



The Prevalence and Clinical Characteristics of Maternal Sepsis among Jordanian Women

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ABSTRACT

Background: Maternal sepsis is a major cause of maternal morbidity and mortality worldwide. **Purpose:** The aim of this study was to describe the prevalence of maternal sepsis, as well as the clinical characteristics and outcomes of women with maternal sepsis in Jordan. **Methods:** This retrospective study reviewed 20,774 deliveries documented in the electronic medical records between 2017 and 2024. Out of these, 158 cases were identified with maternal sepsis. **Results:** The prevalence of maternal sepsis was 0.76% of all deliveries over the 7-year study period. Cesarean delivery was more common (59.5%) compared with normal delivery (40.5%). In general, the women who developed maternal sepsis have common clinical characteristics including premature rupture of membrane (PROM) and emergency Caesarian section. The length of the stay in the hospital among women who underwent Caesarian delivery was significantly longer compared to those who delivered vaginally, indicating higher clinical complexity and longer recovery associated with surgical births and maternal sepsis. **Conclusion:** Maternal sepsis complications can be preventable, but potentially preventable by performing good preparation and close monitoring of women with identified clinical characteristics leading to maternal sepsis. **Implications for Nursing:** It is essential to establish clinical nursing guidelines or protocol and implement standardized clinical guidelines which may help reduce the burden of maternal sepsis.

Keywords: Maternal sepsis, Clinical characteristics, Cesarean section, PROM.

What does this paper add?

1. This study describes the prevalence of maternal sepsis and identifies the high risk of women who can get maternal sepsis.
2. This study found that delivery type and obstetric complications, such as pre-mature rupture of

- membrane and Caesarian section, are the most clinical characteristics observed for maternal sepsis.
3. Application of standard guidelines and close monitoring for risky women can reduce developing sepsis in those patients.

Introduction

Globally, around 810 women die every day related to maternal and pregnancy complications (Bakhtawar et al., 2020). Maternal sepsis is defined as “a life-threatening organ dysfunction caused by an infection during pregnancy, delivery, puerperium or after an abortion (Arora et al., 2016). Maternal sepsis is one of the most prevalent complications that occur during pregnancy and after delivery, especially in undeveloped countries, causing maternal morbidity and mortality worldwide (Burlinson et al., 2018). Maternal sepsis is the direct cause of over 260,000 maternal death cases worldwide (Burlinson et al., 2018). In 2019, 21 million cases of maternal sepsis and 17 thousand deaths were reported worldwide (Vos et al., 2020). The incidence and prevalence of maternal sepsis differ according to geographical distribution and the socioeconomic status. For example, maternal sepsis is low in developed countries due to the increase in the awareness of using a broad spectrum of antibiotics, while maternal sepsis is high in low-middle incomes countries, noting that the highest number of maternal sepsis cases was recorded in South Asia (Chen et al., 2021).

There are different demographic characteristics and medical conditions associated with the existence of maternal sepsis, like age, and pre-existing infection (Al-Ostad et al., 2021). Large incidence is observed in young females (20-24 year group) and older than 35 years (Chen et al., 2021). Pre-existing comorbidities, such as diabetes mellitus, cardiovascular disease, anemia, eclampsia and premature rupture of membrane, increase the risk of developing maternal sepsis after delivery (Al-Ostad et al., 2021). Complications that occur during labor and post-delivery increase the risk of developing sepsis and maternal readmission, such as pre-term labor, post-term pregnancy, instrument delivery, spontaneous vaginal delivery, Caesarian section, chorioamnionitis and puerperal infection (Al-Ostad et al., 2021). The Caesarian section rate has risen worldwide according to change in fertility, maternal medical conditions, like uncontrolled hypertension and antepartum hemorrhage (Khasawneh et al., 2020) and the need of fetal monitoring (Sandall et al., 2018). The most prevailing complication of Cesarean section is post-operative infection (Shi et al., 2022).

Maternal infection usually occurs in pregnant women due to physiological, mechanical and hormonal changes (Bonet et al., 2018). The most common

infection that occurs during pregnancy is urinary tract infection and genital infection. The infection during pregnancy can cause pre-term delivery, fetal mortality and can develop to sepsis (Surgers et al., 2013; Knowles et al., 2015). Maternal sepsis has bad outcomes on mothers and neonates. For women, it can cause ectopic pregnancy, infertility, chronic pelvic pain and death (Chen et al., 2021). For neonates, annually more than one million neonates die related to maternal sepsis (Greer et al., 2019). Early recognition and detection of early signs of maternal sepsis, as well as the presence of guidelines or a protocol for early detection and management of sepsis, can contribute to prevent maternal morbidity and mortality related to sepsis and improve patients' outcomes (Olvera & Dutra, 2016).

Early detection and timed management of sepsis require a multidisciplinary approach, including doctors, nurses, pharmacists and laboratories (Elsayed et al., 2019). Post-partum care, whether for normal delivery or Cesarean section patients, must monitor vital signs, obtain blood culture and initiate the broad spectrum of antibiotics. This approach can reduce the risk of developing sepsis and reduce the length of stay in the hospital (Elsayed et al., 2019). One in five laboring women has Group B *streptococcus*, according to a recent study conducted in Jordan using vaginal swabbing (Clouse et al., 2019). An earlier study carried out in Jordan in 2007/2008 revealed that the maternal mortality rate was 19.1 deaths per 100,000 due to sepsis, thrombosis, thromboembolism, and hemorrhage (Amarin et al., 2010). Few research examined the incidence, prevalence, demographics, and consequences for both women and fetuses of maternal sepsis in Jordan. Thus, the aim of this study was to describe the prevalence of maternal sepsis and the clinical characteristics and outcomes of women with maternal sepsis in Jordan.

Materials and Methods

Study Design

This is a retrospective study which covered 7 years (from 2017 to 2024) by using electronic health medical records. The cases were identified by International Classification of Diseases, tenth revision (ICD-10) codes. Specifically, cases were identified using relevant ICD-10 codes related to maternal infections and sepsis during pregnancy, childbirth, or the postpartum period (e.g., O85: puerperal sepsis). All identified cases were reviewed to ensure that they met the clinical definition

of maternal sepsis as a life-threatening organ dysfunction resulting from infection during pregnancy, delivery, or the postpartum period.

The inclusion criteria included all women with post-partum delivery either undergoing normal delivery or a Caesarian section who were diagnosed with sepsis. There is no need for estimation of sample size, because the first aim of this research is to describe the prevalence of sepsis depending on the number of cases from which we extracted data. Also, in this research, no questionnaire was used, because the data required had been extracted from the medical records only. This study was conducted and reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

Setting

This study was conducted by extracting data from electronic health medical records at King Abdullah University Hospital in northern Jordan. The hospital is the primary medical hospital for the region and the main hospital for complicated cases according to the hospital workload and number of delivery cases.

Data Collection

The demographic and clinical variables, such as age, number of previous deliveries, number of previous abortions, type of delivery whether normal or Caesarian, along with any complications before pregnancy, including anemia, diabetes mellitus and cardiovascular disease, the recorded complications during the current pregnancy, including eclampsia, anemia, gestational diabetes, infection, as well as the complications during delivery or post-delivery, such as premature rupture of membrane, pre-term birth, post-partum hemorrhage, chorioamnionitis and puerperal infection, are considered. Finally, any occurrence of sepsis was also noted.

Ethical Considerations

Ethical approval was obtained from the Ethics Review Committee at Al-Balqa Applied University. Then, ethical approval was taken from the Ethics Review Committee at King Abdullah University Hospital. The researchers extracted data from the system. Privacy and confidentiality of the collected data were assured throughout the study. No personal data was collected. All study data was saved in a password

protected computer. All procedures were performed in accordance with the ethical standards of the institutional committee.

Statistical Analysis

The data was coded and entered into SPSS (version 25). Continuous variables were presented as means $\pm$ standard deviations or medians (IQR), while categorical data was presented as numbers and percentages. The differences in patients' data were analyzed using t-test, Mann-Whitney U test, Chi-squared test, Fisher -Exact test or one-way ANOVA as appropriate. Statistical significance was considered as $p \leq 0.05$.

Results

Descriptive Statistics

This retrospective study reviewed 20,774 deliveries documented in the electronic medical records between 2017 and 2024. Out of these, 158 cases were diagnosed with maternal sepsis. The distribution of delivery types is shown in Table 1. As seen, the majority of births were by Cesarean section (62.9%), followed by normal vaginal delivery (35.9%). Assisted vaginal deliveries (forceps and vacuum) were rare, representing less than 1% of all cases. Also, breech deliveries were uncommon (0.03%). Among the reviewed deliveries, 158 cases of maternal sepsis were identified, representing about 0.76% of all deliveries during the 7-year period in the studied hospital.

Table 1. Number and type of deliveries between 2017-2024

Delivery Type	Count	Percentage (%)
Forceps	72	0.3%
Vacuum	148	0.7%
Breech	6	0.03%
Cesarean Section	13,080	62.9%
Normal Delivery	7,468	35.9%
Total	20,774	100%

Descriptive statistics were calculated for key continuous variables as summarized in Table 2. The participants had a mean age of 33.55 years, with admission periods ranging from 0.10 to 61.00 days (Mean = 4.71). WBC counts ranged from 4.80 to 34.90 (Mean = 12.26), and temperatures on admission ranged from 36.0°C to 40.0°C (Mean = 37.85°C). The mean gestational age was 37.33 weeks, BMI averaged 29.06, Para number 2.78, and Gravida number 3.04 weeks.

Table 2. Descriptive statistics of continuous variables

Variable	N	Min.	Max.	Mean	SD
Age	158	19.00	49.00	33.55	7.71
Admission period (hrs)	158	2.23	1465.13	113.11	154.62
Admission period (days)	158	0.10	61.00	4.71	6.44
WBC	115	4.80	34.90	12.26	4.95
Temperature on admission	93	36.00	40.00	37.85	0.95
BMI	67	15.90	40.90	29.06	5.56
Gestation week	123	25.00	42.00	37.33	3.53
Para number	115	1.00	10.00	2.78	2.13
Gravida number	115	0.00	10.00	3.04	2.21

Frequencies of Categorical Variables

As seen in Table 3, the most frequent diagnoses were “Other complications of obstetric surgery” (34.2%) and “Infection of obstetric surgical wound” (26.6%). Puerperal sepsis accounted for 9.5% of cases. Cesarean delivery was more common (59.5%) than normal delivery (40.5%). Among tested cases, 38.6% were negative and 37.3% were positive; 24.1% of results were missing. The premature rupture of membranes (PROM) was reported in 12.0%, diabetes mellitus in 3.2%, pre-term delivery in 1.3%, thrombophilia and gestational hypertension in 2.5% each, and emergency cesarean in 4.4%.

Among 158 maternal sepsis cases, 41 women (25.7%)

had clinical profile of maternal sepsis cases. The most frequent was PROM (12.0%), followed by emergency Cesarean section (CS) (4.4%). Together, these accounted for over 65% of risk-factor cases. Diabetes (3.2%), thrombophilia (2.5%), gestational hypertension (2.5%), and pre-term delivery (1.3%) were less common, but clinically relevant. PROM and emergency CS were among the most commonly observed clinical characteristics in maternal sepsis cases, while chronic conditions, such as diabetes mellitus, hypertension, and thrombophilia, increase vulnerability. Preventing PROM, minimizing emergency CS, and close monitoring of high-risk women are essential strategies.

Table 3. Frequencies of categorical variables

Variable	Category	Frequency (n)	Percent (%)	Cumulative Percent (%)
Diagnosis	Complications of labour and delivery, not elsewhere classified (Traumatic delivery)	2	1.3	1.3
	Pyrexia during labour	1	0.6	1.9
	Other complications of obstetric surgery and procedures	54	34.2	36.1
	Vaginal delivery following previous cesarean section	13	8.2	44.3
	Complication of labour and delivery, unspecified	14	8.9	53.2
	Puerperal sepsis	15	9.5	62.7
	Infection of obstetric surgical wound	42	26.6	89.2
	Other infection of genital tract following delivery	1	0.6	89.9
	Urinary tract infection following delivery	1	0.6	90.5
	Pyrexia of unknown origin following delivery	15	9.5	100.0
Type of Delivery	Total	158	100.0	
	Normal Delivery	64	40.5	40.5
	Cesarean Section	94	59.5	100.0
	Total	158	100.0	
Blood Culture Result	Negative	61	38.6	50.8
	Positive	59	37.3	100.0
	Total Available	120	75.9	
	Missing Data	38	24.1	
Risk Factors	Total	158	100.0	
	PROM	19	12.0	12.0
	DM	5	3.2	15.2
	Pre Term delivery	2	1.3	16.5
	Thrombophilia	4	2.5	19.0
	Gestational Hypertension	4	2.5	21.5
	Emergence CS	7	4.4	25.9
	Total	41	25.7	

Association between Maternal Sepsis and Categorical Variables

A Chi-square test of independence examined the association between maternal sepsis and categorical variables summarized in Supplementary Table 1. Blood culture results were not significantly associated with maternal sepsis ($p = 0.855$). In contrast, type of delivery ($p = 0.017$) and all investigated clinical characteristics observed as maternal sepsis cases ($p < 0.001$) showed strong and significant associations, indicating their relevance as maternal sepsis risk indicators.

Comparison of Continuous Variables by Type of Delivery

Descriptive statistics by type of delivery indicated that most continuous variables (age, WBC, temperature on admission, gestational week, Para number, Gravida number, and BMI) did not significantly differ between normal and Cesarean deliveries, as found in Supplementary Table 2. However, the data showed that the admission period and age ($p = 0.045$; $p = 0.052$, respectively) were with Cesarean patients staying longer in the hospital and with a higher mean age.

Comparative and Inferential Analysis of Maternal Sepsis Variables

To examine group differences among women with maternal sepsis, two inferential statistical tests were applied: an independent sample *t*-test to compare normal versus Cesarean deliveries, and a one-way ANOVA to

assess variation across multiple subgroups for continuous variables. The *t*-test results, as in Supplementary Table 3, showed significant differences in only two main variables. The first one was the admission period per days ($p = 0.000$); women who underwent Cesarean delivery had a significantly longer hospital stay compared to those who delivered vaginally, indicating higher clinical complexity and longer recovery associated with surgical births and maternal sepsis. The second one was the para number ($p = 0.033$). Cesarean cases had a higher parity on average than normal deliveries, suggesting that women with multiple previous births were more likely to undergo Cesarean delivery and more at risk to get maternal sepsis.

The ANOVA test, Table 4, suggested that temperature on admission ($p = 0.020$), and gestational age per week ($p = 0.013$) varied significantly among subgroups of sepsis diagnosis, possibly reflecting different stages of infection severity and timing of delivery. ANOVA showed a significant difference in gestational week ($F = 2.558$, $p = 0.013$) and level of temperature on admission ($F = 2.548$, $p = 0.02$) among groups; however, *post-hoc* comparisons were not performed, because at least one group had fewer than two cases. However, these findings highlight the importance of monitoring infection-related physiological changes and the potential added burden of surgical delivery on maternal outcomes. Overall, these findings emphasize the importance of delivery type and obstetric clinical characteristics of maternal sepsis and suggest potential clinical indicators for patient monitoring and intervention.

Table 4. One-way ANOVA results of examining differences in continuous variables across multiple groups of sepsis diagnosis

Variable	F (Between/Within df)	p-value
Age	1.431 (9,148)	0.180
Admission Period (days)	1.248 (9,148)	0.270
WBC	1.208 (7,107)	0.305
Temperature on Admission	2.548 (7,85)	0.020*
BMI	1.815 (6,60)	0.111
Gestation Week	2.558 (8,114)	0.013*
Para Number	0.903 (7,107)	0.507
Gravida Number	0.585 (7,107)	0.767

* p -value ≤ 0.05 was considered statistically significant.

Discussion

This retrospective cohort study measured the period

prevalence of sepsis and sepsis-related mortality among pregnant women in Jordan, covering seven years from

2017-2024, by using electronic health medical records, and evaluated its association with various obstetric outcomes, by examining the patterns, clinical profile and clinical characteristics of maternal sepsis. Over the seven-year period, a total of 20,774 deliveries were recorded, of which 158 maternal sepsis cases were identified, yielding a prevalence of 0.76% in Jordan. The results highlight key associations between delivery type, obstetric clinical characteristics observed among maternal sepsis cases, providing important insights for improving maternal infection prevention and management strategies. Very limited studies have looked at sepsis in Jordan, let alone record its prevalence and associated factors; nonetheless, this prevalence percentage falls within the lower range of global estimated percentages reported in recent meta-analyses (Woodd et al., 2019; Yu et al., 2025).

Specifically, a recent report from the Ministry of Health in Jordan assessed over the 12-month period between 2022-2023 maternal morbidity cases evaluating quality of care in all public and private Jordanian hospitals and health centers and found very low incidence of only 36 cases of maternal sepsis among all assessed cases, while 44% of women with sepsis cases were parity one and the other 40% were multiparous (Ministry of Health, 2023). Furthermore, 133 reported cases of post-partum hemorrhage and 136 cases of severe pre-eclampsia/eclampsia were reported. The majority of these cases were found in women with a mean age of 29 years and these women were mainly multiparous of 2-4 parities. Surprisingly, in the context of Jordan, a report on the maternal mortality ratio stood at 85.2 per 100,000 live births in 2021 (Ministry of Health, 2021), and around 75% of these maternal fatalities occurred during the post-partum period. In comparison, pooled global data from a recent systematic review and meta-analysis estimated that the maternal sepsis prevalence is under 10 % of live births, though incidence rates estimated vary widely (9 to 49 per 100,000 deliveries), reflecting heterogeneity across different regions and countries (Yu et al., 2025).

Consistent with the rising Cesarean section rates observed in many countries (Betran et al., 2021), at 62.9%, Cesarean section was the most common delivery mode in the study population in Jordan. Among women with maternal sepsis, Cesarean delivery was far more prevalent than vaginal delivery (59.5% vs. 40.5%) within the maternal sepsis cohort. This is shown in the

significant association between delivery type and sepsis, $p = 0.017$, highlighting the infection risks associated with surgical birth, such as wound complications, endometritis, and post-operative morbidity (Childs et al., 2020; Shree et al., 2016). Particularly, a retrospective study conducted in 2022 revealed that the risk of chronic endometritis increased by approximately 77% among women who have a Cesarean scar defect (Wel et al., 2022). A surprisingly alarming study conducted by Clapp et al. suggested a direct affect of higher Cesarean delivery rate on maternal post-operative morbidity rates, where for every 1% increase in the Cesarean delivery rate, a 3.3% increase is seen in severe maternal morbidity, including serious complications, such as hemorrhage, ICU admission and the need of blood transfusion (Clapp et al., 2021).

Maternal sepsis holds a burden on the hospital facilities and healthcare provides, where extended hospitalization among Cesarean patients seen in our study likely reflects post-operative recovery needs and heightened monitoring requirements in the presence of infection. Not only women who delivered by Cesarean section had longer hospital stays and were older. These results are consistent with earlier research that found prolonged admission times among septic postpartum women, especially following emergency or complicated Cesarean deliveries (Mitchell et al., 2023). Furthermore, consistent with typical inflammatory responses to infection, our results revealed moderately elevated mean WBC levels and admission temperatures among sepsis cases. The noted patterns support the clinical value of early physiological indicators, like fever and leukocytosis, in identifying women who are more susceptible to serious maternal infections (Filetici et al., 2023).

Approximately 18.7% of the women who developed maternal sepsis had identifiable clinical characteristics observed related to limited time for optimal pre-operative preparation, including PROM, pre-term delivery and emergency Cesarean section. PROM is linked to significant maternal and prenatal morbidity and mortality, especially in developing countries, where the prevalence rates of PROM are higher (Sahoo et al., 2022; Tiruye et al., 2021). Not only does it increase the risk of ascending infection in mothers, but it is also associated with risk of neonatal sepsis as well (Andini et al., 2023). Women with intrauterine infection deliver earlier than non-infected women, and infants born with

sepsis have a mortality rate four times higher than those without sepsis do. PROM's prominent role in our findings reinforces the need for close clinical monitoring and timely preventive measures when membranes rupture early, as PROM increases the chances of maternal complications, such as intra-amniotic infection (Lin et al., 224). Moreover, PROM contributes to more than 40% of pre-term deliveries. Interestingly, the most important clinical characteristic for PROM is the presence of chronic maternal diseases, including diabetes mellitus and hypertension (Boskabadi & Zakeri, 2019), and several recent systematic reviews linked these conditions with neonatal and maternal obstetric complications (Tiruye et al., 2021; Lin et al., 2024). This is also supported by our findings, where even though the presence of chronic maternal conditions, such as diabetes, thrombophilia, and hypertension, were less common in our cohort, representing 8% of linked observed clinical characteristics, yet still showed significant association with the development of maternal sepsis. Their significance in our study emphasizes how crucial it is to closely monitor and provide supportive care for women with these comorbidities throughout pregnancy, labor and the post-partum period. Our study has also revealed that Cesarean section patients had significantly higher parity and hospital admission duration. The notably longer hospitalization length among Cesarean sepsis cases ($p < 0.001$) emphasizes the clinical implications of managing post-operative infections, which may require prolonged antibiotic therapy, wound care, or further monitoring. This highlights the need for targeted monitoring and preventive interventions among women with these risk conditions or undergoing Cesarean delivery specifically.

Collectively, in light of factors that may significantly lower sepsis risk, our results and the literature call for 1) reducing avoidable Cesarean sections, 2) prompt diagnosis and management of PROM, 3) enhanced consultation, surveillance and monitoring of high-risk obstetric patients, especially women with diabetes mellitus, thrombophilia, or hypertension, and finally 4) monitoring early physiological markers, such as maternal fever and elevated WBC count, as this remains crucial in post-partum care and a critical preventative measure for prevention and early detection of maternal sepsis.

Strengths and Limitations

A major strength of this study is the duration period, spanning over seven years, representing a large sample size of the Jordanian population. However, several limitations must be acknowledged. Due to the limitation in the electronic records, critical variables, including BMI, blood culture results, were missing. The retrospective design of the study may underreport certain clinical characteristics not captured consistently in the electronic records or incompletely. Also, missing data in some clinical variables, such as BMI, WBC count, and temperature, may have influenced the precision of the estimates. Those limitations can improve potential bias. Future research should incorporate prospective data collection and possibly exploring microbiological patterns to support our understanding of major observed clinical characteristics of maternal sepsis and how targeted antimicrobial protocols may influence its outcomes.

Implications for Nursing

The findings of this study provide the main characteristics and factors associated with adverse outcomes among women with sepsis. Close supervision and applying evidence-based guidelines for those women during antenatal stage and post-partum may help reduce maternal morbidity and mortality rates related to sepsis. Also, it is essential to establish clinical nursing guidelines or a protocol and implement standardized clinical guidelines which may help reduce the burden of maternal sepsis. Additionally, conducting structured educational programs and sessions for nursing and midwifery students is recommended to provide effective and safe management of maternal sepsis.

Recommendations

The authors recommend conducting future studies that may integrate different types of research methodologies that identify risky women for developing maternal sepsis to be applied using large samples in different geographical areas in Jordan.

Conclusion

In conclusion, maternal sepsis is a potentially preventable condition. We found that delivery type, particularly Cesarean section, and obstetric complications, such as PROM and emergency Cesarean, are characteristics associated with maternal sepsis.

Furthermore, some high-risk groups, such as those with the presence of chronic diseases, are more likely to get sepsis. Closer supervision of these women is warranted. In order to lower the case fatality rate of maternal sepsis and to reduce maternal sepsis burden, we must enhance the standards of obstetric treatment by improving risk-based monitoring of these patients.

Availability of Data and Materials

All relevant materials and raw data used to extract figures can be shared upon reasonable request.

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Conflict of Interests

The authors have no conflict of interests to declare.

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Author Contributions

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