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Original Research Article

Determinants of puerperal sepsis among postpartum women admitted to hospitals in Dire Dawa, Ethiopia: an unmatched case-control study

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ABSTRACT

Background: Puerperal sepsis is an infection of the genital tract that occurs at any time from 2 to 42 days of puerperium. Despite various efforts undertaken, it remains among the leading causes of maternal mortality, including in Ethiopia. However, studies in Ethiopia have been inconsistent and lacking in the study area. Therefore, this study was aimed at assessing puerperal sepsis's determinants, which could help in interventions.
Methods: A hospital-based unmatched-case control study was used among 600 postpartum women (150 cases and 450 controls). Cases (postpartum women with puerperal sepsis) and controls (postpartum women without puerperal sepsis) were selected by a systematic sampling technique. Data were collected using a structured questionnaire and a medical record review, entered and cleaned by Epi DATA (version 3.1), and analyzed using SPSS (version 22). A p value of 0.25 at bivariate to select variables for multivariate and ≤ 0.05 at multivariate with 95% confidence intervals was considered statistically significant.
Results: Determinants of puerperal sepsis were housewives, merchants, rural residences, home deliveries, cesarean deliveries, and vaginal examinations and prolonged rupture of membranes.
Conclusion: Puerperal sepsis determinants are primarily obstetric-related, with occupation and residence being the most significant. Accordingly, early interventions on all these determinant factors of puerperal sepsis could make a difference in overcoming morbidity and mortality related to puerperal sepsis. Thus, hospitals are recommended to conduct further research and improve institutional delivery and use standard procedures during the labor and delivery.

Keywords: Puerperal, Sepsis, Postpartum, Dire Dawa

INTRODUCTION

Puerperal sepsis is defined as an infection of the genital tract that occurs at any time between the rupture of the membranes or labor and the first 42 days postpartum.[1,2] Puerperal sepsis mainly occurs in the first 24 hours of parturition when streptococci colonizing the genital tract or acquired nosocomial infections invade the endometrium, adjacent structures, lymphatic system, and bloodstream.[1,3] Studies show puerperal sepsis is responsible for uterine inflammation, clot formation in the arteries of the lungs, and a quarter of maternal deaths as short-term complications.[4-7] Besides, as a long-term complication, puerperal sepsis remains an unsolved problem as it is caused by many causative bacteria types.[8,9] Despite advanced technology for diagnosis and standard practices, they are also present in high-income countries.[1,7,10,11] This is related to many risk factors and multi-bacterial causes of puerperal sepsis.[2,8,12] The major problem of puerperal sepsis is not only the multi-cause effect but also the multiple risk factors that expose the mother to this infection.[2,12-14] But it is a largely

preventable condition with standard practices before, during, and after delivery through aseptic practices.[10,11,15] Still, the occurrence of puerperal sepsis varies from place to place in terms of maternal infection outcomes and case fatality rates.[2,16,17] Studies in Pakistan and Nepal show that puerperal sepsis contributes 6.27 percent of hospital admissions and 14 percent of maternal mortality.[17-19] According to the World Health Organization's (WHO) estimation of 295,000 maternal deaths, about 10.7% of them were associated with sepsis that occurred during intrapartum periods.[20] Besides, the latest global estimates suggest that obstetric infections are the third (10.7%) most common cause of maternal mortality and most commonly occur in low- and middle-income countries.[2,21] From this, sub-Saharan Africa accounts for 2/3, accounting for higher maternal deaths related to it.[22] Although maternal infection is a serious threat to women's health in sub-Saharan Africa, getting complete data remains challenging.[2,12] Despite the limited data, the incidence of puerperal sepsis in sub-Saharan Africa shows variations among countries. For instance, studies in Uganda and Kenya revealed that puerperal sepsis is among the major causes of maternal mortality, accounting for 30.9 percent 10 and 15 percent of deaths, respectively.[23] Moreover, studies in Egypt, Nigeria, and Tanzania show that puerperal sepsis is the second leading cause of maternal mortality.[24-26] Besides, lack of early recognition and treatment delays are the leading causes of maternal mortality.[9,16,17,27-29] Decreasing maternal mortality (MM) <70/ 100,000 live births by 2030 by working on preventable causes of maternal mortality like puerperal sepsis is one of the targets of Sustainable Development Goals (SDG). But in Ethiopia, although various efforts are undertaken, its burden remains one of the direct causes of maternal mortality, so puerperal sepsis is still a problem 13,14,21. Moreover, in Ethiopia, a systematic review with meta-analysis of the causes of maternal death (1990–2016) shows that puerperal sepsis accounts for 14.68% of the fourth main direct cause of maternal death (29.9%).[16] But so far, few studies across Ethiopia are conducted only considering public hospitals and are inconsistent in determinant factors. Early identification and treatment of the contributing factors would help reduce its burden. Therefore, this study was aimed at identifying the determinants of puerperal sepsis among postpartum women by including some variables like home delivery and occupation of women and including both public and private hospitals in the Dire Dawa city administration, Eastern Ethiopia.

METHODS

Study design and setting

The study was conducted in the Dire Dawa city administration at two public and three private hospitals from September 01 to October 26, 2022, using an unmatched case-control study design. Dire Dawa city administration is located 515 kilometers from Addis Ababa, the capital city of Ethiopia. According to 2020 population projections, 506,000 people live in the Dire Dawa Administration (68% of whom are estimated to be urban inhabitants), which has 38 rural and 9 urban kebeles (the smallest administrative units). This administration has six hospitals, including two public (one referral and one general) and four private ones, 1 defense force hospital, 17 health centers and 34 health posts. There are 35 drug shops, 35 pharmacies, 10 higher special clinics, 9 medium level clinics and 48 primary clinics. Additionally, there are 2 non-governmental clinics (Family guidance and Maristops international clinics). Dilchora Referral Hospital and Sabiyan General Hospital are public hospitals, being the only referral and general hospital of the Dire Dawa administration. The other three (Bilal, ART, and Yemariyam-Werk) are private general hospitals found in Dire Dawa city. All these hospitals provide medical services for more than 2000,000 people living in Dire Dawa and its surrounding communities, like the East and West Hararghe Zones of Oromia and the Somali region.[30]

Population

Source populations

All postpartum women who get medical or postnatal care services at public and private hospitals in the Dire Dawa city administration were our source populations.

Study population

Cases were all postpartum women admitted with puerperal sepsis (diagnosed for puerperal sepsis by laboratory), and controls were postpartum women admitted with other cases (without puerperal sepsis) during the study period in the selected public and private hospitals in Dire Dawa city administration.

Eligibility criteria

Inclusion criteria for cases

Postpartum women admitted with puerperal sepsis within 42 days of delivery during the data collection period and who stayed for more than one day in the selected hospitals were included in the study as cases.

Inclusion criteria for controls

Postpartum women admitted with other medical cases (without puerperal sepsis) within 42 days of delivery during the data collection period and who stayed for more than one day in the selected hospitals were included in the study as controls. Both cases and controls were selected from the same hospitals.

Exclusion criteria for cases

Postpartum women with puerperal sepsis who were critically ill and unable to respond were excluded.

Exclusion criteria for controls

Postpartum women without puerperal sepsis but admitted for other medical cases who were critically ill and unable to respond were excluded.

Sample size and sampling procedure

Sample size determination

The sample size was estimated using EPI INFO (Version 7) software. Different variables, such as the number of vaginal examinations, mode of delivery, duration of labor, educational level, and residence of women that have a high contribution to puerperal sepsis, were included, and the variable that yielded the maximum sample size was used. Sample size was calculated using r=3 (ratio of controls to cases), power=80%, and a 95% confidence level. Then the variable determining the development of puerperal sepsis, which is the proportion of primary education level among controls (16.4%) and among cases (26.9%), was taken from a similar study in the Oromia region of Ethiopia.[31]The maximum sample size is 167 cases plus 500 controls, or 667 samples. By adding a 5% non-response rate to the total sample size (33), the final sample size becomes 667+33=700 samples (175 cases and 524 controls). This was estimated for two months (700/60=11.7). But our study was for fifty-four days (11.7x54=631.8≈632). Thus, total cases=158 and total controls=474.

Sampling procedure

Both public hospitals (Dilchoral referral, DRH and Sabiyan General, SGH) and three private general hospitals (Bilal, ART and Yemariam-Work) which are giving obstetric and gynecologic services were included in the study. The three private hospitals were selected based on maximum number of puerperal sepsis cases considering their prior six months report from HMIS register. Postpartum women admitted for other medical cases without puerperal sepsis for DRH, SGH, BGH, ARTGH, and YWGH were 598, 412, 334, 278 and 258 respectively. While the diagnosed cases (puerperal sepsis) within six prior months for DRH, SGH, BGH, ARTGH, and YWGH were 476, 373, 275, 233, and 223 respectively.

Dividing each for six and multiplying by two to estimate for two months gives 159, 124, 92, 78, and 74 for DRH, SGH, BGH, ARTGH, and YWGH respectively. Considering these previous 6 months' case flow at each hospital, the total sample size was allocated proportionally. Cases were selected purposively while three eligible controls for each case (3:1) were selected from the same hospitals by convenient sampling method until the required sample size was achieved. All postpartum women diagnosed (laboratory confirmed) with puerperal sepsis during the data collection period in each hospital were consecutively selected as cases (Figure 1).

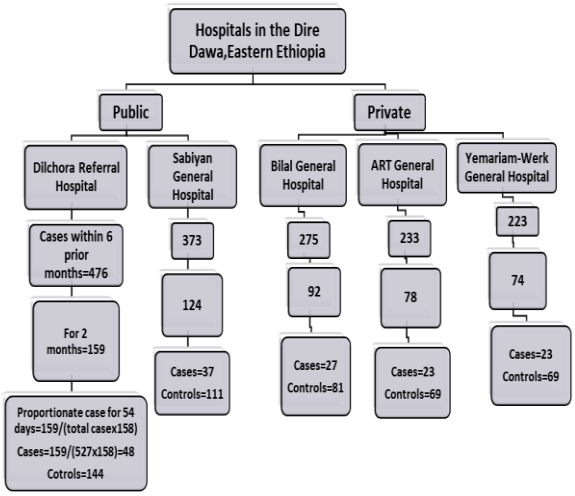

Figure 1: Diagram presentation of sample size allocation for the determinants of puerperal sepsis among postpartum women at hospitals, Dire Dawa, Ethiopia, 2022.

Data collection methods

The data was collected via face-to-face interview using a pre-tested structured questionnaire that was adapted from literature designed for the same study purpose and medical card reviews.[29,31-36] The questionnaire contains four main parts, socio-demographic characteristics, reproductive and obstetrics characteristics, maternal health and health care system related factors. Four health professionals (2 BSC nurses and 2 BSC midwives) collected the data. Two MSC nurses supervised the whole data collection process on each data collection day.

Operational definitions

Prolonged PROM

Rupture of the amniotic membrane for greater than 12 hours 37.

Prolonged labor

labor that is longer than 24 hours starting from the diagnosis of true labor.[37]

Data quality assurance

The questionnaire was developed in English and translated into the local languages (Afan Oromo, Somali, and Amharic) and then back to English to maintain its consistency. Two days of training were provided to all data collectors and supervisors. We performed a pretest on 5% of the sample size out of the selected hospitals (Hiwot-Fana Specialized University Hospital) 2 weeks before the actual data collection. Based on the findings of the pretest, variables were reviewed to suit the local context and we made minor modifications to the questionnaire. The data collection process was closely supervised, and the completeness of each questionnaire

was checked by the investigators and supervisors daily. Data was entered into the EPI DATA software as part of data management. During data cleaning, a logical checking technique was used to identify the errors. Questionnaires are secured in a safe place for confidentiality and as a backup for later, in case a check is necessary. Finally, double data entry was done by two data clerks, and the consistency of the entered data was cross-checked.

Data management and analysis

The data were coded and entered into the Epi Data (Version 3.1) and then exported to SPSS (Version 22). Then the data were cleaned, recoded, categorized, and analyzed. Summary statistics like standard deviation, frequency and percentage were used to describe the study population about their socio-demographic and other relevant characteristics. Bivariable analysis was performed to identify candidate variables for multivariable conditional logistic regression. Then all variables were analyzed by the backward stepwise method.

Variables having a p<0.20 during bivariable analysis were taken into a multivariable conditional logistic regression model to determine the association between the dependent and each independent variable and to adjust the effect of confounders on the occurrence of puerperal sepsis. Multicollinearity was checked by a variance inflation factor (VIF) and variables with VIF -values<10 was planned to be included in the model but there was no variable having such high VIF. Hosmer-Lemeshow goodness-of-fit test was done to check model fitness (>0.05). Those variables, with a p value<0.05, during multivariable analysis were taken as statistically significant determinants of puerperal sepsis. Finally, results were compiled and presented using tables, and texts.

RESULTS

Socio-demographic characteristics

In this study, 600 postpartum women participated (150 as cases and 450 as controls), with an overall response rate of 95%. Respondents ranged in age from 19 to 40 years old, with a mean age of 33 (SD = 4.7) years among cases and 18 to 40 years old, with a mean age of 26 (SD = 5.3) years among controls. The majority of the study participants (both cases and controls) were within the age range of 25–29, or 30.4% and 28.4%, respectively. The majority of both cases and controls were housewives (42.7% and 46.4%, respectively), had a secondary level of education (42% and 35.3%) (Table 1).

Reproductive and Obstetrics characteristics

Participants had 1-2 ANC follow-ups (cases = 68.7% and controls = 65%, respectively). Diabetes and anemia were present in only 12.7% (cases) and 22.2% (controls), 26% (cases) and 13.8% (controls) during pregnancy. The majority of participants in the study (86% cases, 79.3% controls) had term gestation (Table 2).

Maternal health status and health care system related factors

Only 6.3% of study participants (2.7% from cases and 3.6% from controls) had HIV infection, and 14.0% (8% from cases and 6% from controls) had urinary tract infection (3). About 28.7% (16% from cases and 12.7% from controls) of study participants were referred from other health facilities, and 22.7% (10% from cases and 12.7% from controls) had one week or more of admission days (Table 3).

Determinants of puerperal sepsis

In the multivariable Binary logistic regression analysis, residence, occupation, place, and mode of delivery, as well as vaginal examinations and parity, were found to have a significant association with puerperal sepsis.The determinants of puerperal sepsis were housewives (AOR = 2.24, 95% CI: 1.13-4.45), merchants (AOR = 2.98, 95% CI: 1.47-6.03), residence (AOR = 0.19, 95% CI: 2.34-6.74), home deliveries (AOR = 2.61, 95% CI: 1.02-6.70), cesarean deliveries (AOR = 2.40, 95% CI: 1.43-3.99), vaginal examinations (AOR = 3.50, 95% CI: 1.50-8.20), and primipara (AOR=0.26, 95%CI: 1.02-3.60) (Table 4).

Table 1: Socio-demographic characteristics of participants, Dire Dawa, Ethiopia (n=600), 2022.

Variables	Category	Cases (n=150) N (%)	Controls (n=450) N (%)	Total (n=600) N (%)
Age (in completed years)	>34	18 (12)	71 (15.8)	89 (14.8)
	30-34	27 (18)	111 (24.7)	138 (23)
	25-29	45 (30)	128 (28.4)	173 (28.8)
	20-24	38 (25.3)	80 (17.8)	118 (19.7)
	<20	22 ((14.7)	60 (13.3)	82 (13.7)
Occupation	House-wife	64 (42.7)	209 (46.4)	273 (45.5)
	Merchant	36 (24)	132 (29.3)	168 (28)
	Private employee	18 (12)	68 (15.1)	86 (14.3)
	Public employee	32 (21.3)	41 (9.1)	73 (12.2)

Continued.

Variables	Category	Cases (n=150) N (%)	Controls (n=450) N (%)	Total (n=600) N (%)
Level of education	No formal education	25 (16.7)	90 (20)	115 (19.2)
	Primary (1-8th grade)	38 (25.3)	147 (32.7)	185 (30.8)
	Secondary	63 (42)	159 (35.3)	222 (37)
	Post-secondary	24 (16)	54 (12)	78 (13)
Residence	Urban	32 (21.3)	254 (56.4)	286 (47.7)
	Rural	118 (78.7)	196 (43.6)	314 (52.3)
Income	≤1500	20 (13.3)	70 (15.6)	90 (15)
	1501-2500	18 (12)	90 (20)	108 (18)
	2501-3500	41 (27.3)	127 (28.2)	168 (28)
	3501-4500	35 (23.3)	81 (18)	116 (19.3)
	>4500	36 (24)	82 (18.2)	118 (19.7)
Marital status	Married	144 (96)	427 (94.9)	571 (95.2)
	Others	6 (4)	23 (5.1)	29 (4.8)

Table 2: Obstetric characteristics of study participants, Dire Dawa, Ethiopia (n=600), 2022.

Variables	Category	Cases	Controls	Total (N %)
Prolonged rupture of membrane	<6 hours	41 (27.3)	103 (22.9)	144 (24)
	6-12 hours	79 (52.7)	235 (52.2)	314 (52.3)
	>12 hours	30 (20)	112 (24.9)	142 (23.7)
ANC follow up	No	19 (12.7)	119 (26.4)	138 (23)
	Yes	131 (87.3)	331 (73.6)	462 (77)
ANC frequency(n=462)	1-2 times	90 (68.7)	215 (65)	305 (66)
	3-4 times	40 (30.5)	111(33.5)	151 (32.7)
	>4 times	1 (0.8)	5 (1.5)	6 (61.3)
Diabetes in pregnancy	Yes	19 (12.7)	100 (22.2)	119 (19.8)
	No	131 (87.7)	350 (77.8)	481 (80.2)
Anemia in pregnancy	Yes	18 (12)	64 (14.2)	82 (13.7)
	No	132 (88)	386 (85.8)	518 (86.3)
Gestation of pregnancy	preterm	21 (14)	93 (20.7)	114 (19)
	Term	129 (86)	357 (79.3)	486 (81)
Start of labour	Induced	21 (14)	88 (19.6)	109 (18.2)
	spontaneous	129 (86)	362 (80.4)	491 (81.8)
Duration of labor	Prolonged	16 (10.6)	82 (18.2)	98 (16.3)
	Not prolonged	134 (89.3)	368 (81.8)	502 (83.7)
Episiotomy	Yes	19 (12.7)	90 (20)	109 (18.2)
	No	131 (87.3)	360 (80)	491 (81.8)
Place of delivery	Home	19 (12.7)	133 (29.6)	152 (25.3)
	Health facility	131 (87.3)	317 (70.4)	448 (74.7)
Mode of delivery	C/s	36 (24)	198 (44)	234 (39)
	Instrumental	38 (25.3)	63 (14)	101 (16.8)
	SVD	76 (50.7)	189 (42)	265 (44.2)
Number of vaginal examinations	≥5 times	11 (7.3)	106 (23.6)	117 (19.5)
	3-4 times	84 (56)	194 (43.1)	278 (46.3)
	1-2 times	20 (13.3)	86 (19.1)	106 (17.7)
	Do not know	35 (23.3)	64 (14.2)	99 (16.5)
Parity	Primipara	20 (13.3)	159 (35.3)	179 (29.8)
	Multipara	130 (86.7)	291 (64.7)	421 (70.2)
postpartum complications	Yes	23 (15.3)	104 (23.1)	127 (21.2)
	No	127 (84.7)	346 (76.9)	473 (78.8)
Types of postpartum complications	Diarrhea	5 (21.7)	19 (11.9)	24 (13.4)
	Anemia	8 (34.8)	84 (52.8)	92 (51.4)
	Bleeding	10 (43.5)	56 (35.2)	66 (35.2)

Table 3: Maternal health status and health care system-related factors of study participants, Dire Dawa, Ethiopia (n=600), 2022.

Variables	Category	cases	Controls	Total (%)
HIV	Yes	4 (2.7)	16 (3.6)	20 (3.3)
	No	146 (97.3)	434 (96.4)	580 (96.7)
Tuberculosis	Yes	8 (5.3)	23 (5.1)	31 (5.2)
	No	142 (94.7)	427 (94.9)	569 (94.8)
Wound site infection	Yes	18 (12)	60 (13.3)	78 (13)
	No	132 (88)	390 (86.7)	522 (87)
UTI	Yes	12 (8)	27 (6)	39 (6.5)
	No	138 (92)	423 (94)	561 (93.5)
Use of prophylaxis antibiotic for UTI	Yes	18 (12)	57 (12.7)	75 (12.5)
	No	132 (88)	393 (87.3)	525 (87.5)
Referral status	Yes	24 (16)	57 (12.7)	81 (13.5)
	No	126 (84)	393 (87.3)	519 (86.5)
Duration of admission days	≥1week	15 (10)	57 (12.7)	72 (12)
	< 1week	135 (90)	393 (87.3)	528 (88)

Table 4: Bivariable and multivariable binary logistic regression analysis of factors associated with puerperal sepsis, Dire Dawa, Ethiopia (n=600), 2022.

Variables	Category	Puerperal sepsis		COR (95% CI)	AOR (95% CI)
		Case (n=150) N (%)	Control (n=450) N (%)		
Residence	Rural	118 (78.7)	196 (43.6)	1	1
	Urban	32 (21.3)	254 (56.4)	0.21 (3.10-7.40)***	0.19 (2.34-6.74)***
Occupation	House-wife	64 (42.7)	209 (46.4)	2.55 (1.50-4.40)**	2.24 (1.13-4.45)*
	Merchant	36 (24)	132 (29.3)	2.86 (1.60-5.20)***	2.98 (1.47-6.03)**
	Private employee	18 (12)	68 (15.1)	2.95 (1.47-5.91)**	1.48 (0.60-3.64)
	Public employee	32 (21.3)	41 (9.1)	1	1
Income	≤1500	20 (13.3)	70 (15.6)	1.54 (0.82-2.90)	0.98 (0.46-2.06)
	1501-2500	18 (12)	90 (20)	2.20 (1.16-4.16)*	1.76 (0.83-3.70)
	2501-3500	41 (27.3)	127 (28.2)	1.36 (0.80-2.30)	1.22 (0.65-2.26)
	3501-4500	35 (23.3)	81 (18)	1.02 (0.58-1.80)	0.96 (0.50-1.85)
	>4500	36 (24)	82 (18.2)	1	1
ANC follow up	Yes	131 (87.3)	331 (73.6)	1	1
	No	19 (12.7)	119 (26.4)	2.48 (1.47-4.20)**	0.95 (0.37-2.50)
Diabetes in pregnancy	No	131 (87.7)	350 (77.8)	1	1
	Yes	19 (12.7)	100 (22.2)	1.97 (1.16-3.35)*	3.62(0.86-15.33)
Episiotomy	No	131 (87.3)	360 (80)	1	1
	Yes	19 (12.7)	90 (20)	1.72 (1.01-2.94)*	1.60 (0.75-3.30)
Place of delivery	Health facility	131 (87.3)	317 (70.4)	1	1
	Home	19 (12.7)	133 (29.6)	2.90 (1.72-4.90)***	2.61 (1.02-6.70)*
Postpartum complications	No	127 (84.7)	346 (76.9)	1	1
	Yes	23 (15.3)	104 (23.1)	1.66 (1.01-2.72)*	0.33 (0.08-1.40)
Mode of delivery	C/s	36 (24)	198 (44)	2.21 (1.42-3.45)***	2.40 (1.43-3.99)**
	Instrumental	38 (25.3)	63 (14)	0.70 (0.41-1.08)	0.83 (0.48-1.46)
	Spontaneous vaginal	76 (50.7)	189 (42)	1	1
Duration of labor	Not prolonged	134 (89.3)	368 (81.8)	1	1
	Prolonged	16 (10.6)	82 (18.2)	1.87 (1.05-3.30)*	1.72 (0.90-3.31)
Number of vaginal examinations	≥5 times	11 (7.3)	106 (23.6)	5.27 (2.50-11.10)***	3.50 (1.50-8.20)**
	3-4 times	84 (56)	194 (43.1)	1.26 (0.80-2.05)	0.96 (0.52-1.80)
	1-2 times	20 (13.3)	86 (19.1)	2.35 (1.24-4.45) **	1.40 (0.64-3.02)
	Do not know	35 (23.3)	64 (14.2)	1	1
Parity	Multipara	130 (86.7)	291 (64.7)	1	1
	primipara	20 (13.3)	159 (35.3)	0.28 (2.13-5.91) ***	0.26 (1.02-3.60) *

Significant at: *p=<0.05, **p=<0.01, ***p=0.000, 1=reference

DISCUSSION

This study was aimed at assessing the determinants of puerperal sepsis among postpartum women in public and private hospitals in Dire Dawa Administration, Ethiopia, through an unmatched case-control study. Accordingly, the findings revealed that urban resident postpartum women were less likely to develop puerperal sepsis compared with rural resident postpartum women (AOR=0.21; 95% CI: 2.34-6.74). This is supported by research from Uganda 10 and Ethiopia.[31] In contrast, a study in Bangladesh showed no significant association between puerperal sepsis and place of residence.[17] The possible association may be due to unclean delivery, low sanitation in rural areas, and lower awareness about puerperal sepsis in rural areas than urban areas.

Those postpartum women who had five or more vaginal examinations during delivery were more than three times more likely to develop puerperal sepsis compared to those who had fewer (AOR: 3.50; 95%CI: 1.50–8.20). This finding is consistent with research from Kenya and Ethiopia.[31,38,39] A study in Pakistan (Karachi) also showed that the increased number of vaginal examinations was two times higher among cases as compared to controls.[6] This could be due to the fact that frequent manipulation of the genital tract might facilitate the ascension of pathogenic microorganisms from the lower genital tract, thereby increasing the probability of developing puerperal sepsis in postpartum women.

In this study, the mode of delivery was also a significant determinant of puerperal sepsis. Postpartum women who gave birth via cesarean section were almost two times more likely to develop puerperal sepsis compared to those delivered through instrumental and spontaneous vaginal delivery (SVD) (AOR=2.40; 95%CI: 1.43–3.99). This was consistent with findings from Scotland, Uganda, Kenya, Tanzania and Ethiopia.[10,31,32,39,40]

Besides, a study in northern Nigeria identified caesarean section (C/S) (with OR=4.99) as a risk factor for puerperal sepsis.[41] Similarly, a Ugandan study found that cesarean delivery was associated with an increased risk of postpartum infection in hospitals (AOR=3.9, 95% CI: 1.5-10.3, P=0.006).[35] Additionally, a study in Nigeria showed that, from 130 women with puerperal sepsis, 17.6 percent were given birth with an emergency caesarean section.[42] This could be due to the fact that staph bacteria naturally exist on people's hair and skin. When they multiply and enter a wound, in this case the surgery site from a caesarean section, they can cause several types of infection, like puerperal sepsis. Furthermore, the immune system is slightly weakened during pregnancy; after delivery, this weakened immunity makes postpartum women susceptible to infections because it takes some time for it to return to a pro-inflammatory state. Multiparity was the other identified determinants of puerperal sepsis. Primipara women were less likely to develop puerperal sepsis compared to those multiparous women who had no PPROM (AOR=0.26; 95% CI: 1.02–3.60). The possible reason might be due to prolonged exposure of internal parts during repeated pregnancy exposure since during pregnancy immunity slightly decreases which can lead to the entry of ascending microorganisms from the vagina and external reproductive organs that are favorable for bacterial growth and causing puerperal sepsis in multiparous postpartum women.

This study identified the place of delivery as having an association with puerperal sepsis. Postpartum women who gave birth at home were more than twice as likely as those who gave birth in a hospital to develop puerperal sepsis (AOR=2.61; 95% CI: 1.02–6.70). This was in line with studies conducted in Pakistan and Nigeria.[6,18,25,41] This might be due to the prolonged time to arrive at a hospital and probable unclean vaginal examinations by traditional birth attendants at local or home or on the way to the hospital, which might contribute to the development of puerperal sepsis at home delivery compared to clean and sterile procedures along with the use of prophylaxis as prevention methods when needed at health facilities. A study in India supports this; it showed that delivery by an untrained person was the main identifiable risk factor for puerperal sepsis43. Thus, lack of practice of aseptic measures like hand washing, use of antiseptic materials, perinatal hygiene by unskilled birth attendants, and frequent vaginal examination could be key features for developing puerperal sepsis.[31,38,42] A study in Pakistan also reported that the odds of puerperal infection was more than two times among women who delivered in unhygienic conditions at homes as compared to deliveries conducted at health facilities.[44]According to this study, occupation was also associated with puerperal sepsis; postpartum women who were housewives (AOR: 2.24; 95%CI: 1.13-4.45) and merchants (AOR: 2.98; 95%CI: 1.47-6.03) were nearly two- and three-times more likely to develop puerperal sepsis than others. This was in contrary to a study in Bangladesh showed no association between maternal occupation and the development of puerperal sepsis.[17] The possible explanation might be that housewives may have lower awareness prevention cares about puerperal sepsis and those merchants might have higher exposure to variety of bacteria as they are mobile from different markets but this needs more research for the future. This was also slightly highlighted by a study in Nigeria.[45] The study was focused on puerperal sepsis, which is among the most common direct obstetrics-related causes of maternal mortality worldwide. Moreover, the study included both public and private hospitals in the study area, which increases the external validity of the study and enables comparison, which could help to prioritize where the problem is higher. The findings of the study could have implications for society, research, and practice (for health professionals and health care managers).

The study findings imply the need for continuous awareness among pregnant and postpartum women and

the community about the need for institutional delivery and risk factors of PPS. Since rural residence, housewives, merchants, and home delivery were found to be associated with PPS. The study implies the need for future research to identify further determinants of PPS like home delivery, housewives, merchants, duration of labor and others need further study.

According to the study's findings, health facilities require counseling pregnant women about the importance of institutional diversity and the risk of home delivery during ANC visits and taking precautions during prolonged rupture of membranes, vaginal examinations, and cesarean deliveries (wound site care). Since prolonged rupture of membranes, vaginal examinations and cesarean deliveries were found to be associated with PPS. Due to the case-control nature of the study, it did not show causal relationships between variables, and a hospital-based study might not generalize to other women.

CONCLUSION

In general, this study revealed that the majority of puerperal sepsis occurs either during the prenatal or postnatal period. Residence, occupation (housewife and merchant), parity, number of vaginal examinations (5 times or more), and place and mode of delivery (home delivery and cesarean delivery) were the identified determinants of puerperal sepsis. Considering this, community awareness of the importance of institutional delivery and the risk of home delivery and, for health care providers, the care needed during and post CS for postpartum women) were recommended. Accordingly, early interventions on all these determinant factors of puerperal sepsis could make a difference in overcoming morbidity and mortality (mother and child) related to puerperal sepsis.

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