterine dimensions were measured: longitudinal length (from the fundus to the external os), anteroposterior (AP) diameter (maximum dimension in the midsagittal section), and transverse width (maximum width in the transverse section). The uterine volume was then calculated using the formula:

$$\text{Volume} = L \times W \times AP \times 0.523$$

All ultrasound scans were performed by trained radiologists to ensure accuracy and consistency in measurements. The data collected were analyzed using the (SPSS) version 24.0. Descriptive statistics, such as mean and standard deviation, were used to summarize quantitative variables including age, weight, height, BMI, and uterine dimensions. Frequencies and percentages were calculated for categorical variables such as marital status. The relationship between uterine size, age, and BMI was analyzed using Pearson's correlation coefficient (r), and a p-value of less than 0.05 was considered statistically significant.

All ethical considerations were strictly observed throughout the study. Ethical approval was obtained from the institutional review board of King Edward Medical University, Lahore. Written informed consent was obtained from every participant after explaining the purpose and procedures of the study. The confidentiality of patient data was maintained at all stages of the research. Since ultrasound is a non-invasive diagnostic tool, the study did not pose any risk to the participants.

RESULTS

A total of **50 nulliparous women** without any uterine or ovarian pathology were included in this study. All participants underwent pelvic ultrasonography in the Department of Radiology, Mayo Hospital, Lahore. The following results were obtained from the analysis of the collected data.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
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TABLE 1: DISTRIBUTION OF SUBJECTS BY MARITAL STATUS

Marital Status	Frequency (n)	Percentage (%)
Married	13	26
Unmarried	37	74
Total	**50**	**100**

A total of 13 (26%) participants were married, while the majority, 37 (74%), were unmarried. Since the study included nulliparous women, marital status did not influence uterine size assessment.

TABLE 2: DISTRIBUTION OF SUBJECTS BY AGE GROUP

Age Group (Years)	Frequency (n)	Percentage (%)
Less than 20	3	6
20–30	35	70
More than 30	12	24
Total	**50**	**100**
Mean ± SD	**27.3 ± 5.6 years**	

Most participants (70%) were between 20 and 30 years of age, with a mean age of 27.3 ± 5.6 years, indicating that the study population largely consisted of women in their reproductive age group.

TABLE 3: MEAN UTERINE DIMENSIONS AND PHYSICAL PARAMETERS (N = 50)

Parameter	Mean ± SD	Minimum	Maximum
Longitudinal Length (cm)	7.5 ± 1.13	4.9	10.6
Anteroposterior Diameter (cm)	3.3 ± 0.66	1.9	5.8
Transverse Width (cm)	4.0 ± 0.74	2.4	6.0

Parameter	Mean ± SD	Minimum	Maximum
Uterine Volume (cm^3)	100.9 ± 53.6	22.3	338.1
Height (cm)	158.8 ± 7.2	134.1	173.7
Weight (kg)	61.5 ± 12.1	40.0	100.0

The average uterine dimensions were **7.5 ± 1.13 cm** (longitudinal length), **4.0 ± 0.74 cm** (transverse width), and **3.3 ± 0.66 cm** (anteroposterior diameter). The calculated mean uterine volume was **100.9 ± 53.6 cm^3**. These findings represent the baseline uterine size for nulliparous women in the studied population.

TABLE 4: CORRELATION OF UTERINE VOLUME WITH BMI

Variables	Pearson's r	p-value	Interpretation
Uterine Volume vs. BMI	0.236	0.01	Significant positive correlation

A moderately positive correlation (r = 0.236, p = 0.01) was observed between uterine volume and BMI, indicating that as BMI increases, uterine size also tends to increase. This relationship was found to be statistically significant ($p < 0.05$).

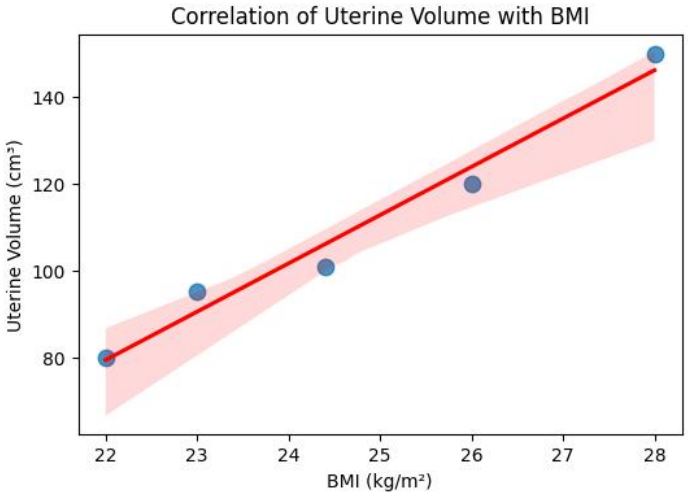
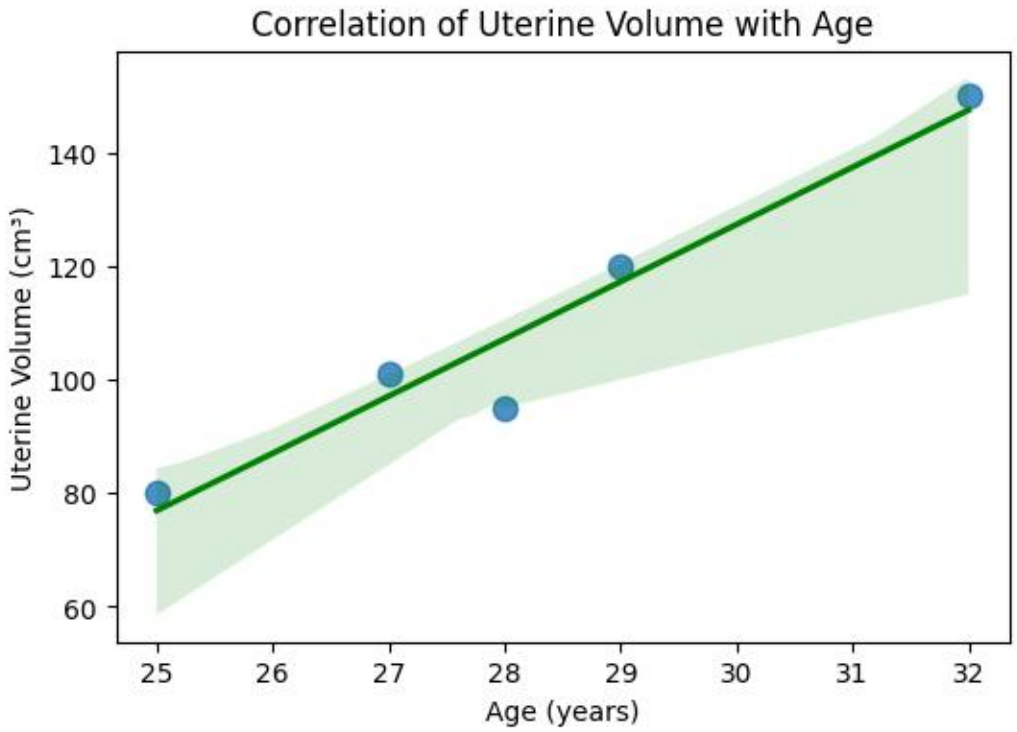


TABLE 5: CORRELATION OF UTERINE VOLUME WITH AGE

Variables	Pearson's r	p-value	Interpretation
Uterine Volume vs. Age	0.352	0.01	Significant positive correlation

A significant positive correlation (r = 0.352, p = 0.01) was found between uterine volume and age, suggesting that uterine size increases progressively with advancing age in nulliparous women.



In a study of nulliparous Pakistani women (mean age 27.3 years, mean BMI 24.4 kg/m^2), the average uterine size was 7.5 × 4.0 × 3.3 cm, with a mean volume of 100.9 cm^3. Uterine dimensions showed a significant positive correlation with age and BMI. No uterine or ovarian abnormalities were detected on ultrasound.

DISCUSSION

This study provides baseline sonographic measurements of the uterus in nulliparous Pakistani women and examines the relationship between uterine size, age, and body mass index (BMI). The mean uterine dimensions observed were 7.5 ± 1.13 cm (longitudinal length), 4.0 ± 0.74 cm (transverse width), and 3.3 ± 0.66 cm (anteroposterior diameter), with a mean uterine volume of 100.9 ± 53.6 cm^3. These findings contribute to establishing local reference values, as there is limited data available regarding normal uterine dimensions in this population (16).

The uterine dimensions reported in this study align with those observed in other populations. For instance, a study conducted in Nepal reported similar measurements for the uterus in nulliparous women, with a mean length of 6.88 ± 0.75 cm, anteroposterior diameter of 3.89 ± 0.44 cm, and transverse width of 4.2 ± 0.50 cm, resulting in a mean volume of 61.41 ± 16.96 cm^3 (17). These consistent findings across different studies underscore the reliability of the measurements obtained in this research.

The positive correlation between uterine volume and BMI ($r = 0.236$, $p = 0.01$) observed in this study is consistent with previous research indicating that increased adiposity may influence uterine size. A study by Chen et al. (2023) found that BMI was positively correlated with uterine measurements, including myometrial thickness and external dimensions, in reproductive-aged women (18). This suggests that BMI may be an important factor to consider when assessing uterine size.

Similarly, the positive correlation between uterine volume and age ($r = 0.352$, $p = 0.01$) observed in this study aligns with findings from other studies. For example, a study by Gergolet et al. (2025) reported that uterine dimensions, including length, thickness,

and angles, increased with age in nulliparous women (19). This indicates that uterine size tends to increase progressively with advancing age in nulliparous women.

Nulliparous women represent an ideal population for assessing baseline uterine dimensions, as parity itself is known to alter uterine morphology (16). By excluding multiparous and postmenopausal women, this study provides a clearer picture of the physiological baseline for the local population. The absence of uterine or ovarian pathology in all participants further strengthens the reliability of the reported measurements.

The main limitations of this study include a relatively small sample size and single-center design, which may affect the generalizability of the findings. Larger multicenter studies would be valuable to validate these reference values and explore additional factors such as menstrual cycle phase, hormonal status, and ethnic differences within Pakistan (16,17).

This study provides normative sonographic measurements of the uterus in nulliparous Pakistani women and demonstrates that uterine size is positively correlated with age and BMI. These findings contribute to establishing population-specific reference standards, which are essential for improving the accuracy of gynecological imaging and early detection of uterine pathology (16-19).

CONCLUSION

This study provides normative sonographic measurements of the uterus in nulliparous Pakistani women, establishing baseline values for longitudinal length, transverse width, anteroposterior diameter, and uterine volume. The findings demonstrate a significant positive correlation between uterine size, age, and body mass index, highlighting the influence of physiological factors on uterine dimensions. These results contribute to the

development of population-specific reference standards, which are essential for accurate interpretation of gynecological imaging, early detection of uterine pathology, and improved clinical decision-making in reproductive health care.

LIMITATIONS

This study has several limitations. First, the sample size was relatively small (n = 50), which may limit the generalizability of the findings to all nulliparous Pakistani women. Second, the study was conducted at a single tertiary care center, and regional or ethnic variations within Pakistan were not assessed. Third, factors such as menstrual cycle phase, hormonal status, and nutritional status, which may influence uterine dimensions, were not controlled for.

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