Original Research **ISSN 2835-6276**

American Journal of Medical and Clinical Research & Reviews

Determinants of puerperal sepsis and maternal outcomes in a Nigerian tertiary health institution: a retrospective case-control study

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Received: 07 Feb 2025; Accepted: 15 Feb 2025; Published: 25 Feb 2025

Citation: Akinwaare M.O. et al. Determinants of puerperal sepsis and maternal outcomes in a Nigerian tertiary health institution: a retrospective case-control study. AJMCRR. 2025; 4(2): 1-12.

Abstract

Objectives: *To examine how sociodemographic and obstetric factors are related to puerperal sepsis. The study also assessed the consequences of puerperal sepsis on the health of mothers diagnosed with puerperal sepsis.*

Design: *This is a retrospective case-control study. The health records of 8990 mothers who delivered at the health facility within five years (January 2015–December 2019) were retrieved from the hospital's health record department. A total of 6479 had antenatal registration, 2511 did not, and 660 patients were randomly selected to participate in the study. A validated checklist was used for data collection from 660 health records included in the study. Logistic regression using odd ratios at 95%CI was used to identify factors associated with puerperal sepsis. Also, Chi-square was used to examine the significant association between puerperal sepsis and the mother's sociodemographic characteristics. Additionally, frequency and percentage were used to describe the maternal outcomes.*

Setting: *Obstetrics and Gynaecology unit of the University College Hospital, Ibadan, Nigeria.*

Participants: *A total of 660 postpartum women with and without antenatal registration at the hospital were included in the study.*

Primary outcome measures: *Puerperal sepsis, and the resultant maternal outcomes within the five years of the study.*

Results: *A total of 21.1% of 660 postpartum women were diagnosed with puerperal sepsis. The analysis revealed that women with fewer numbers of ANC attendance had an increased likelihood of developing puerperal sepsis, with an AOR of 4.76(2.32 – 49.78), indicating that they were 4.76 times more likely to*

have this condition compared to those with more numbers of ANC attendance. Also, women who had tertiary education were 5.4 times more likely to have puerperal sepsis [AOR = 5.40 (1.31 – 22.33)] compared to those who had primary education. Similarly, women with PCV < 25 were found to be 4.8 times more likely to have puerperal sepsis [AOR = 4.84(1.62 – 14.59)] compared with their counterparts with PCV > 33. Also, there were significant associations between the diagnosis of puerperal sepsis and maternal age (X^2 = 22.03; p < 0.001), occupation (X^2 = 27.75; p < 0.001), marital status (X^2 = 4.53; p = 0.033), length of stay (X^2 = 73.50; p < 0.001) and place of delivery (X^2 = 38.70; p < 0.001). Additionally, maternal outcomes include septicemia (12.4%), septic shock (11.5%), pelvic abscess (7.3%), peritonitis (6.4%), and death (5.0%).

***Conclusions**: Both sociodemographic and obstetric factors are strong determinants of puerperal sepsis. The puerperal sepsis has consequences on the health of the mother. Therefore, it is recommended that effective interventions targeting prevention of puerperal sepsis should be planned, and implemented by care providers and policy makers in charge of maternal health.*

Key Words: Puerperal Sepsis, Maternal deaths, Pregnancy, Postpartum, Nigeria.

Strengths and limitations of this study

- It covers a long period that can give reliable results
- It includes mothers with and without antenatal registration for a suitable comparison
- It uses health facility records, thereby devoid of self-reporting bias
- It could ascertain causality from inferential analysis
- It lacks postpartum follow-up of mothers and their babies

Introduction

Childbirth period and the period of few days following childbirth (postpartum period) are critical periods for most women and girls who become pregnant worldwide as they face a lifetime risk of maternal death[1]. Most reviews on maternal death rates associated with puerperal sepsis range from 4-8%, or approximately 0.6 maternal deaths per 100,000 live births in developed countries[2]. Studies from high-income countries reported an increase in the incidence of maternal morbidity due to sepsis from 0.65 per 1000 deliveries in 2002 to 1.13 per 1000 deliveries in 2008[3]. A similar study also reported that puerperal sepsis is among the causes of various forms of morbidity among women[4]. Hence, regardless of massive intervention programs to improve safe motherhood and the advanced scientific research in various areas of knowledge, puerperal sepsis still constitutes a major public health problem, as evidenced by its high prevalence contributing to maternal deaths especially in low and middle-income countries (LMICs)[5].

Puerperal sepsis is an infection of the genital tract occurring at any time between rupture of a membrane or labour and 42 days postpartum in which two or more of the following are present; pelvic pain, fever, abnormal vaginal discharge, delay in the rate of uterine involution[3]. In Africa, puerperal sepsis, severe bleeding (mostly bleeding after childbirth), high blood pressure during pregnancy (pre-eclampsia and eclampsia), complications from

delivery, and unsafe abortion are the major complications that accounted for almost 75% of maternal deaths[6,7,8,9]. Puerperal sepsis is a preventable public health issue, it is said to be the second most common cause of maternal morbidity and mortality in the developing world[10]. In a study conducted in Uganda, puerperal sepsis accounted for 31% of maternal deaths, this was recorded as the commonest cause of maternal mortality in that country[11]. However, in Nigeria, puerperal sepsis has been reported as the third leading cause of maternal mortality after preeclampsia/eclampsia and hemorrhage, accounting for 12% of maternal deaths[12]. In a study conducted in Southeastern Nigeria, the prevalence of puerperal sepsis was 1.7%, and the associated risk factors included intrauterine fetal death, obstructed labor, and perineal tear[13].

The risk factors for puerperal sepsis in Nigeria have been associated with antenatal registration, emergency cesarean section, labor initially monitored outside proper health facility, and prolonged labour[13]. Although maternal deaths have declined globally since the 1990s, the pace of reduction has been much slower in Nigeria compared to the rest of Africa[14]. The associated risks of maternal death are higher in women living in rural areas and among poorer communities[13]. The range is wide and includes the behavior of families and communities, social status, education, income, age, parity, antenatal registration status, place of birth, and availability of health services[15].

Therefore, to achieve the Sustainable Development Goal (SDG) related to the reduction of maternal mortality, it is important to identify the determinants of puerperal sepsis and assess the clinical outcomes of women with puerperal sepsis[16], which is a major contributor to maternal morbidity and mortality. However, there is a lack of relevant data in Southwestern Nigeria. It was on these premises that this study was conducted to identify sociodemographic and obstetric factors associated with puerperal sepsis and to provide information on the consequences of puerperal sepsis on the health of mothers diagnosed with puerperal sepsis.

Methods

Study design and data sources

This is a retrospective case-control study. The study compares patients who had puerperal sepsis (cases) with patients who did not (controls), and looked back into their hospital records retrospectively to compare how frequently the exposure to certain risk factors are present in each group to determine the relationship between the risk factors and puerperal sepsis. The study investigated the determining factors and subsequent outcomes of puerperal sepsis among women admitted to the University College Hospital (UCH) - a foremost teaching hospital in Nigeria for five years. It is the first teaching hospital in Nigeria and a national referral center in Southwestern Nigeria. It provides healthcare services and trains various health professionals. The health records of women diagnosed with puerperal sepsis from January 2015 to December 2019 were retrieved from the obstetric and gynecology department of the hospital and were used for analysis.

Study participants

The health records of 660 postpartum women admitted to the hospital within the 5-year period of the study were included in the analysis. This included women who were referred to the hospital for delivery without antenatal registration in the hospital, and those who registered, received antenatal care, and delivered in the hospital. Those whose

records have been mutilated beyond recognition, misplaced, or cannot be found were excluded from the study.

Sampling technique

The sample size was determined using double population proportion formula. Antenatal care (ANC) registration status was used as a determinant in this study. Proportion for controls with ANC registration (72.1%) and cases with ANC registration (27.9%), considering 95% confidence interval, 80% power of test with 3:1 ratio of controls to cases[8].

$$n = \left(\frac{r+1}{r}\right)\left(\frac{p(1-p)*(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}\right) \qquad \text{Where, } p = (p_1+p_2)/2$$

$$n = (3+1)/3\ \{0.4(1-0.4) \times (0.84+1.96)^2\}/\ (0.5-0.3)^2$$

$$n = 66$$

The sample size per group in a year was 66, therefore the two groups (control and case) were 132 for a year. And for the five (5) years, 5 X 132 = 660. The total number of case notes was 660 as required for the study. Therefore, the proportion for the control group was 660 X 0.72 = 475 while 660 X 0.27 = 185 for the case group.

Health records of 660 postpartum women who were admitted into UCH, Ibadan between January 2015 and December 2019 were selected based on the inclusion and exclusion criteria. The health records were randomly selected for each year (Table 1).

Table 1: Total number of women who delivered from January 2015 to December 2019

Year	Number of delivered mothers with antenatal registration	Sample of mothers with antenatal registration	Number of delivered mothers without antenatal registration	Sample of mothers without antenatal registration	Total sample
2015	771	57	424	31	**88**
2016	1526	112	540	40	**152**
2017	1466	107	533	39	**146**
2018	1161	85	374	28	**113**
2019	1555	114	640	47	**161**
TOTAL	**6479**	**475**	**2511**	**185**	**660**

Study Variables

Dependent variable

Puerperal sepsis

Independent variables

The independent variables include sociodemographic and obstetric factors such as; educational level attainment, area of residence (urban vs rural), number of ANC attendance, number of babies, place of delivery, and packed cell volume (PCV).

Data collection

A validated, pretested structured checklist was used as a guide to retrieve information from the women's case files. Ten research assistants were recruited and trained in line with the study's objective to assist with data collection under supervision after collecting ethical approval from the University of Ibadan ethics committee and a letter of approval from the Chairman, Medical Advisory Committee, University College Hospital. The trained research assistants visited the records unit of University College Hospital, where case files were retrieved to elicit information about all postpartum women within the study period.

Relevant information was extracted from the case files. This information includes the sociodemographic characteristics of the women, their obstetric characteristics, such as parity and antenatal history, diagnosis of puerperal sepsis, health outcomes of the mother, and health outcomes of the babies. For six weeks, the records unit was visited daily (weekends excluded).

Outcomes measures

The study assessed all mothers diagnosed with puerperal sepsis within five days of delivery. The diagnosis was made based on the presentation of fever (temperature >37.2^{0}C), pelvic pain, and foul-smelling vaginal discharge. Also, the health status of the mothers after delivery was assessed to describe how the puerperal sepsis affected the health of the mothers.

Data analysis

Multivariate analysis (logistic regression) using odd ratios at 95% Confidence Interval was used to test the odds of some sociodemographic characteristics and obstetric factors being associated with puerperal sepsis. Also, Chi-square was used to examine the significant association between puerperal sepsis and the selected mother's sociodemographic characteristics. Additionally, frequency and percentage were used to describe the pregnancy outcomes in relation to the health of the mothers. The level of significance was set at α=0.05.

Ethical Consideration

Ethical approval was obtained from the University of Ibadan/University College Hospital ethics review board with approval number UI/EC/20/0140. Confidentiality was maintained by not including names and addresses of the patient or any form of identifier.

Patient and public involvement

None

RESULTS

Socio-demographic characteristics of the participant's record

Results, as presented in Table 2, show that 95.3% of the women aged between 21 and 40years, their estimated median (IQR) age was 31 (27 – 35), 38.3% were into business and 33.7% were civil servants, 95.9% were married, 55.9% were Christians, 77.3% were from Yoruba tribe and 64.9% length of stay in the hospital was less than 5 days with median (IQR) 4 (3 – 7).

Table 2: Socio-demographic characteristics of the participants

Variable	Frequency	Percentage (%)
Age (yrs.)		
Below 21	7	1.1
21 – 30	308	46.7
31 – 40	321	48.6
Above 40	24	3.6
Median (IQR) = 31(27-35)		
Occupation		
Housewife	65	10.4
Student	76	12.1
Business	240	38.3
Civil service	211	33.7
Artisan	34	5.4
Marital status		
Single	26	4.1
Married	612	95.9
Religion		
Christianity	367	55.9
Islam	281	42.8
Others	9	1.3
Ethnicity		
Igbo	78	11.9
Yoruba	508	77.3
Hausa	35	5.3
Others	36	5.5
Length of stay in the hospital		
Below 5	412	64.9
6 – 10	146	23.0
11 – 15	42	6.6
Above 15	35	5.5
Median(IQR) = 4(3-7)		

Association between diagnosis of puerperal sepsis and associated risk factors

Results, as presented in table 3, show that there were significant associations between the diagnosis of puerperal sepsis and educational status (X^2 = 72.26; p < 0.001), partner educational status (X^2 = 44.74; p < 0.001), area of residence (X^2 = 30.80; p < 0.001), number of babies (X^2 = 10.05; p = 0.002), place of delivery (X^2 = 38.70; p < 0.001), PCV (X^2 = 56.15; p < 0.001) and pre-existing morbidity (X^2 = 10.74; p < 0.001) while ANC attendance in UCH (X^2 = 1.94; p = 0.164), parity (X^2 = 1.37; p = 0.504) and placenta (X^2 = 3.62; p = 0.164) was not significantly associated with diagnosis of puerperal sepsis.

Table 3: Association between diagnosis of puerperal sepsis and associated risk factors

Variables	Puerperal sepsis			
	No	Yes	X^2 Value	p-value
Attendance of ANC in UCH				
Yes	357 (93.7)	29 (100.0)	1.94	0.164
No	24 (6.3)	0 (0.0)		
Educational status				
Primary	9 (1.8)	6 (4.4)	72.26	< 0.001*
Secondary	126 (24.7)	83 (61.0)		
Tertiary	376 (73.6)	47 (34.6)		
Partner Educational status				
Primary	10 (2.0)	13 (9.4)	44.74	< 0.001*
Secondary	199 (39.8)	85 (61.2)		
Tertiary	291 (58.2)	41 (29.5)		
Area of residence				
Urban	35 (6.9)	16 (11.5)	30.80	< 0.001*
Semi-urban	208 (40.8)	87 (62.6)		
Rural	267 (52.4)	36 (25.9)		

Number of babies				
Singleton	447 (87.1)	106 (76.3)	10.05	0.002*
Multi-gestation	66 (12.9)	33 (23.7)		
Parity				
Primipara	158 (30.3)	37 (26.6)	1.37	0.504
Multipara	333 (63.9)	91 (65.5)		
Grand-multipara	30 (5.8)	11 (7.9)		
Place of delivery				
Home	8 (1.6)	10 (7.2)	38.70	< 0.001*
Health center	56 (11.2)	22 (15.9)		
TBA/Mission house	8 (1.6)	13 (9.4)		
Hospital	428 (85.6)	93 (67.4)		
Parked cell volume (PCV)				
>33%	138 (27.2)	14 (10.1)	56.15	< 0.001*
< 25%	370 (61.8)	125 (63.0)		
Pre-existing morbidity				
Yes	83 (16.4)	40 (28.8)	10.74	0.001*
No	422 (83.6)	99 (71.2)		
Placenta delivery				
Complete	208 (40.3)	67 (49.3)	3.62	0.164
Retained	35 (6.8)	7 (5.1)		
Manual removal	273 (52.9)	62 (45.6)		

Significant association at p < 0.05, Fisher's exact value was reported for small cells

Logistic regression showing Odd Ratios and 95% CI of factors associated with puerperal sepsis

Table 4 shows the results of the unadjusted and adjusted Odds Ratios of factors associated with maternal puerperal sepsis. The analysis revealed that women with fewer numbers of ANC attendance had an increased likelihood of developing puerperal sepsis, with an AOR of 4.76(2.32 – 49.78), indicating that they were 4.76 times more likely to have this condition compared to those with more numbers of ANC attendance. Also, women who had tertiary education were 5.4 times more likely to have puerperal sepsis [AOR = 5.40 (1.31 – 22.33)] compared to those who had primary education. Similarly, women with PCV < 25 were found to be 4.8 times more likely to have puerperal sepsis [AOR = 4.84(1.62 – 14.59)] compared with their counterparts with PCV > 33.

Table 4: Logistic regression showing Odd Ratios and 95% CI of factors associated with puerperal sepsis

	Unadjusted ORs (95%CI)	Adjusted ORs (95%CI)
Number of ANC attendance		
5 and above	1.00	1.00
Less than 5	0.36(0.16 – 0.79)	4.76(2.32 – 49.78)*
Educational level		
Primary	1.00	1.00
Secondary	5.33(1.82 – 15.65)*	1.46(0.59 – 3.32)
Tertiary	5.37 (3.50 – 7.95)*	5.40 (1.31 – 22.33)*
Area of residence		
Urban	1.00	1.00
Semi-urban	3.39(1.71 – 6.73)*	1.30(0.09 – 18.12)
Rural	3.10 (2.02 – 4.76)*	4.15(2.59 – 77.34)*
Number of babies		
Singleton	1.00	1.00
Multi-gestation	2.11(1.32 – 3.37)*	0.29(0.04 – 2.35)
Place of delivery		
Health center	1.00	1.00
Home	5.75(2.21 – 14.97)*	3.56(0.25 – 51.00)*
TBA/Mission	1.81(1.05 – 3.11)*	2.15(0.01 – 1.80)*

Parked Cell Volume (PCV)		
>33% < 25%	1.00 2.35(1.29 – 4.31)*	1.00 4.84(1.62 – 14.59)*
Pre-existing morbidity		
No Yes	1.00 2.05(1.33 – 3.18)*	1.00 12.13(2.48 – 59.27)*
Episiotomy/Perineal tear		
No Yes	1.00 1.19(0.71 – 1.98)	1.00 0.98(0.23 – 4.19)

Maternal outcomes for mothers with puerperal sepsis

Results, as shown in Table 5, revealed that 82 (12.4%) of the mothers developed septicemia, 76 (11.5%) had septic shock, 48 (7.3%) had pelvic abscess, 42 (6.4%) had peritonitis, 29 (4.4%) developed other morbidities and 33 (5.0%) of the mothers died.

Table 5: Maternal outcomes for mothers with puerperal sepsis

Maternal health outcomes	Frequency	Percentage (%)
Septicaemia	82	12.4
Septic shock	76	11.5
Disseminated Intravascular Coagulopathy	32	4.8
HELLP syndrome	15	2.3
Respiratory distress	21	3.2
Altered medical status	16	2.4
Peritonitis	42	6.4
Pelvic abscess	48	7.3
Acute organ dysfunction	11	1.7
Other morbidities	29	4.4
Other morbidities		
Anemia	2	6.9
Anemic heart failure	1	3.4
Deep venous thrombo-embolism	1	3.4
Endometritis	3	10.3
Heart failure	1	3.4
Inter obstruction	4	13.8
Intraabdominal mass	3	10.3
PPH, hemorrhagic shock, pelvic collection pulmonary oede-ma	3	10.3
Pre-eclampsia	1	3.4
Pulmonary embolism	1	3.4
Pyelonephritis	4	13.8
Renal disease	1	3.4
Renal failure	2	6.9
Renal impairment	1	3.4
Severe eclampsia	1	3.4
Death of mother	33	5.0
Clinical cause of death		
Anemic heart failure	3	9.1
Chronic renal disease	6	18.2
Complication from with hypoglycemia	2	6.1
Disseminated intravascular coagulopathy	6	18.2
Hyperglycemia	1	3.0
Overwhelming sepsis	1	3.0
Peritonitis	3	9.1
Septic shock	6	18.2
Septicemia	4	12.1
Thrombo-embolism	1	3.0

Discussion

The study examined the determinants of puerperal sepsis and maternal outcomes among women who were delivered in a tertiary teaching hospital in Nigeria for a period of five years. Using the health records of the hospital, the analysis was based on selected records of women who had their delivery in the hospital, whether they registered and received antenatal care in the hospital or not. This study contributes to the existing knowledge in identifying determinants of one of the direct causes of maternal deaths globally[17,18,19,20]. Therefore, recommends planned interventions to address identified determinants in Nigeria if the third SDG will be achieved.

The sociodemographic characteristics showed that most women were within the childbearing age, financially empowered, married, from the Yoruba tribe which is the dominant tribe in Southwestern Nigeria, and had a short hospitalization period, which could indicate that they received adequate and timely treatment. These are the usual characteristics of most women in Southwestern Nigeria[20]. Their financial empowerment has been attributed to their high educational level. Hence, female education is being advocated for in other regions of the country.

The study found an association between the area of residence and puerperal sepsis. Women in rural areas have a higher chance of developing puerperal sepsis. Hence, a disparity in maternal mortality among rural women compared to their counterparts in urban areas. This has been attributed to unequal access to maternal health services among women in the rural and urban areas[21]. Therefore, adequate preparation for normal delivery and emergency readiness has been encouraged especially among rural and semi-urban dwellers[22].

Also, the study identified the site of delivery as a strong determinant for puerperal sepsis. This is consistent with previous studies[21,23] in Nigeria which reported that delivery outside the hospital is associated with maternal deaths. Oladipo et al[19] in a study conducted in Lagos, Nigeria reported that three-quarters of maternal deaths have been attributed to non-institutional delivery. Delivery outside the hospital is not likely to have a skilled birth attendance, hence the higher chance of maternal deaths. Therefore, delivery outside the hospital is highly discouraged among women in developing countries like Nigeria.

Similarly, maternal education was found to be associated with puerperal sepsis in this current study. This is consistent with previous studies[21,22]. Women with lower educational attainment, especially those who had either incomplete or completed only primary school have a higher chance of puerperal sepsis and consequently maternal death. This could imply that women with at least a secondary school education and those with higher educational attainment are likely to have access to information, as well as be financially empowered to prevent puerperal sepsis and consequently maternal death. Therefore, female education should be advocated for in developing countries like Nigeria.

Furthermore, antenatal clinic attendance was found to be associated with puerperal sepsis in this study. This is similar to what has been reported in other studies[21,24]. Akinwaare et al[20] reported in another study that women who had more than four antenatal clinic attendance are well prepared for normal birth, and for any complication that may occur immediately after delivery. Hence, puerperal sepsis and

consequently maternal death could be prevented by antenatal care registration, as well as regular visits to the antenatal clinic, where birth-related education is offered by skilled professionals to avert any complication.

The prevailing negative pregnancy outcomes among women diagnosed with puerperal sepsis in this current study include septicemia and septic shock. This is similar to the reports of Khaskheli et al[4] who reported that the complication of puerperal sepsis at a tertiary healthcare center was septicemia. This has been identified as the major complication which may lead to death among women diagnosed with puerperal sepsis. Other consequences of puerperal sepsis found in this study such as peritonitis, pelvic abscess, and disseminated intravascular coagulopathy have also been reported in other studies[24], and therefore healthcare professionals, especially midwives should be proactive in the management of women diagnosed with puerperal sepsis. The provision of timely and adequate care by skilled professionals following the diagnosis of puerperal sepsis could be life-saving.

This study used only medical records being a retrospective study. Thus, lack postpartum follow-up of mothers and their babies. Although, the use of medical records prevents reporting bias. However, a face-to-face interview with the mothers would have provided more information on factors associated with puerperal sepsis which could have been omitted in the records.

Acknowledgment

The authors acknowledge the contribution of Olayinka Adekunmi Adekola, who supervised the research assistants during the data collection. The research assistants are sincerely appreciated for their commitment during the data collection. Special thanks to the staff and management of University College Hospital for their cooperation during the study.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests

None declared.

Authors Contributions

MOA was involved in the study conception, study design, supervision, and writing of the manuscript. UHO was involved in the conception of the study, data collection, analysis, and interpretation.

Patient consent for publication

Not applicable.

Ethics approval

Ethical approval for this study was obtained from University of Ibadan/University College Hospital ethics approval board, with approval number UI/EC/20/0140.

Data availability statement

Data may be obtained from the authors on request and are not publicly available.

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