BMC Women's Health

RESEARCH Open Access

Determinants of puerperal sepsis among postpartum women admitted to Harar town public hospitals in eastern Ethiopia: an unmatched case-control study

Tarikuwa Habetamu[1], Tilahun Abdeta[2], Adera Debella[2], Addis Eyeberu[2] and Tesfaye Assebe Yadeta[2*]

Abstract

Background Globally, 75,000 maternal deaths occur each year from puerperal sepsis, with higher rates in low-income countries. In Ethiopia, puerperal sepsis is the fourth leading cause of maternal morbidity and mortality. This study aimed to identify determinants of puerperal sepsis among postpartum women admitted to public hospitals in Harar, eastern Ethiopia.

Method A retrospective unmatched case-control study was conducted from June 15 to July 15, 2022, among 423 postpartum women (106 cases and 317 controls) in Public Hospitals in Harar town, Harari Regional State, Eastern Ethiopia. Participants were selected using a simple random sampling method based on medical registration numbers. Data was extracted using a checklist and analyzed using SPSS version 25 statistical software. Logistic regression was used to identify determinants of puerperal sepsis, with adjusted odds ratios and a 95% confidence interval to estimate the strength and direction of the association. Statistical significance was declared at a p-value of less than 0.05.

Results The determinants of puerperal sepsis were found to be cesarean section delivery (AOR = 2.32, 95% CI 1.24–4.33), rupture of membranes lasting more than 24 h (AOR = 4.34, 95% CI 1.93–9.76), labor duration exceeding 24 h (AOR = 2.91, 95% CI 1.11–7.62), undergoing more than 4 vaginal examinations (AOR = 3.02, 95% CI 1.32–6.92), and being referred from other health institutions (AOR = 2.48, 95% CI 1.42–4.36).

Conclusions This study identified factors that independently predict puerperal sepsis, including mode of delivery, duration of labor, duration of rupture of the membrane, number of vaginal examinations, and referral status. It is essential for all stakeholders to work together to reduce the risk factors of puerperal sepsis.

Keywords Puerperal sepsis, Determinants, Harar town, Eastern Ethiopia

*Correspondence:
Tesfaye Assebe Yadeta
tesfaye.assb@gmail.com
[1]Hiwot Fana Specialized University Hospital, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia
[2]School of Nursing and Midwifery, College of Health and Medical Sciences, Haramaya University, P.O. Box. 235, Harar, Ethiopia

Background

Puerperal sepsis is an infection of the genital tract that can occur from the time of membrane rupture or labor up to 42 days after childbirth [1]. It mainly occurs within the first 24 h after delivery when infectious agents invade the endometrium, nearby structures, lymphatic system, and bloodstream [2, 3]. This condition can be prevented by following good antenatal care, maintaining aseptic delivery practices, and providing proper postpartum care [4].

Puerperal sepsis is a significant cause of maternal morbidity and mortality, ranking among the top five causes of maternal death worldwide [5]. Globally, approximately 75,000 maternal deaths occur each year due to puerperal sepsis [6, 7]. Long-term complications such as chronic pelvic pain, fallopian tube obstruction, and infertility are common outcomes of puerperal sepsis [8]. Maternal mortality from sepsis is particularly high in low-income countries [4, 7, 9–12]. In Ethiopia, puerperal sepsis is the fourth leading cause of maternal morbidity and mortality, following hemorrhage, obstructed labor, and hypertensive disorders, with a pooled prevalence of 14.8% [13, 14].

Despite advances in modern medicine and the production of multiple antimicrobial agents, puerperal sepsis remains a public health problem. Many of the predisposing factors for puerperal sepsis are preventable. Optimal antiseptic measures and careful monitoring are essential throughout the labor process [3, 12, 15–20]. Clean delivery kits with sterile draping and packaged instruments can help reduce risks. Prophylactic antibiotics in cases of preterm rupture of membranes can decrease sepsis by 52–90% [19]. Other preventive measures include attention to antiseptic procedures during delivery, a nutritious diet rich in protein and vitamins during pregnancy, therapeutic antibiotics for prolonged rupture of membranes or obstructed labor, proper use of the partograph, prophylactic antibiotics before cesarean section, and an efficient referral system [11, 21].

Ethiopia has committed to achieving the sustainable development goal of reducing maternal mortality to less than 70 per 100,000 live births by 2030. To address maternal morbidity and mortality related to sepsis, key strategies include ensuring that every birth is attended by a skilled birth attendant, providing access to comprehensive emergency obstetric care, implementing standard infection prevention practices in health facilities, and establishing an effective referral system [13, 22]. Despite these strategies, maternal health-seeking behavior in Ethiopia remains low, with 51% of deliveries taking place at home, 50% attended by skilled birth attendants, and only 34% of women receiving a postnatal check within the first two days after giving birth [23]. Although, much is being done to reduce maternal infection by the government of Ethiopia and various stakeholders, evidences on the determinants of puerperal sepsis in the study area are limited. Therefore, this unmatched case-control study aimed to identify the factors influencing puerperal sepsis among postpartum women admitted to public hospitals in Harar town, eastern Ethiopia.

Methods and materials

Study design, setting and study period

A facility-based retrospective unmatched case-control study was conducted from June 15 to July 15, 2022, among 429 postpartum women in Public Hospitals located in Harari Regional State, Eastern Ethiopia. Harar, the capital city of Harari Regional State, is situated 526 km east of Addis Ababa, the capital city of Ethiopia. The study took place at Hiwot Fana Specialized University Hospital (HFSUH) and Jugol General Hospital (JGH), both of which serve a population of over 5 million in the area.

Populations and eligibility criteria

Cases The study included postpartum women with puerperal sepsis who were admitted to postnatal or gynecology wards at Public Hospitals in Harar town, eastern Ethiopia between January 1, 2020, and December 31, 2021, and met the WHO diagnostic criteria for puerperal sepsis [24].

Controls Postpartum women without puerperal sepsis, admitted to postnatal or gynecology wards at Public Hospitals in Harar town, eastern Ethiopia between January 1, 2020, and December 31, 2021, were included in the study. Postpartum women with missing important variables in their medical records were excluded from the study. Six records were missing maternal-related characteristics, and the notebooks of midwives, nurses, and physicians were unavailable, leading to their exclusion due to missing key variables. A complete case analysis was conducted as the missing data was only 1.4%.

Sample size determination and sampling procedures

The sample size for determining the factors of puerperal sepsis was calculated using the double population proportion formula. The calculation was done using Epi Info 7 software Stat Cal with the following assumptions: 95% confidence level, 80% power, a ratio of 1:3 for cases to controls, 20.7% of controls with exposure, and 35.8% of cases with exposure [3]. A 10% non-response rate was also considered. The initial sample size was determined to be 390, and after accounting for the non-response rate, the final sample size was 429 (107 cases and 322 controls).

The admission records of postpartum women from the postpartum and gynecology wards at Hiwot Fana Specialized University Hospital and Jugol Hospital were evaluated for the years 2020 and 2021. The total number of postpartum women admitted was 9,087 at Hiwot Fana and 4,298 at Jugol Hospital. Among them, 100 cases of puerperal sepsis were identified at Hiwot Fana and 46 cases at Jugol Hospital. The hospital identification numbers of all postpartum women from January 1, 2020, to December 31, 2021, were recorded from the admission registration logbook. A list of postpartum women diagnosed with puerperal sepsis was created, and patient cards for all cases were collected from the record office. A total of 146 cases were identified, and 107 were selected using a simple random sampling technique. The sample size was proportionally allocated to both hospitals (Fig. 1).

Variables

The study collected data on the dependent variable, puerperal sepsis, from medical records. This variable was identified as a case. Independent variables, also obtained from medical records, included the mother's age, residence, parity, number of antenatal care visits (ANC), presence of pregnancy-induced hypertension (PIH) and gestational diabetes mellitus (GDM), occurrence of preterm labor and obstructed labor, mode of delivery, postpartum hemorrhage (PPH), duration of labor, duration of ruptured membrane (PROM), number of vaginal examinations during labor and delivery (PV), presence of anemia during labor and delivery, and referral from other health institutions.

Data collection tool and procedures

The checklist for data extraction was developed based on various related literatures [3, 10, 17, 18]. It

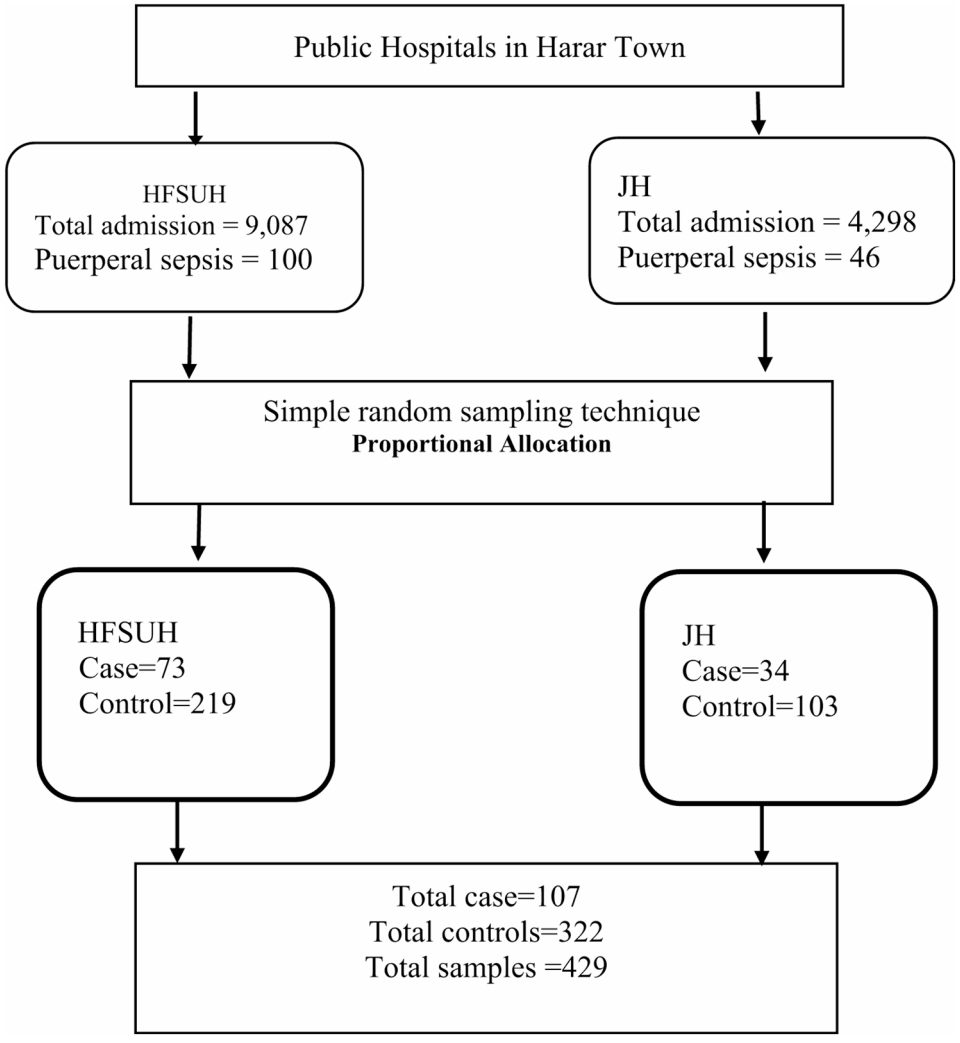

Fig. 1 Schematic presentation of the sampling procedure and sampling technique for the determinants of puerperal sepsis among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022

consists of four parts: socio-demographic characteristics, obstetric information, maternal medical details, and healthcare system data. Twelve BSc midwives from Harar town were enlisted for data collection, while two BSc and two MSc midwives were assigned as supervisors to oversee the data collection process. Data was obtained from medical records using a pretested checklist. The data collection involved reviewing specific sources within the hospital card, included nursing, physician, and consultation notes, admission and discharge reports, laboratory and diagnostic test reports, surgical reports, referral details, and other clinical and patient personal information, as well as demographic data.

Data quality assurance

To ensure data quality, we used pretested and validated checklists based on a literature review. Data collectors and supervisors received four days of training on study objectives and data collection instruments. A pretest on 10% of the sample size was conducted before data collection to ensure instrument reliability and validity. After the pretest, we removed variables from the checklist that were not recorded on the medical record, such as educational status and income, and added chronic medical illness. We also made checklist edits for readability and clarity. Supervisors and the lead investigator reviewed the data daily to ensure completeness, correctness, and consistency. Data was double-entered by two individuals and validated to reduce errors.

Statistical analysis

The data was organized and processed using Epi-Data version 3.1 and then transferred to SPSS version 25 for analysis and cleaning. Descriptive statistics, tables, and figures were used to present the data. A binary logistic regression analysis was conducted to identify factors related to the Puerperal Sepsis. Candidate variables for the Multi-variable logistic regression analysis were selected based on bi-variable logistic regression analysis. Multicollinearity was checked to see the linear correlation among the associated independent variables by using VIF and standard error. Variables with VIF > 5 and a standard error of > 2 were dropped from the multivariable analysis. The model's fit was assessed using the Hosmer-Lemeshow test, chi square = 0.83 p-value of 0.56 indicating a good fit. Variables with a p-value of 0.25 were included in the final Multi-variable logistic regression analysis to determine factors significantly associated with puerperal sepsis. Crude and adjusted odds ratios with a 95% confidence interval were calculated to assess the strength of the association. A p-value of 0.05 at a 95% confidence interval was considered statistically significant.

Table 1 Socio demographic characteristics among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022 ($n = 423$)

Variable	Cases *n*(%)	Controls *n*(%)
Age of mother in years		
≤ 24	47 (44.3)	159 (50.2)
> 24–34	48 (45.3)	117 (36.9)
> 34	11 (10.4)	41 (12.9)
Residence		
Urban	42 (39.6)	185 (58.4)
Rural	64(60.4)	132(41.6)

Results

Socio-demographic characteristics

Out of the initial sample size of 429 postpartum women, 423 were included in the analysis, resulting in a response rate of 98.6%. The exclusion reasons were incomplete data for 3 participants and referral for 3 participants. The final analysis included 423 participants (106 cases and 317 controls). The mean age of women was 25 years (SD ± 6) for cases and 26 years (SD ± 5). In terms of maternal residence, 60.4% of cases and 41.6% of controls were rural (Table 1).

Obstetric characteristics

Among the participants, 65.1% of cases and 76% of controls had ANC follow-up. Primiparous women accounted for 36.8% of cases and 34.7% of controls. Obstetric complications in current pregnancies included 6.6% of cases and 7.6% of controls with antepartum hemorrhage (APH), 7.5% of cases and 2.5% of controls with preterm labor. The majority of cases (85.8%) and controls (98.7%) gave birth at a health institution. Spontaneous onset of labor was reported by 85.8% of cases and 91.5% of controls (Table 2).

Maternal medical illness related history

Out of the total study subjects, 12 (11.3%) of cases and 19 (6%) of controls had a history of medical health problems, with chronic hypertension in 3 (2.8%) of cases and 3 (0.9%) of controls, anemia in 7 (6.6%) of cases and 11 (3.5%) of controls (Fig. 2).

Health care and referral system

In terms of the referral system, 57.5% of cases and 24% of controls were referred from other health institutions. Among these, 78.7% of cases and 69.7% of controls were referred from Health centers. Additionally, 79.2% of cases had an admission duration of less than or equal to 3 days, compared to 86.8% of controls (Table 3).

Table 2 Obstetrics characteristics among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022 ($n=423$)

Variable	Response	Cases *n*(%)	Controls *n*(%)
ANC	Yes	69(65.1)	241(76)
	No	37(34.9)	76(24)
Frequency of ANC visits	One	7(10.1)	3 (1.2)
	Two	26 (37.7)	35(14.5)
	Three	24 (34.8)	60 (24.9)
	Four and above	12 (17.4)	143 (59.3)
Parity	Primiparous	39 (36.8)	110 (34.7)
	Multiparous	38 (35.8)	166 (52.4)
	Grand multiparas	29 (27.4)	41 (12.9)
APH	Yes	7(6.6)	24(7.6)
	No	99(93.4)	293(92.4)
PIH	Yes	10(9.4)	12(3.8)
	No	96(90.6)	305(96.2)
GDM	Yes	1(0.9)	4(1.3)
	No	105(99.1)	313(98.7)
Type of pregnancy	Single	103 (97.2)	305 (96.2)
	Multiple	3 (2.8)	12 (3.8)
Preterm labor	Yes	8(7.5)	8(2.5)
	No	98(92.5)	309(97.5)
Obstructed Labor	Yes	7 (6.6)	6 (1.9)
	No	99 (93.4)	311 (98.1)
Place of delivery	At Home	15 (14.2)	4 (1.3)
	At health institution	91 (85.8)	313 (98.7)
Onset of labor	Spontaneous	91(85.8)	290(91.5)
	Induced	11(10.4)	17(5.4)
	Elective C/s	4(3.8)	10(3.2)
Duration of labor	< 12 h	47 (44.3)	216 (68.1)
	12–24 h	35 (33)	83 (26.2)
	> 24 h	24 (22.6)	18 (5.7)
Duration of PROM	≤ 24 h	88 (83)	294 (92.7)
	> 24 h	18 (17)	23 (7.3)
PV frequency	≤ 4	75(70.8)	297(93.7)
	> 4	31 (29.2)	20(6.3)
Mode of delivery	SVD	45 (42.5)	212 (66.9)
	C/S	45 (42.5)	70 (22.1)
	Instrument delivery	16 (15.1)	35 (11)
Mode of placenta delivery	spontaneous	15 (14.2)	4 (1.3)
	Control cord traction	74 (69.8)	301 (95)
	Manual removal	17 (16)	12 (3.8)
Has episiotomy	Yes	33 (31.1)	71 (22.4)
	No	73 (68.9)	246 (77.6)
Has perinatal tear	Yes	12 (11.3)	20 (6.3)
	No	94 (88.7)	297(93.7)
PPH	Yes	13 (12.3)	16(5)
	No	93 (87.7)	301(95)
Anemia during in L&D	Yes	34(32.1)	41 (12.9)
	No	72(67.9)	276(87.1)
Fetal out come	Live birth	91 (85.8)	293(92.4)
	Still birth	6 (5.7)	9 (2.8)
	IUFD	9 (8.5)	15 (4.7)

Note: ANC, antenatal care; APH, antepartum hemorrhage; PIH, pregnancy induced hypertension; GDM, gestational diabetes mellitus; PROM premature rapture of the membrane; PV; PV frequency; Number of vaginal examinations during labor and delivery; SVD, spontaneous vaginal delivery; C/S, cesarean section; PPH, postpartum hemorrhage; IUFD, intrauterine fetal death

Determinants of puerperal sepsis

Variables with a p-value < 0.25 in the Bi-variable analysis included. In the Bi-variable analysis residence, parity, antenatal care visits (ANC), pregnancy-induced hypertension (PIH), preterm labor, obstructed labor, mode of delivery, postpartum hemorrhage (PPH), duration of labor, duration of ruptured membrane (PROM), number of vaginal examinations during delivery and labour (PV), anemia during labor and delivery, and referral from other health institutions were significantly associated with puerperal sepsis. After controlling the possible confounders, only mode of delivery, duration of labor, number of vaginal examinations during delivery (PV), premature of ruptured membrane (PROM), and referral system were identified as independent predictors of puerperal sepsis in the multivariable logistic regression analysis.

Women who gave birth through C/S had 2.32 times higher odds of puerperal sepsis compared to those who gave birth by SVD [AOR = 2.32, 95% CI (1.24, 4.33)]. Additionally, women with ruptured membranes for more than 24 h had 4.34 times higher odds of puerperal sepsis [AOR = 4.34, 95% CI (1.93, 9.76)] than those with intact membranes. Furthermore, women with a labor duration of > 24 h had about 3 times higher odds of puerperal sepsis [AOR = 2.91, 95% CI (1.11, 7.62)] compared to those with a labor duration of < 12 h. Additionally, women who underwent more than 4 vaginal examinations during labor were 3.02 times odds of puerperal sepsis [AOR = 3.02, 95% CI (1.32, 6.92)] compared to those who had 4 or fewer vaginal examinations. Finally, postpartum women who had referred from other health institutions were 2.48 times more likely to have puerperal sepsis [AOR = 2.48, 95% CI (1.42, 4.36)] compared to non-referred women (Table 4).

Discussion

The aim of this study was to determine the factors contributing to puerperal sepsis in postpartum women at the public Hospital in Harar town, Eastern Ethiopia. The study found that mode of delivery, duration of labor, duration of ruptured membranes, number of vaginal examinations during delivery, and being referred from another health institution were all significant determinants of puerperal sepsis.

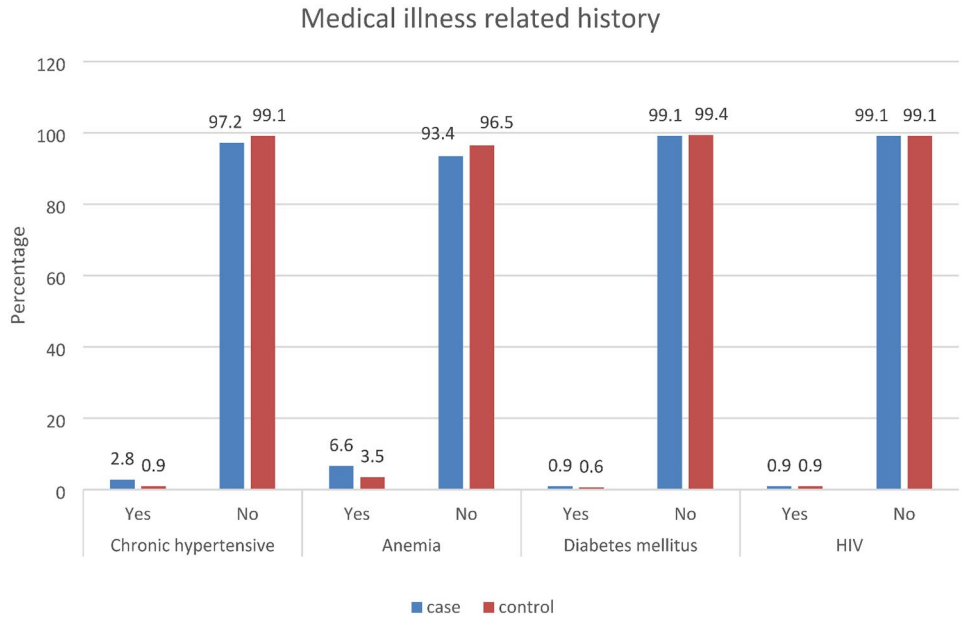

Fig. 2 Maternal medical illness related history characteristics among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022 ($n=423$)

Table 3 Health care system related characteristics among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022 ($n=423$)

Variable	Cases *n*(%)	Controls *n*(%)
Referred		
Yes	61 (57.5)	76 (24)
No	45 (42.5)	241 (76)
Referred from		
Hospital	11 (18)	12 (15.8)
Health center	48 (78.7)	53 (69.7)
Private health facility	2 (3.3)	11(14.5)
Duration of admission		
≤ 3 days	84 (79.2)	275 (86.8)
> 3 days	22 (20.8)	42 (13.2)

Women who underwent cesarean section were found to have a higher risk of developing puerperal sepsis compared to those who had a spontaneous vaginal delivery. This finding aligns with a study conducted in West Shoa Zone, Oromia, Ethiopia [3]. The increased risk in cesarean deliveries may be attributed to the greater tissue trauma and manipulation involved in the procedure compared to spontaneous vaginal deliveries [4]. Early administration of antibiotic prophylaxis, along with preoperative preparation such as skin preparation and hair removal, is crucial in preventing sepsis [24].

This study found that women who had a labor duration of more than 24 h were at a higher risk of developing puerperal sepsis compared to those with a labor duration of less than 12 h. Similar findings have been reported in studies conducted in Pakistan, Nigeria, and the West Shoa Zone of Oromia, Ethiopia [3, 11, 20]. Prolonged labor often involves multiple vaginal examinations, which can lead to a prolonged open cervix and ruptured membranes, increasing the risk of infections ascending from the vagina [4]. Additionally, prolonged labor can result in adverse maternal outcomes such as postpartum hemorrhage, which may require frequent uterine manipulation and further increase the risk of puerperal sepsis [25]. Healthcare providers should prioritize counseling pregnant women to raise awareness about birth preparedness, recognize labor symptoms, understand the importance of seeking timely healthcare, and be ready for potential complications. They should also use a partograph to monitor labor progress and prevent complications that could result in sepsis.

The study found that women who experienced premature rupture of membranes for more than 24 h were at a higher risk of developing puerperal sepsis. This finding is consistent with studies conducted in Pakistan [11], Kenya, and Ethiopia [3, 12]. Prolonged rupture of membranes weakens natural barriers, allowing infections to ascend from the vagina [20]. Delayed use of prophylactic antibiotics may also contribute to this increased risk [26]. Furthermore, prolonged premature rupture of membranes often leads to the induction of labor, which further elevates the risk of puerperal sepsis [22]. Intrapartum antibiotic prophylaxis is crucial for preventing infection and sepsis in pregnant women [27, 28]. Healthcare providers should administer antibiotics when a pregnant woman experiences premature rupture of membranes.

Additionally, women who underwent more than 4 vaginal examinations during labor were found to have a

Table 4 Multivariable analysis on determinants of puerperal sepsis among postpartum women who were admitted to Harar town public hospitals, Eastern Ethiopia, 2022 ($n=423$)

Variables	Study subjects		COR (95% CI)	AOR(95%CI)
	Cases n(%)	Controls n(%)		
Residence				
Urban	42 (39.6)	185 (58.4)	1	1
Rural	64 (60.4)	132 (41.6)	2.14 (1.36, 3.34)*	1.40 (0.80, 2.46)
Parity				
Primiparous	39 (36.8)	110 (34.7)	1	1
Multiparous	38 (35.8)	166 (52.4)	0.65 (0.39, 1.07)	0.89 (0.47, 1.68)
Grand multiparas	29 (27.4)	41 (58.6)	1.99 (1.09, 3.63)*	2.05 (0.96, 4.37)
ANC visit				
Yes	69 (65.1)	241 (76)	1	1
No	37 (34.9)	76 (24)	1.70 (1.06, 2.73)*	1.59 (0.88, 2.89)
PIH				
Yes	10 (9.4)	12 (3.8)	2.65 (1.11, 6.32)*	2.78 (0.94, 8.20)
No	96 (90.6)	305 (96.2)	1	1
Preterm labor				
Yes	8 (7.5)	8 (2.5)	3.15 (1.15, 8.62)*	2.97 (0.89, 9.81)
No	98 (92.5)	309 (97.5)	1	1
Obstructed labor				
Yes	7 (6.6)	6 (1.9)	3.66 (1.20, 11.16)*	1.43 (0.39, 5.25)
No	99 (93.4)	311 (98.1)	1	1
Mode of delivery				
SVD	45 (42.5)	212 (66.9)	1	1
C/S	45 (42.5)	70 (22.1)	3.03(1.85, 4.96)*	2.32(1.24, 4.33)**
Instrument delivery	16 (15.1)	35 (11)	2.15 (1.09, 4.22)*	1.90 (0.84, 4.29)
PPH				
Yes	13 (12.3)	16 (5)	2.63 (1.22, 5.67)*	1.67 (0.64, 4.37)
No	93 (87.7)	301 (95)	1	1
Duration of labor				
< 12 h	47(44.3)	216(68.1)	1	1
12–24 h	35(33)	83(26.2)	1.94 (1.17, 3.21)*	1.44 (0.77, 2.72)
> 24 h	24(22.6)	18(5.7)	6.13 (3.08, 12.19)*	2.91(1.11, 7.62)**
Duration of rupture of the membrane				
≤ 24	88 (83)	294 (92.7)	1	1
≥ 25	18 (17)	23 (7.3)	2.61 (1.35, 5.06)*	4.34 (1.93, 9.76)**
PV frequency				
≤ 4	75(70.8)	297(93.7)	1	1
> 4	31(29.2)	20(6.3)	6.14 (3.31, 11.37)*	3.02 (1.32, 6.93)**
Anemia diagnosed in L&D				
Yes	34 (32.1)	41 (12.9)	3.18 (1.88, 5.36)*	1.42(0.74, 2.72)
No	72 (67.9)	276 (87.1)	1	1
Referred				
Yes	61 (57.5)	76 (24)	4.29 (2.70, 6.83)	2.48 (1.42, 4.36)**
No	45 (42.5)	241 (76)	1	1

Significant at *COR and $p<0.05$; Significant at **AOR and $p<0.05$ (PV frequency; Number of vaginal examinations during labor and delivery; PPH, Postpartum hemorrhage; PIH, pregnancy-induced hypertension; L and D, lobar and delivery; SVD, Spontaneous vaginal delivery; C/S, Cesarean section delivery; COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval)

higher risk of developing puerperal sepsis. This finding is in line with studies conducted in Egypt and the West Shoa Zone of Oromia, Ethiopia [3, 29]. The increased risk is likely due to the frequent vaginal examinations and manipulation of the genital tract, which can facilitate the ascent of microorganisms from the lower genital tract, increasing the likelihood of developing puerperal sepsis [3]. Healthcare professionals are expected to adhere to the standard of conducting vaginal examinations every four hours as recommended by the World Health Organization (WHO) [24].

Postpartum women who were referred from other health institutions were more likely to have puerperal sepsis. This finding is consistent with studies conducted in Pakistan, Uganda, and West Shoa Zone, Oromia, Ethiopia [3, 30, 31]. The prolonged time required to reach the hospital and the possibility of unclean vaginal examinations on the way to the hospital may contribute to the development of puerperal sepsis [3]. Ascending infections can lead to choriodecidua infection, which can weaken the membrane and allow pathogens to enter the bloodstream, causing sepsis [27, 32]. During antenatal care, health professionals should counsel pregnant women on birth preparedness and complication readiness, recognizing maternal danger signs, and seeking prompt medical attention to prevent delays in care. Early diagnosis and referral by healthcare providers are also crucial.

Preventing puerperal sepsis involves addressing predisposing factors such as using clean delivery practices, sterile draping, and sterilized instruments. Prophylactic antibiotics for premature rupture of membranes can be

beneficial. Other measures include antiseptic procedures during delivery, maintaining a nutritious diet during pregnancy, administering antibiotics for prolonged rupture of membranes or obstructed labor, using the partograph, giving antibiotics before cesarean section, and establishing an efficient referral system to prevent and minimize puerperal sepsis. Collaboration among healthcare providers, governmental bodies, and stakeholders is essential for implementing these preventive strategies. Mothers who experience puerperal sepsis require treatment with antibiotics [11, 21, 24].

Strength and limitation of the study

This study's strength lies in the selection of controls and cases from the same hospitals, which helps reduce selection bias. It aims to evaluate crucial factors related to puerperal sepsis, particularly obstetrical factors that have not been thoroughly examined in previous studies. However, the study was limited to public hospitals, excluding individuals who sought care at private facilities. Additionally, as a facility-based study, its findings may not be generalizable to the wider population. Unmatched case-control studies prone to selection bias and representativeness bias. Lastly, unaccounted for and residual confounding may have influenced the observed association. Future research should consider a prospective cohort study design to establish a stronger causal relationship between identified risk factors and puerperal sepsis. Further investigation is needed to assess the effectiveness of interventions targeting these risk factors to reduce puerperal sepsis incidence in this population.

Conclusions

This study identified factors that independently predict puerperal sepsis, including mode of delivery, duration of labor, duration of rupture of the membrane, number of vaginal examinations, and referral status. It is essential for all stakeholders to work together to reduce the risk factors of puerperal sepsis.

Abbreviations

AOR	Adjusted Odd Ratio
ANC	Antenatal Care
APH	Antepartum Hemorrhage
C/S	Caesarean Section
CI	Confidence Interval
GDM	Gestational Diabetes Mellitus
HMIS	Health Management Information System
IHRERC	Institutional Health Research and Ethics Review Committee
MRN	Medical Registration Numbers
PIH	Pregnancy-Induced Hypertension
PPH	Postpartum Hemorrhage
PROM	Premature Rupture of Membrane
SVD	Spontaneous Vaginal Delivery
SPSS	Statistical Package for Social Sciences
PV	Per Vagina
WHO	World Health Organization

Acknowledgement

We forward our gratitude to Haramaya University, College of Health and Medical Sciences for providing financial support and for reviewing the ethical protocol of this study and giving approval. All study participants, data collectors and supervisors and all those contributed directly or indirectly to accomplishment of this study are also thankful.

Author contributions

TH, TA, AD and TAY conceived, designed the study, acquired data, analyzed, and interpreted the findings. TH, TA, AD, AE and TAY reviewed the manuscript for important intellectual content, revised the article and provided critical intellectual content. AD and TAY and drafted the manuscript. All authors have read and approved the final version of the manuscript for submission.

Funding

This study was financially supported by Haramaya University. The funder had no role in the study selection, data collection, analysis, conclusion, and interpretation.

Data availability

All data supporting the study findings are within the manuscript. Additional detailed information and raw data used for the analysis are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted in compliance with the Helsinki Declaration. Ethical clearance was obtained from the Institutional Health Research and Ethics Review Committee (IHRERC) of the College of Health and Medical Sciences at Haramaya University with approval reference number IHRERC/102/2022. Before data collection, an official letter of support from IHRERC was provided to the hospitals to secure administrative permission. Participants provided voluntary written and signed consent after being informed of the study's purpose and benefits. Confidentiality of information was ensured during data collection and dissemination.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 31 October 2023 / Accepted: 3 March 2025
Published online: 15 March 2025

References

1. WHO. Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions. 2020.
2. Gourlay M, Gutierrez C, Chong A, Robertson R. Group A Streptococcal sepsis and ovarian vein thrombosis after an uncomplicated vaginal delivery. J Am Board Family Pract. 2001;14(5):375–80.
3. Demisse GA, Sifer SD, Kedir B, Fekene DB, Bulto GA. Determinants of puerperal sepsis among post partum women at public hospitals in West SHOA zone oromia regional STATE, Ethiopia (institution BASEDCASE control study). BMC Pregnancy Childbirth. 2019;19(1):1–6.
4. Pradhan B, Duwal S, Singh A, Bhandary S, RC L, Shrestha R. Puerperal Sepsis and its cause in Patan hospital. Nepal J Obstet Gynecol. 2015;10(1):33–5.
5. UNICEF, UNFPA. Trends in maternal mortality 2000 to 2017: estimates by WHO. World Bank Group and the United Nations Population Division. 2019.
6. Escobar MF, Echavarría MP, Zambrano MA, Ramos I, Kusanovic JP. Maternal sepsis. Am J Obstet Gynecol MFM. 2020;2(3):100149.
7. van Dillen J, Zwart J, Schutte J, van Roosmalen J. Maternal sepsis: epidemiology, etiology and outcome. Curr Opin Infect Dis. 2010;23(3):249–54.
8. WHO. WHO recommendations for prevention and treatment of maternal peripartum infections: highlights and key messages from the World Health Organization's 2015 global recommendations. In.: World Health Organization. 2015.

9. Kehoe S, Neilson J, Norman J. Maternal and infant deaths: chasing millennium development goals 4 and 5: RCOG. 2010.
10. Taskin T, Sultana M, Islam T, Khan N, Chowdhury S. Socio-demographic factors and puerperal sepsis: experiences from two tertiary level hospitals in Bangladesh. Int J Community Fam Med. 2016;1(113):2.
11. Shamshad S, Shamsher S, Rauf B. Puerperal sepsis—still a major threat for parturient. J Ayub Med Coll Abbottabad. 2010;22(3):18–22.
12. Chepchirchir MV, Nyamari J, Keraka M. Associated factors with puerperal Sepsis among reproductive age women in Nandi County, Kenya. J Midwifery Reproductive Health. 2017;5(4):1032–40.
13. Melkie A, Dagnew E. Burden of puerperal sepsis and its associated factors in Ethiopia: a systematic review and meta-analysis. Archives Public Health. 2021;79(1):1–11.
14. Mekonnen W, Gebremariam A. Causes of maternal death in Ethiopia between 1990 and 2016: systematic review with meta-analysis. Ethiop J Health Dev. 2018;32(4).
15. Organization WH. WHO recommendations for prevention and treatment of maternal peripartum infections. World Health Organization. 2016.
16. Kajeguka DC, Mrema NR, Mawazo A, Malya R, Mgabo MR. Factors and causes of puerperal Sepsis in Kilimanjaro, Tanzania: A descriptive study among postnatal women who attended Kilimanjaro Christian medical centre. East Afr Health Res J. 2020;4(2):158.
17. Admas A, Gelaw B, Worku A, Melese A. Proportion of bacterial isolates, their antimicrobial susceptibility profile and factors associated with puerperal sepsis among post-partum/aborted women at a referral hospital in Bahir Dar, Northwest Ethiopia. Antimicrob Resist Infect Control. 2020;9(1):1–10.
18. Atlaw D, Seyoum K, Woldeyohannes D, Berta M. Puerperal sepsis and its associated factors among mothers in university of Gondar referral hospital, Ethiopia, 2017. Int J Pregn Chi Birth. 2019;5(5):190–5.
19. WHO. WHO recommendations for prevention and treatment of maternal peripartum infections. World Health Organization. 2016.
20. Ononuju C, Nyengidiki T, Ugboma H, Bassey G. Risk factors and antibiogram of organisms causing puerperal sepsis in a tertiary health facility in Nigeria. Trop J Obstet Gynecol. 2015;32(2):73–82.
21. Momoh M, Ezugworie O, Ezeigwe H. Causes and management of puerperal sepsis: the health personnel view point. Adv Biol Res. 2010;4(3):154–8.
22. Acosta C, Bhattacharya S, Tuffnell D, Kurinczuk J, Knight M. Maternal sepsis: a Scottish population-based case–control study. BJOG: Int J Obstet Gynecol. 2012;119(4):474–83.
23. Indicators K. Mini demographic and health survey. EPHI and ICF. 2019.
24. World Health Organization. Education material for teachers of midwifery. Midwifery education modules - second edition. World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland. 2008.
25. Song H, Hu K, Du X, Zhang J, Zhao S. Risk factors, changes in serum inflammatory factors, and clinical prevention and control measures for puerperal infection. J Clin Lab Anal. 2020;34(3):e23047.
26. Boushra M, Rahman O. Postpartum Infection. 2020.
27. Yadeta TA, Worku A, Egata G, Seyoum B, Marami D, Berhane Y. Vertical transmission of group B Streptococcus and associated factors among pregnant women: a cross-sectional study, Eastern Ethiopia. Infect Drug Resist. 2018;397–404.
28. Yadeta TA, Worku A, Egata G, Seyoum B, Marami D, Berhane Y. Maternal group B Streptococcus Recto vaginal colonization increases the odds of stillbirth: evidence from Eastern Ethiopia. BMC Pregnancy Childbirth. 2018;18:1–7.
29. El-Mahally AA, Kharboush IF, Amer NH, Hussein M, Youssef A. Risk factors of puerperal sepsis in Alexandria. J Egypt Public Health Assoc. 2004;79(3–4):311–31.
30. Khaskheli M, Baloch S, Sheeba A. Risk factors and complications of puerperal sepsis at a tertiary healthcare centre. Pakistan J Med Sci. 2013;29(4):972–6.
31. Ngonzi J, Tornes YF, Mukasa PK, Salongo W, Kabakyenga J, Sezalio M, Wouters K, Jacqueym Y, Van Geertruyden J-P. Puerperal sepsis, the leading cause of maternal deaths at a tertiary university teaching hospital in Uganda. BMC Pregnancy Childbirth. 2016;16(1):1–7.
32. Vanderhoeven JP, Bierle CJ, Kapur RP, McAdams RM, Beyer RP, Bammler TK, Farin FM, Bansal A, Spencer M, Deng M. Group B Streptococcal infection of the choriodecidua induces dysfunction of the cytokeratin network in amniotic epithelium: a pathway to membrane weakening. PLoS Pathog. 2014;10(3):e1003920.

Publisher's note