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Cross-Sectional Study

Ultrasounds-based evaluation of the etiology of pelvic pain in early pregnancy: a cross-sectional study

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ABSTRACT

The current study aimed to investigate the prevalence and etiological factors of pelvic pain in pregnant women during their first trimester in Sudan. The research involved 100 pregnant individuals in their first trimester, all experiencing pelvic pain, who underwent ultrasound examinations. Data were collected on variables including age, gestational age, and body mass index (BMI). Logistic regression analyses were conducted to assess the relationship between these variables and the nature of the pelvic pain. The study found a 53% prevalence of pelvic pain among the participants, with 47% also reporting vaginal bleeding and pelvic pain. 72% had gynecological etiologies, most commonly miscarriage at 29%, followed by fibroids 15%, while 9% had non-gynecological etiologies, led by appendicitis at 5%. The remaining 14% showed normal findings. The co-occurrence of pelvic pain and vaginal bleeding significantly increased the odds of the pain being gynecological (Odds Ratio=5, p=0.03). However, other variables like age, gestational age, and BMI did not show a statistically significant association with the etiology of the pain. This study provides critical insights into the prevalence and etiology of pelvic pain in pregnant women during the first trimester. It suggests that the presence of both pelvic pain and vaginal bleeding necessitates more rigorous diagnostic evaluations. The findings have important implications for healthcare providers in the diagnosis and management of pelvic pain in pregnant women.

Keywords: Pelvic pain, Pregnancy, First trimester, Vaginal bleeding, Ultrasound, Etiology

Introduction

Pelvic pain in the first trimester of pregnancy is a clinical concern that demands precise evaluation due to its potential association with various underlying causes [1, 2]. Ultrasonography has emerged as a pivotal tool for assessing the diverse etiologies contributing to pelvic pain during early pregnancy. In recent years, numerous studies have explored the utility of ultrasonography in diagnosing and elucidating the causes of pelvic pain among pregnant women [3-6].

Ultrasonography has demonstrated its efficacy as a non-invasive imaging technique that plays a crucial role in identifying the underlying factors responsible for pelvic pain during pregnancy. Previous studies have reported compelling findings related to this area. A research study revealed that bleeding was a dominant finding in pregnant women experiencing chronic pelvic pain during early pregnancy [7]. Similarly, a study emphasized that fibroids and cysts were prevalent among females with pelvic pain in early pregnancy [6]. Moreover, ultrasonography has been recognized as the primary imaging investigation for pregnant and postpartum women with acute pelvic pain [1, 8]. A previous

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study underscored that threatened abortion was the most common cause of bleeding in the first trimester, underlining the diagnostic significance of ultrasonography in this context [9]. This sentiment is echoed in several studies, which emphasized that ultrasound aids in the timely diagnosis and effective management of first-trimester vaginal bleeding [10, 11]. Furthermore, ultrasonography has been found indispensable in evaluating ectopic pregnancies and assessing the location of pregnancy [12]. A recent study highlighted the reliability of ultrasonography in assessing pelvic pain caused by gynecological factors [13]. Non-gynecological causes of pelvic pain were studied in the current study, including appendicitis, which compares with the study mentioned that accurate diagnosis of appendicitis in pregnancy is the largest challenge since the signs and symptoms may vary depending on the trimester in which the patient presents [14, 15]. Also highlight other cause of pelvic pain during pregnancy as urinary tract infection and stones, urinary tract infections (UTIs) are amongst the most frequent community-acquired and healthcare-associated bacterial infections, and they are to be found in many specialties, such as internal medicine, gynecology, urology and intensive care medicine [16]. Notably, ultrasonography is cost-effective, radiation-free, and capable of offering functional and morphological information, rendering it a suitable first-line imaging modality [2, 17]. Due to the rapid change in uterine size, the development of associated theca lutein cysts, or ovarian torsion caused by these cysts, molar pregnancy can lead to pelvic pain . Imaging plays a crucial role in providing clinical evidence for timely diagnosis and treatment, which is vital for the well-being of both the mother and the fetus . In cases of chronic pelvic pain, several causes have been identified in early pregnancy, including ectopic pregnancy, bleeding, cysts, and fibroids [18, 19].

In the context of Sudan, limited research has been conducted to comprehensively investigate the diverse causes of pelvic pain during the first trimester of pregnancy using ultrasonography. Hence, this study seeks to bridge this gap by shedding light on the unique aspects of pelvic pain experienced by women in Sudan during early pregnancy. The significance of this research lies in its potential to enhance the understanding of pelvic pain etiologies, thereby enabling more accurate diagnoses and informed medical decisions. The objectives of this study are to evaluate the various causes of pelvic pain in the first trimester of pregnancy using ultrasonography and to contribute to the body of knowledge surrounding this topic.

Materials and Methods

Study design, setting, and population

This study was a descriptive, cross-sectional study that aimed to investigate the causes of pelvic pain in pregnant women in the first trimester using ultrasound imaging. The study was carried out in Al Gezira state, Alsedearah hospital in Sudan. The study population consisted of 100 pregnant women aged 18 to 41 years who presented with pelvic pain in the first trimester of pregnancy. To determine the appropriate sample size for this study, the following formula was used: $n = Z2 \times P \times (1-P)/E^2$. Were Z confidence level (95%), P estimated prevalence (0.55), and an E margin of error 8%, a final sample size of around 100 participants was chosen. The study period was from January 2023 to March 2023.

Sampling size technique

To determine the appropriate sample size for this study, the following formula was used;

$n=Z^2\times P\times(1-P)/E^2$. Were Z confidence level(95%), P estimated prevalence(0.55), and E margin of error 8%, a final sample size of around 100–150 participants was chosen.

Inclusion and exclusion criteria

The inclusion criteria were: (1) pregnancy confirmed by urine or blood test, (2) gestational age up to 12 weeks, (3) presence of pelvic pain, and (4) willingness to participate in the study. The exclusion criteria were: (1) pregnancy beyond the first trimester, (2) absence of pelvic pain, (3) history of pelvic surgery or trauma, (4) multiple pregnancy, and (5) any contraindication to transvaginal ultrasound.

Ethical considerations

The study protocol was approved by the research ethical committee of the University of Medical Sciences and Technology, Faculty of Graduate Studies. Verbal informed consent was obtained from each participant before the start of the ultrasound examination. The participants were assured of the confidentiality and anonymity of their data and the voluntary nature of their participation. They were also informed of the potential benefits and risks of the study and their right to withdraw at any time without any consequences.

Ultrasonographic equipment and technique

The ultrasound examinations were performed by a trained sonographer using an ultrasound machine with real-time, gray-scale, two-dimensional (2D) and Doppler capabilities. The machine had transabdominal and transvaginal probes, adjustable acoustic power output controls with output display standards, freeze frame and zoom functions, electronic calipers, and the capacity to print or store images. The machine was regularly maintained and serviced according to the manufacturer's instructions [20-25].

The scanning method (transvaginal or transabdominal). A transabdominal scan was performed first, and the participants were asked to fill their bladder and lie in a supine position, using a 3.5 MHz convex probe with a generous amount of gel applied on the abdomen. The scan covered the entire pelvis and assessed the intra- and extrauterine structures, such as the uterus, ovaries, adnexa, bladder, bowel, and placenta. The echo structure of the placenta was evaluated for any abnormal findings, such as masses, cysts, or fluid collections [26-30].

A transvaginal scan was performed next, if needed, using a 5-10 MHz endovaginal probe with a disposable cover and gel applied

on the tip. The participants were asked to empty their bladder they were then positioned in a lithotomy position. The probe was gently inserted into the vagina until a clear image of the cervix was obtained. The scan focused on the gestational sac and the embryo within it, and the ovaries. The gestational sac was measured in three orthogonal planes, and the mean gestational sac diameter (MSD) was calculated as the average of these measurements. The crown–rump length (CRL) of the embryo was measured from the top of the head to the bottom of the rump along its longest axis. The gestational age was estimated based on the CRL using a nomogram [31-36].

Data collection and analysis

Data were collected using data collection sheets that were designed to include all the variables of the study. The variables were: indications, gestational age, patient age, BMI, and US findings. The US findings are classified into three categories: normal findings, gynecological causes, and non-gynecological causes. Gynecological causes are those that are related to the female reproductive system. Non-gynecological causes are those that are not related to the female reproductive system. Data were analyzed using SPSS (Statistical Package for the Social Sciences) software. Descriptive statistics were used to summarize the data using frequencies and percentages. Logistic regression analyses were conducted to assess the relationship between demographic variables and the nature of the pelvic pain (gynecological causes and non-gynecological causes). A p-value of less than 0.05 was considered statistically significant.

Results and Discussion

The demographic and clinical characteristics of the 100 pregnant women in the first trimester are summarized in **Table 1**. Regarding age distribution, the majority of participants fell within the 18 – 25 years age group (45%), followed by those in the 26 – 35 years age group (32%), while a smaller proportion was within the 36 – 41 years age group (23%). Gestational age distribution showed that 48% of participants were between 5 – 9 weeks of gestation, 41% were in the 10 – 12 weeks range, and 11% were in the <5 weeks category. BMI distribution indicated that 45% of participants had a healthy BMI, 51% were categorized as overweight, and 4% were classified as underweight. Clinical signs varied among participants, with 53% experiencing pelvic pain, 47% presenting with pelvic pain and vaginal bleeding.

Table 1. Frequency distribution of demographic and clinical characteristics of 100 pregnant women in the first trimester.

Variable		Frequency	Percent
Age	18 – 25	45	45%
	26 – 35	32	32%
	36 – 41	23	23%
Gestational age	<5 weeks	11	11%
	5-9 weeks	48	48%
	10-12 weeks	41	41%
BMI	Underweight	4	4%
	Healthy	45	45%
	Overweight	51	51%
Clinical sign	Pelvic pain	53	53%
	Pelvic pain and vaginal bleeding	47	47%

Table 2 shows the frequency of different findings of pelvic pain in 100 pregnant women. The majority of the causes of pelvic pain in this group were gynecological, accounting for 77% of the cases. The remaining 9% of the cases were due to non-gynecological causes, and 14% of the cases had normal findings. The most common gynecological causes of pelvic pain in 100 pregnant women are miscarriage and fibroids, which occur in 29% and 15% of the women, respectively. Other common gynecological causes include ovarian cyst (9%), Pelvic Inflammatory Disease (PID) (8%), and ectopic pregnancy (6%). The least common gynecological causes of pelvic pain are ovarian torsion (3%), oligohydramnios (2%), and subchorionic hemorrhage, which occurs in 1% of women. The most common non-gynecological cause of pelvic pain is appendicitis, which occurs in 5% of women. Other non-gynecological causes include cystitis (3%) and urinary bladder stone (1%).

Table 2. Distribution of US findings in 100 pregnant women in the first trimester.

Findings	Frequency	Percent
Normal	14	14%
Gynecological		
Miscarriage	29	29%
Fibroid	15	15%
Ovarian cyst	9	9%
PID	8	8%
Ectopic	6	6%
Hemorrhage cyst	4	4%
Ovarian torsion	3	3%
Oligohydrominus	2	2%
Subchorionic hemorrhage	1	1%
Total	77	77%
Non-gynecological		
Appendicitis	5	5%
Cystitis	3	3%
Urinary bladder stone	1	1%
Total	9	9%

In **Table 3**, the logistic regression model aiming to classify pelvic pain as either gynecological or non-gynecological, only the presence of both pelvic pain and vaginal bleeding (V.B.) is statistically significant (p=0.03, Odds Ratio=5) [37-45]. This suggests that when pelvic pain is accompanied by vaginal bleeding, it is five times more likely to be of a gynecological nature. Other predictors like age groups, gestational age, and BMI do not show a statistically significant impact on the classification.

Table 3. Logistic regression analysis for classifying pelvic pain into gynecological and non-gynecological causes.

						95% Confidence Interval	
Predictor	**Estimate**	**SE**	**Z**	**p**	**Odds ratio**	**Lower**	**Upper**
Intercept	0.83	1.49	0.56	0.576	2.3	0.12	42.32
Age groups:							
18–25 – 26 –35	-0.63	0.77	-0.82	0.415	0.53	0.12	2.41
36– 41 – 26 –35	1.29	0.96	1.34	0.179	3.62	0.55	23.66
Gestational Age:							
5-9 weeks – <5 weeks	-1.47	1.1	-1.35	0.178	0.23	0.03	1.96
10-13 weeks – <5 weeks	0.11	1.12	0.09	0.925	1.11	0.12	9.95
BMI:							
Normal – Underweight	2.1	1.49	1.41	0.158	8.18	0.44	151.05
Overweight – Underweight	0.39	1.36	0.28	0.776	1.47	0.1	21.15
Indications:							
Pelvic pain and V.B. – Pelvic pain	1.61	0.74	2.17	0.03	5	1.17	21.44

The present study aimed to characterize the distribution of pelvic pain among pregnant women in their first trimester and determine whether factors like age, gestational age, and BMI could predict the gynecological or non-gynecological nature of the pain. According to **Table 1**, the prevalence of pelvic pain was 53%, with 47% of participants also presenting with vaginal bleeding. The prevalence of pelvic pain during pregnancy is quite high, ranging from 14% to 67% [46, 47]. About 3 in 4 pregnant women experience pelvic pain, low back pain, or both. In addition to the high prevalence of pelvic pain itself, many women also experience associated symptoms. Pelvic pain frequently accompanies vaginal bleeding, especially when the bleeding is heavy. Almost half of women with pelvic pain also report vaginal bleeding [48]. In the logistic regression analysis **(Table 3)**, the most noteworthy finding is that the presence of both pelvic pain and vaginal bleeding significantly increases the odds (Odds Ratio=5, p=0.03) of the pain being gynecological. The finding that pelvic pain and vaginal bleeding are associated with an increased risk of gynecological causes of pain is supported by the existing literature. A study by Eyvazzadeh *et al*. found that the odds of having a gynecological cause of pelvic pain were 5.5 times higher in women who also had vaginal bleeding [49]. This offers a critical clinical marker for healthcare providers and suggests that more rigorous diagnostic evaluations may be warranted in such cases. However, other variables like age groups, gestational age, and BMI did not show a statistically significant association with the pain's etiology.

A study by Albert *et al*. found that pregnant women who reported pelvic girdle pain were statistically more likely to have a body mass index (BMI) above 30, or gain more weight than recommended, when compared with pain-free women [50]. The pelvic pain tends to be worse in women with higher BMIs [51]. On average, about half of pregnant women experience pelvic pain at some point. The pain tends to start around weeks 5 to 8 of pregnancy, and for most women lasts less than 3 days at a time, though 12% continue to experience pain for their entire pregnancy [48]. A variety of factors are associated with an increased risk of pelvic pain during pregnancy. Parity, or having been pregnant before, is a major risk factor [4]. Other risks include long periods of standing, previous low back pain, and a family history of pelvic pain during pregnancy [4, 47]. Interestingly, the type of previous deliveries does not seem to impact a woman's risk [51].

Regarding the etiology of pelvic pain, **Table 2** demonstrates that a majority of cases (72%) were gynecological, primarily miscarriages (29%), followed by fibroids (15%), ovarian cyst (9), PID (8%), and Ectopic (6%). Appendicitis (5%) was the most common non-gynecological cause. A previous study reported that 20-25% of pregnant women may experience bleeding in early pregnancy, with about 50% of first-trimester bleeding resulting in miscarriage. Miscarriages, including incomplete abortions, missed abortions, and blighted ovum, were detected in 1.68-4.57% of patients in previous investigations [52, 53]. Several studies reported that the most common causes of pelvic pain detected on ultrasound are fibroids, cysts, and complications of early pregnancy like ectopic pregnancy or miscarriage [6, 7, 53]. Fibroids were the leading cause of pelvic pain in two studies, found in 16.9-31.4% of patients [6, 7]. PID, an infection of the female reproductive organs, accounts for 1 in 60 doctor visits by women under 45 [54]. Pelvic pain can be acute, chronic, recurring, or functional. UC evaluation begins with history and exam, prioritizing urgent diagnoses like ectopic pregnancy, ovarian torsion, and tubo-ovarian abscess. Ultrasound is the preferred initial imaging due to its speed. It also helps detect other causes of pelvic pain, such as pelvic inflammatory disease, which was found in 1.8% of patients, or molar pregnancies, found in 0.34-1.2% of patients [52, 53, 55]. Ovarian cysts that twist, rupture, or hemorrhage internally can also lead to acute pain episodes [56]. Ovarian cysts were also frequently detected, in 17.4-19.6% of patients [6, 7]. Ectopic pregnancies were found in 0.6-5.5% of patients [6, 7, 53]. Less common gynecological causes include ovarian vein thrombosis, a blood clot in the veins draining the ovary, and endometritis, an infection of the uterine lining [54, 56]. Some papers also point out that non-gynecological issues like irritable bowel syndrome, interstitial cystitis, or fibromyalgia can contribute to chronic pelvic pain [16,

37]. Trauma to the pelvis or pelvic joints that become overly relaxed during pregnancy may also lead to pain [37].

Psychosocial factors, such as anxiety, depression, or a history of abuse, are linked to chronic pelvic pain, though the associations are complex [37]. Notably, the occurrence of normal findings in this study (14% of the cases) might indicate that some cases of pelvic pain are not necessarily attributed to pathological conditions but could be due to physiological changes during pregnancy.

Pelvic pain during early pregnancy is a prevalent and multifactorial condition, with gynecological causes being the most common. The strong association between pelvic pain and vaginal bleeding highlights the need for thorough clinical evaluation and imaging to ensure timely diagnosis and intervention. While factors such as BMI and parity contribute to pain severity, other variables, like age and gestational age, showed no significant association. The identification of both gynecological and non-gynecological causes underscores the importance of a multidisciplinary approach in managing pelvic pain.

Limitations of the study

Limitations of the study include the relatively small sample size, which may affect the generalizability of the results. Future research should consider a larger sample size and explore additional predictors that could improve the model's predictive power. Moreover, it would be beneficial to investigate the impact of other clinical parameters and incorporate them into a more comprehensive predictive model.

Conclusion

This study investigated the prevalence and etiology of pelvic pain in pregnant women in their first trimester. The results showed that the prevalence of pelvic pain was 53%, either 47% of participants also presented with vaginal bleeding. The most common causes of pelvic pain were gynecological, primarily miscarriages, followed by fibroids. Appendicitis was the most common non-gynecological cause. The presence of both pelvic pain and vaginal bleeding significantly increased the odds of the pain being gynecological. Other factors, such as age, gestational age, and BMI, did not show a statistically significant association with the pain's etiology.

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Ethics statement: All participants were emailed a copy of the consent form prior to the examinations, and verbal consent was obtained.

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