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# Determinants of puerperal sepsis at public hospitals in West Ethiopia: A case-control study

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## Abstract

**Introduction:** Puerperal sepsis is one of the second and fifth most reasons for maternal mortality in the least resourced countries and global levels, respectively. Despite this, the determinants of puerperal sepsis are still inconsistent and not largely identified in Ethiopia, specifically in the study area. This study aimed to identify the determinants of puerperal sepsis among postpartum women at hospitals in the East Wollega, West Ethiopia.

**Methods:** A case-control study was conducted among 108 cases and 324 controls in East Wollega public hospitals. The collected data were entered into EPI INFO and transported to SPSS for analysis. Results were presented using frequencies, percentages, tables, and graphs. In the bivariate analysis, variables with a p-value < 0.25 were entered into multivariate logistic regression. Adjusted Odds Ratio (AOR) with the 95% Confidence Interval (CI), and a P-value <0.05 were used to declare a statistical significance.

**Results:** Living in rural (AOR:6.73,95 CI:2.70,16.80), lack of formal education (AOR:3.25,95 1.01,10.45), home delivery (AOR:4.6625,95 CI 1.48,14.63), being referred from other facilities (AOR:6.04,95% CI:2.40,16.80), cesarean section (AOR:3.34, 95% CI:1.09,17.20), duration of labor (AOR:3.45,95% CI:1.81,49.27), frequent vaginal examinations (AOR: 3.4, 95% CI: 1.30, 10.96), birth and emergency preparation plans (AOR:6.76,95% CI:2.46,18.56), and low number of antenatal care(ANC) follow-up (AOR:9.37, 95% CI:2.38,36.88) were the determinants of puerperal sepsis.

**Conclusions:** Place of residence, maternal educational level, place of delivery, referral status, mode of delivery, duration of labor, frequent vaginal examinations, birth and emergency preparation plans, and the number of ANC were the identified determinants of puerperal sepsis.in this study. Therefore, facilitating infrastructure for rural dwellers, intensifying women's educational level, appropriate use of the partograph by all skilled attendants to prevent prolonged labor and frequent vaginal examinations as well as enhancing the awareness of birth and emergency preparation for women by communicating with mothers on full ANC follow-up is compulsory.

## Introduction

World Health Organization (WHO) defined puerperal sepsis as an infection of the genital tract, which occurs at any time from the rupture of membranes or time of labor and up to 42 days after childbirth [1]. It occurs when two or more of the following signs and symptoms happen: pelvic pain, high body temperature (that, is oral temperature of 38.5°C or above on any occasion), abnormal genital discharge (presence of pus), bad smell or foul odor discharge, delay in the reduction of the size of the uterus (less than 2 centimeters/day with in the first eight days, sudden onset of fever during the postnatal period, chills, sweating, generalized body pain, headache and loss of appetite [1]. Some of the factors associated with puerperal sepsis are premature rupture of the membrane, pelvic inflammatory disease, infected episiotomy, sexually transmitted diseases, anemia, obstructed labor, cesarean section, multiparous, prolonged labor, frequent vaginal examinations with poor hygiene, poor aseptic technique, rural residence, lack of formal education, and low income [2-6].

Lack of treatment of puerperal sepsis may lead to death or serious long-term morbidities such as chronic pelvic pain, pelvic inflammatory disease, wound infection, mastitis, urinary tract infection, septicemia, septic shock, peritonitis, or abscess formation leading to surgery and future secondary infertility or death [7]. These serious consequences can be easily avoided with better infection control, prompt diagnosis, appropriate treatment, and prophylactic antibiotics during labor and delivery procedures [8,9]. Puerperal sepsis is yet a significant cause of morbidity and mortality among women in developed and low resource countries [10]. Puerperal sepsis is among the leading causes of preventable maternal morbidity and mortality not only in developing countries but also in developed countries as well. According to the WHO report, about 358,000 maternal deaths occurred during labor and childbirth, of which puerperal sepsis contributes to 15% of total maternal deaths. As many as 5.2 million new cases of maternal sepsis are thought to occur annually and an estimated 62,000 maternal deaths result from this condition [11]. In Sub-Saharan countries, puerperal sepsis is the

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*Abbreviations: ANC: Ante Natal Care; C/S: Cesarean Section; HIV/AIDS: Human Immune Virus/Acquired Immune Deficiency Syndrome; PNC: Postnatal Care; PVE: Per Vagina Examination; SDG: Sustainable Development Goal; SPSS : Statistical Package for Social Sciences; WHO: World Health Organization.*

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second most common cause of maternal morbidity and mortality next to hemorrhage [12]. Similarly, in Africa and Asia, puerperal sepsis is the second most common cause of maternal mortality next to hemorrhage [10]. In another way, it is ranked as the sixth leading cause of disease burden for women aged 15-44 years, followed by depression, HIV/AIDS, tuberculosis, abortion, and schizophrenia [11]. In Ethiopia, puerperal sepsis is the third direct leading cause of maternal mortality next to hemorrhage and hypertension [13].

Sustainable development goals (SDG) indicate that every country should reduce the maternal mortality ratio to < 70/100,000 by the year 2030 [14]. To achieve this plan and speed up maternal mortality reduction, identification of the causes of maternal mortality, including determinants of puerperal sepsis is crucial [15]. Despite the few studies conducted at Gondar Referral Hospital, and Dessie Referral Hospital Ethiopia, on puerperal sepsis, they focused on the prevalence of puerperal sepsis and associated factors, which were cross-sectional studies in nature, which is not recommended for studying causal inferences. Specifically, a study conducted at Dessie Referral Hospital, Ethiopia, was focused on secondary data, which was so difficult to get complete information and may be full of errors. Although there is one study conducted regarding determinants of puerperal sepsis in West Shoa, Ethiopia, still an association of some variables with puerperal sepsis like, place of delivery, type of pregnancy, hygiene practice by health care providers, medical problems before delivery, number of deliveries, episiotomy performed, how labor started, who attend the delivery, placental removal, birth and emergency preparation plan, shower after delivery and type of towel used after delivery were not studied [6].

Therefore, Ethiopia, specifically at East Wollega zone public hospitals of Oromia still lacks consistent and largely identified data on puerperal sepsis. Hence, this study aimed to identify the determinants of puerperal sepsis among postpartum women attending public hospitals in the East Wollega zone, Oromia regional state, Western Ethiopia, 2020.

## Methods

Study design, period, and setting

An institutional-based unmatched case-control study was conducted from May to October 2020 in East Wollega pubic hospitals. The East Wollega Zone is one of the 22 administrative zones of Oromia Regional state and is located 332 km to the west of Addis Ababa. It has a population of 1,531,380 (764,159 Males, 767,221 Females). Of all reproductive-age women, 53,139 women give birth annually according to the zonal health office report of April 2020 [16]. Nekemte town is the capital city of the East Wollega Zone. Currently, there are five public hospitals in the zone (two referral hospitals and three district hospitals), 17 Woreda Health Offices, 58 Health Centers, and 287 Health Posts providing services for populations living in the East Wollega Zone. East Wollega has 2340 health professionals out of which 167 are midwiferies [16].

### Source and study population

All postpartum mothers who came for postnatal care or received medical care at public hospitals in East Wollega Zone during the study period were the source population. All postpartum mothers who came for postnatal care or received medical care at public hospitals in East Wollega Zone during the study period and those included in the study were the study population. Cases were postpartum mothers with at least one of the four signs and symptoms listed as follows: (1) abnormal vaginal discharge + fever, (2) foul-smelling lochia + fever, (3) lower abdominal pain + fever, (4) prolonged flow of lochia + fever. Postpartum mother with at least one of the four indicators of puerperal sepsis was considered as or diagnosed as having puerperal sepsis [8]., whereas controls were women who had no puerperal sepsis.

### Eligibility criteria

All postpartum mothers who came for postnatal care or received medical care at public hospitals in East Wollega Zone during the study period who were voluntary to participate were included in the study. All postpartum mothers who came for postnatal care or received medical care at public hospitals in East Wollega Zone during the study period who were severely ill and unable to respond were excluded from the study.

### Sample size determination

The sample size was determined using the double population proportion formula based on the assumption of the mode of delivery by cesarean section (C/S) was a major significant determinant of puerperal sepsis. In a previous case-control study conducted in West Shoa, Ethiopia, the proportion of mothers among cases with the mode of delivery by C/S was 35.8% and the proportion of mothers among controls with the mode of delivery by C/S was 20.7%. The level of significance was 0.05, the power of the test was $(1-\beta) = 80\%$, and the ratio of control to the case was 3. The proportion of exposure among cases (p1) =35.8% with the proportion of exposure among controls (p2) = 20.7% and AOR=0.38 was inserted into EPI INFO version7 to determine the sample size [6]. Accordingly, after considering a 10% non-response rate, the final sample size was 432 with 108 cases and 324 controls.

### Sampling technique

All hospitals in the zone were included in the study. Cases were selected by consecutive sampling technique from postpartum mothers with puerperal sepsis admitted at maternity wards found in all East Wollega public hospitals during the study period until the required sample size was reached while controls were selected by using a systematic random sampling technique. As data obtained from the postnatal care monthly report (previous quarter), per month an average of 42, 21, 57,134 puerperal sepsis mothers were admitted to the maternity ward at Sire, Arjo, Gida Ayana, and Nekemte hospitals respectively. Totally, in all East Wollega public hospitals, around 1552 postnatal non-puerperal sepsis mothers were admitted to the maternity ward during the study period in the previous six months. The total sample size was allocated to each hospital using proportional allocation. Therefore, by dividing N/n (1552/324), we got the $k^{th}$ value of 4 for controls. The first mother was selected by lottery method and then every "k" interval interviews were conducted for admitted non-puerperal sepsis mothers during the study period. Then, based on 1:3 samples of case to controls ratios, for every one case of puerperal sepsis, three controls were selected randomly for an interview by systematic method on the same day and in the same ward (Figure 1).

### Operational definition

**Puerperal sepsis:** Postpartum mothers with at least two of the four signs and symptoms listed as follows: (1) abnormal vaginal discharge + fever, (2) foul-smelling lochia + fever, (3) lower abdominal pain + fever, (4) prolonged flow of lochia + fever. Postpartum mother with at least one of the four indicators of puerperal sepsis was considered as or diagnosed as having puerperal sepsis [8].

### Data collection tools and procedures

The interviewer administered a structured questionnaire which was adapted and modified from the study conducted in West Shoa, Ethiopia and Kenya [4,6]. The questionnaire was initially developed in English and it was translated into Afan Oromo language and then

**List of Figures**

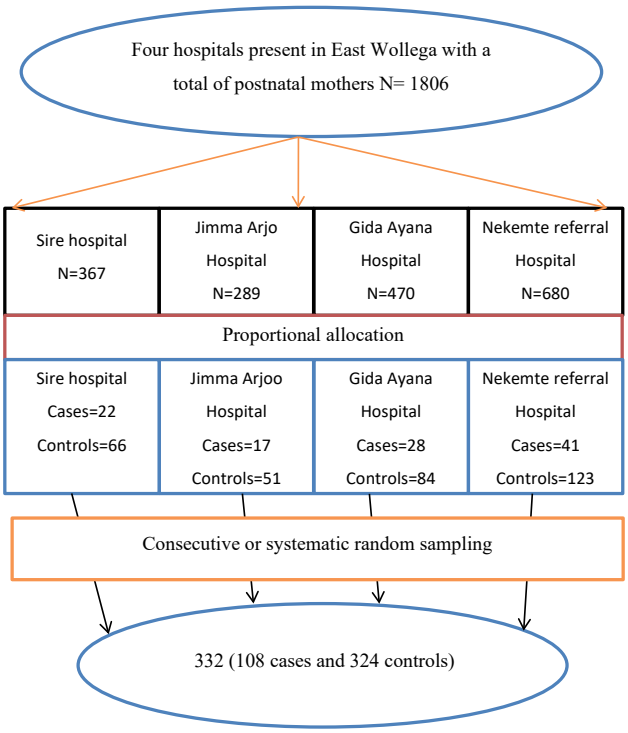


**Figure 1**. Diagrammatic representation of sampling technique for determinants of puerperal sepsis at East Wollega Public Hospitals, Oromia, Ethiopia, 2020.

translated back to English to check its consistency. The questionnaire included socio-demographic characteristics, obstetric, and maternal-related factors. Cases and controls were identified through review of patient card after physician diagnosis and using prepared clinical signs checklists for puerperal sepsis during the study period in the maternity ward. For each hospital, two BSC Nurses for data collection and one BSC Midwifery for supervision were used. The interview was conducted after the patients were treated for puerperal sepsis for all cases.

## Data quality control

Data collectors and supervisors took training for two days before the commencement of the data collection. The training content included the aim of the study, the data collection tool, and how to maintain the confidentiality of the study participants. Before the initiation of the main study, a pretest was conducted on 5% (5 cases and 15 controls) of the sample size among postpartum mothers admitted to Bako district hospital which is outside the study area. The findings from the pretest were utilized in modifying the data collection tool for the main study.

## Data processing and analysis

The collected data were edited, coded, cleaned, and entered into EPI INFO version 7 and exported to SPSS version 23 for analysis. Results were presented using frequencies, percentages, tables, and graphs. Bivariate and multivariate logistic regression analyses were used to identify the association of each independent variable with the outcome variable. Those variables with a p-value < 0.25 in the bivariate analysis were taken and analyzed in multivariable logistic regression [17]. Multicollinearity was checked before computing multivariate analysis. Adjusted odds ratio with 95% confidence intervals and a p-value of less than 0.05 were used to declare a statistically significant association.

## Ethical considerations and consent to participate

Ethical clearance was obtained from Ambo University Ethical Review Committee of the College of Medicine and Health sciences. A letter of cooperation was written to the Zonal health office as per ethical clearance from Ambo University. Written permission was secured from the responsible bodies of the study setting. Written consent was obtained from each study participant after the data collectors had explained the nature, purpose, and procedures of the study for those above 18 years of age and written assent was obtained from their guardian for those below 18 years old. The respondents were informed that they have the right to refuse or terminate at any point in the interview. Codes were used in place of identifiers to maintain the confidentiality of participants.

# Results

Socio-demographic characteristics of the study participants

Out of 429 (108 cases and 324 controls) mothers who were approached for an interview, a total of 428 (107 cases and 321 controls) participated and thus a response rate of 99.8%. The age of respondents ranged from 16 to 42 with a mean age of 26.69 (SD: ±5.71) for cases and 27.07 (SD: ±6.73) for controls. Sixty-five (60.7%) of cases and more than one-sixth (55) 17.1% of controls were from rural areas. Twenty-nine percent (29%) of cases and 9% of controls had no formal education (Table 1).

**Table 1.** Socio-demographic characteristics of postpartum mothers who admitted in East Wollega Zone Public Hospitals, Ethiopia, 2020

| Variables | Cases (n=107) | Controls (n=321) |
|---|---|---|
| **Age group** | | |
| 15-19 | 7 (6.5%) | 35 (10.9%) |
| 20-24 | 23 (21.5%) | 100 (32.2%) |
| 25-30 | 51 (47.7%) | 120 (37.4%) |
| 30-34 | 14 (13%) | 40 (12.5%) |
| ≥35 | 9 (8.4%) | 26 (8.1%) |
| **Residence** | | |
| Rural | 65 (60.7%) | 55 (17.1%) |
| Urban | 42 (39.3%) | 266 (82.9%) |
| **Educational Level** | | |
| No formal education | 31 (29.0%) | 29 (9.0%) |
| Primary school | 50 (46.7%) | 122 (38.0%) |
| Secondary school | 12 (11.2%) | 94 (29.3%) |
| Tertiary/college and above | 14 (13.1%) | 76 (23.7%) |
| **Monthly-income** | | |
| ≤ 500 | 39 (36.4%) | 101 (31.5%) |
| 501–1500 | 45 (42.4%) | 130 (40.5%) |
| 1501–2500 | 10 (9.3%) | 39 (12.1%) |
| 2501-3500 | 9 (8.4%) | 34 (10.6%) |
| >3500 | 4 (3.4%) | 17 (5.3%) |
| **Husband educational level** | | |
| No formal education | 4 (3.7%) | 3 (0.9%0 |
| Primary school | 51 (47.7%) | 74 (23.1%) |
| Secondary school | 28 (26.5%) | 105 (32.7%) |
| Tertiary/college and above | 24 (24.4%) | 139 (43.3%) |
| **Maternal occupation** | | |
| House wife | 43 (40.2%) | 58 (18.1%) |
| Self-employed | 43 (40.2%) | 180 (56.2%) |
| Governmental employed | 15 (14.0%) | 73 (22.7%0 |
| Unemployed | 6 (5.6%) | 10 (3.1%) |
| **Marital status** | | |
| Single | 3 (2.8%) | 4 (1.2%0 |
| Engaged | 104 (97.2%) | 317 (98.8%) |

**Table 2.** Obstetrics related factors of postpartum mother who admitted in East Wollega Zone Public Hospitals, Ethiopia, 2020

| | Cases(n=107) | Controls (n=321) |
|---|---|---|
| **Parity** | | |
| 1 | 28 (26.2)% | 57 (17.8%) |
| 2-3 | 72 (67.3%) | 251(78.2%) |
| ≥4 | 7(6.5%) | 13(4.0%) |
| **Duration of labor** | | |
| 6-12 hours | 26 (24.3%) | 138 (43.0%) |
| 12-24 hours | 19 (17.8%) | 108 (33.65%) |
| 24-36 hours | 48 (44.9%) | 61 (19.0%) |
| ≥ 36hours | 14 (13.1%) | 14(4.4%) |
| **Duration of membrane rapture** | | |
| <24 hours | 7 (6.5%) | 50 (15.6%) |
| 24-36 hours | 6 (5.6%) | 29 (9.0%) |
| ≥36 hours | 94 (87.9%) | 242 (75.4%) |
| **Assisted during delivery** | | |
| Yes | 100 (93.5%) | 319 (99.4%) |
| No | 7 (6.5%) | 2 (0.6%) |
| **Labor started** | | |
| Spontaneously | 91 (85.1%) | 291 (90.7%) |
| Induction | 12 (11.2%) | 20 (6.2%) |
| Others | 4 (3.7%) | 10 (3.1%) |
| **Mode of delivery** | | |
| SVD | 82 (76.6%) | 280 (87.2%) |
| C/S | 20 (18.7%) | 16 (5.0%) |
| Instrumental | 5 (4.7%) | 25 (7.8%) |
| **Episiotomy** | | |
| Yes | 30 (28.0%) | 49 (15.3%) |
| No | 77 (72.0%) | 272 (84.7%) |
| **Number of vaginal examination** | | |
| 1 times | 15 (14.0%) | 29 (9.0%) |
| 2-3 times | 13 (12.2%) | 235 (73.2%) |
| ≥4 times | 79 (73.8% | 57 (17.8%) |
| **Placenta removed** | | |
| Controlled cord traction | 59 (55.0%) | 220 (68.5%) |
| Manual removal of placenta | 18 (12.1%) | 50 (15.6%) |
| I don't know | 13 (12.1% | 18 (3.4%) |
| Spontaneously by itself | 17 (15.9%) | 29 (9.0%) |
| **ANC before delivery** | | |
| Yes | 97 (90.7 %) | 316 (98.4%) |
| No | 10 (9.3%) | 5 (1.6%) |
| **Number of ANC follow up** | | |
| 1-2 | 32 (29.9%) | 19 (5.9%) |
| 3-4 | 62 (57.9%) | 195 (60.7%) |
| ≥4 | 13 (12.2%) | 107 (33.3%) |

## Obstetric related characteristics of the respondents

More than three-fourths 76.6% of cases and 87.2% of controls gave birth by spontaneous vaginal delivery. In less than half, 44.9% of cases and 19% of controls, their labor stayed for 24-36 hours duration. Nearly three-fourths 73.8% of cases and one-sixth 17.8% of controls reported more than four per vaginal examination during labor. The majority of cases 83.2 and almost all controls 94.7% had first ANC follow-up. More than half 57.9 % of cases and 60.7% of controls had 2-3 times ANC follow-up (Table 2).

## Maternal related factors

The majority 97 (90.7%) of cases and nearly all of the controls 314 (97.8%) gave birth at health institutions. Similarly, more than half (54.2%) of cases and around one-sixth (13.7%) of controls were referred from other places. More than half 57.0% of cases, and the majority, 90.7% of controls had birth and emergency preparation plans. The study revealed that 2.8% of cases and 4% of controls had information about puerperal sepsis (Table 3). 1.9% of cases and 0.9% of controls had diabetes. 1.9% of cases and 0.6% controls had HIV/AIDS (Figure 2).

## Determinants of puerperal sepsis

Bivariate logistic regression analysis was done to identify the association of each independent variable with puerperal sepsis. Multiple logistic regression was conducted for controlling the confounding effects of other variables. The results of multiple logistic regression indicated that women who were from rural areas had seven-folds higher odds of developing puerperal sepsis compared to those who live in urban areas (AOR:6.73,95% CI: 2.70,16.80). Similarly, mothers

**Table 3.** Maternal related factors of postpartum mother who admitted at the maternity ward in East Wollega Zone Public Hospitals, Ethiopia, 2020

| Variables | Cases (n=107) | Controls (n=321) |
|---|---|---|
| **Birth attendant** | | |
| Family member | 3 (2.8%) | 2 (0.6%) |
| TBA | 6 (5.6%) | 3 (0.9%) |
| Health worker | 98 (91.6%) | 316 (98.4%) |
| **birth attendant hygienic practice** | | |
| Only used glove | 102 (95.3%) | 269 (83.8%) |
| Both used glove and washed hands | 3 (2.8%) | 48 (15.0%) |
| Didn't used both | 2 (1.9%) | 4 (1.2) |
| **Place of delivery** | | |
| Home | 10 (9.3%) | 7 (2.2%) |
| Health institutions | 97 (90.7%) | 314 (97.8%) |
| **Referral status** | | |
| Yes | 58 (54.2%) | 44 (13.7%) |
| No | 49 (45.8%) | 277 (86.3%) |
| **Birth and emergency preparation plan** | | |
| Yes | 61 (57.0%) | 291 (90.7%% |
| No | 46 (43.0%) | 30 (9.3%) |
| **Shower after delivery** | | |
| Yes | 87 (81.3%) | 275 (85.7%) |
| No | 20 (18.7% | 46 (14.3%) |
| **Day of shower after delivery** | | |
| < 2 days | 42 (39.3%) | 207 (64.5%) |
| ≥2 days | 65 (60.7%) | 114 (35.5%) |
| **Immediately after delivery towel used to cover perineal area** | | |
| Yes | 93 (87.0%) | 307 (95.6%) |
| No | 14 (13.0%) | 11 (3.4%) |
| **Type of towel used** | | |
| Sanitary pad/modes | 88 (82.2%) | 285 (88.8%) |
| Unhygienic cloth(towel) | 6 (5.6%) | 4 (1.2%) |
| Hygiene (towel) prepared for this purpose | 13 (12.1%) | 32 (10.0%) |
| **Information about puerperal sepsis** | | |
| Yes | 3 (2.8%) | 13 (4.0%) |
| No | 104 (97.2%) | 308 (96.0%) |
| **Frequency of meal during pregnancy** | | |
| <3 times | 37 (34.6%) | 66 (20.6%) |
| ≥3times | 70 (65.4%) | 255 (79.4%) |

**Table 4. Multivariate logistic regression analysis of postpartum mothers who were admitted in East Wollega Zone Public Hospitals, Ethiopia, 2020.** COR: Crude Odds Ratio; CI: Confidence Interval; OR: Adjusted Odds Ratio; *:p<0.05.

| Variables | Cases(n=107) | Controls(n=321) | COR(95% CI) | AOR(95% CI) |
|---|---|---|---|---|
| **Residence** | | | | |
| Rural | 65 (60.7%) | 55 (17.1%) | 7.48(4.61,12.15)* | **6.73 ( 2.70,16.80)*** |
| Urban | 42 (39.3%) | 266 (82.2%) | 1 | 1 |
| **Educational level of mother** | | | | |
| No formal education | 31 (36.4%) | 101 (31.5%) | 5.80 (2.70,12.43)* | **3.25 (1.01,10.45)*** |
| Primary school | 45 (42.4%) | 164 (51.05) | 2.23 (1.15,4.30)* | 3.98 (1.00,16.10) |
| Secondary school | 10 (9.3%) | 25 (7.8%) | 0.70 (0.30,1.59) | 1.05 (0.27,4.07) |
| Tertiary/collage | 14 (13.1%) | 76 (23.7%) | 1 | 1 |
| **Place of delivery** | | | | |
| Home | 4 (3.7%) | 13 (4.0%) | 12.28(5.10,29.60)* | **4.66 (1.48,14.63)*** |
| Health institutions | 103 (96.3%) | 308 (96.0%) | 1 | 1 |
| **Referral status** | | | | |
| Yes | 58 (54.2%) | 44 (13.7%) | 7.45 (4.54,12.23)* | **6.04 (2.40,16.80)*** |
| No | 49 (45.8%) | 277 (86.3%) | 1 | 1 |
| **Mode of delivery** | | | | |
| SVD | 82 (76.6%) | 280 (87.2%) | 1 | 1 |
| C/S | 20 (18.7%) | 16 (5.0%) | 4.27 (2.12, 8.61)* | **3.34 (1.09,17.20)*** |
| Instrumental | 5 (4.7%) | 25 (7.8%) | 0.68 (0.25, 1.84) | 0.21 (0.21,1.79) |
| **Duration of labor** | | | | |
| 6-12 hours | 26 (24.3%) | 138 (43.0%) | 1 | 1 |
| 12-24 hours | 19 (17.8%) | 108 (33.65%) | 0.93 (0.49, 1.78) | 0.67 (0.22,2.02) |
| 24-36 hours | 48 (44.9%) | 61 (19.0%) | 4.18 (2.38, 7.34)* | 1.81 (1.68,13.75)* |
| >36hours | 14 (13.1%) | 14 (4.4%) | 5.31 (2.27, 12.43)* | **3.45 (1.81,49.27)*** |
| **Number of vaginal examination** | | | | |
| 1 times | 15 (14.0%) | 29 (9.0%) | 1 | 1 |
| 2-3 times | 13 (12.1%) | 235 (73.2%) | 0.11 (0.05,0.25)* | **0.08 (0.03,0.27)*** |
| >4 times | 79 (73.8%) | 57 (17.8%) | 5.68 (1.32,5.45)* | **3.4 (1.30,10.96)*** |
| **Birth and emergency preparation plan** | | | | |
| Yes | 61 (57.0%) | 291 (90.7%) | 1 | 1 |
| No | 46 (43.0%) | 30 (9.3%) | 7.31 (4.28,12.51)* | **6.76 (2.46,18.56)*** |
| **Number of ANC follow up** | | | | |
| 1 | 32 (29.9%) | 19 (5.9%) | 13.86(6.18,31.11)* | **9.37 (2.38,36.88)*** |
| 2-3 | 62 (57.9%) | 195 (60.7%) | 2.62 (1.34,4.97)* | 1.10 (0.39,2.83) |
| ≥4 | 13 (12.1%) | 107 (33.3%) | 1 | 1 |

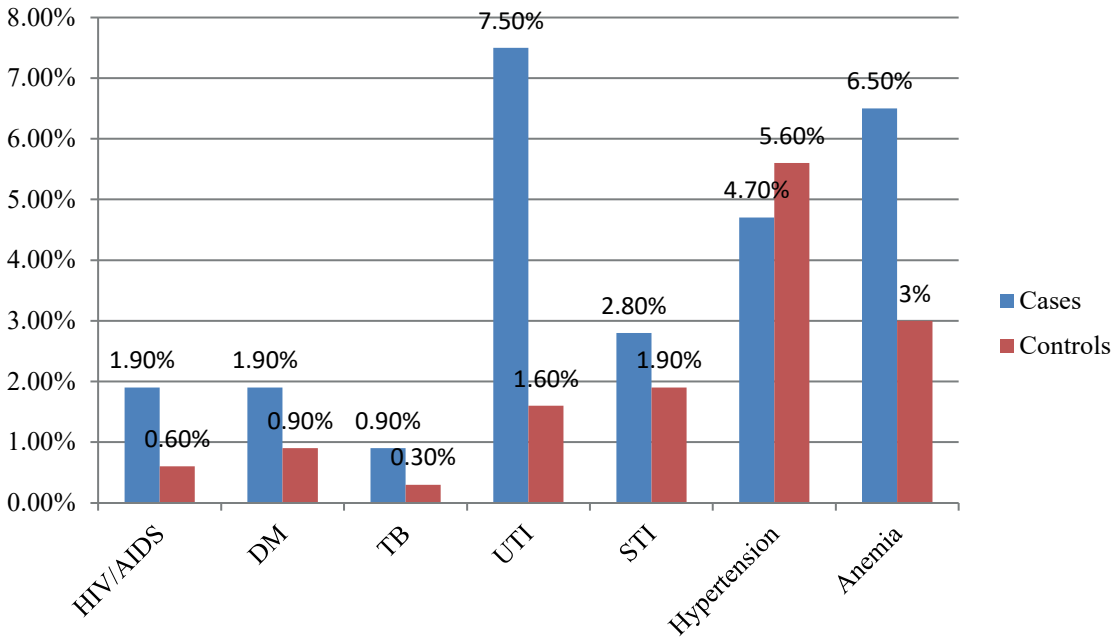


**Figure 2.** Percentage of diseases related characteristics of women attending postnatal care at East Wollega Public Hospitals, West Ethiopia, 2020.

who had no formal education had nearly three times greater odds of developing puerperal sepsis than mothers who had tertiary or College level education. Mothers who delivered at home had five times higher odds of developing puerperal sepsis compared to mothers who gave birth at health institutions (AOR:4.6625,95 1.48,14.63). Mothers who were referred from other health facilities had six-folds higher odds of developing puerperal sepsis compared to mothers served at the study areas (AOR: 6.04, 95% CI: 2.40, 16.80). The odds of developing puerperal sepsis were higher among mothers who gave birth by cesarean section in comparison with mothers who delivered by spontaneous vaginal delivery (AOR: 3.34, 95% CI: 1.09, 17.20). Mothers with prolonged labor for more than 36 hours duration had 3.45 folds higher odds of developing puerperal sepsis than mothers whose labor stayed for 6-12 hours duration (AOR: 3.45,95% CI:1.81,49.27). The study also revealed the odds of developing puerperal sepsis were 3.4 times higher to occur in mothers who underwent more than four vaginal examinations than those who underwent only once (AOR: 3.4, 95% CI: 1.30, 10.96). In addition, mothers who had no birth and emergency preparation plan had about seven-folds higher odds of developing puerperal sepsis than their counterparts (AOR: 6.76,95% CI:2.46,18.56). Furthermore, mothers with only one time ANC follow-up had a greater chance of developing puerperal sepsis than those mothers who attended ANC follow-up more than four (AOR: 9.37,95% CI:2.38,36.88) (Table 4).

## Discussion

This study aimed to identify determinants of puerperal sepsis among postpartum women admitted in a maternity ward at public hospitals in East Wollega Zone, Ethiopia, 2020. The study has shown that place of residence, maternal educational level, place of delivery, referred from other areas, mode of delivery, duration of labor, number of vaginal examinations, birth and emergency preparation plan, number of ANC follow-up were the main determinants for puerperal sepsis.

Living in rural areas was positively associated with puerperal sepsis. The finding is similar to the case-control study conducted in the West Shoa zone, Ethiopia, which showed that women who lived in rural areas were more likely to develop puerperal sepsis than those mothers living in urban areas [6]. This may be because of the fact that mothers from urban areas are in close proximity to health institutions and the availability of various means of transport to reach health institutions which can increase the reception of any kind of antenatal and postnatal care services and thereby decreasing the exposure of puerperal sepsis. Contrary to this, case-control study [18] and a cross-sectional study [19] conducted in Bangladesh showed that there was no significant association between place of residence and puerperal sepsis. The reason why they are different could be due to differences in the study design and the study setting.

This study showed that mothers who had no formal education had a higher incidence of puerperal sepsis than mothers who had tertiary or College level education. This is similar to studies conducted in Gondar [3], West Shoa, Ethiopia [6], Bangladesh [18], Karachi [20], Kenya [3], and Pakistan [21], where low educational status was an independent predictor of puerperal sepsis. This indicates that mothers who joined tertiary or College level had more awareness on ANC, seek health service more, and keep their personal hygiene than those who had no formal education which can decrease the risk of puerperal sepsis.

Home delivery was significantly associated with puerperal sepsis in the current study. Contrarily, a cross-sectional study conducted at Nandi District Hospital, Kenya, showed that home delivery has a negative effect on puerperal sepsis compared to facility delivery [22]. The difference is maybe due to differences in study design and differences in socio-demographic characteristics of the two study populations. The finding is consistent with a cross-sectional study conducted in Mwanza region [23] and a cross-sectional study conducted at Dessie Referral Hospital, Ethiopia, where home delivery was positively associated with puerperal sepsis [24]. This could be because of the fact that home deliveries are un-hygienic practices, attended by nonprofessional care providers and the intervention is usually late that in turn leads to puerperal sepsis.

This study also showed that being referred from other health facilities was also significantly associated with puerperal sepsis. The finding is consistent with the study done in West Shoa, Ethiopia, which showed that those mothers who referred from other health institutions had higher odds of developing puerperal sepsis than those served in the study areas [6] and other studies in Pakistan [21] and Uganda [10] showed that women referred from other health institutions were more likely to develop puerperal sepsis compared to those who had no referral history. The reason could be the fact that the referred mothers were those who came with different obstetric complications, were in transit, gave birth at home, and those from rural areas which easily predisposed them to puerperal sepsis.

The study indicated that the odds of developing puerperal sepsis were higher among mothers who gave birth by cesarean section than those mothers delivered by spontaneous vaginal delivery. This is similar to a cohort study conducted in Pakistan [25], a cross-sectional study conducted at Dessie Referral Hospital, Ethiopia [24], and a case-control study conducted in West Shoa, Ethiopia, [6], a cohort study conducted at the University of Khartoum [26], a cohort study at Kampala international university [27], cross-sectional study conducted in Kenya [28] that showed the probability of developing puerperal sepsis were higher among mothers who delivered by cesarean section than mothers delivered by spontaneous vaginal delivery [4]. This is because of the fact that infection of surgical wounds can facilitate the progressive multiplication of microorganisms which leads to the development of puerperal sepsis. This study also revealed that prolonged labor for more than 36 hours was an independent predictor of puerperal sepsis. The finding is in line with a case-control study conducted in West Shoa Zone, Ethiopia [6], a cohort study from Ayub Teaching Hospital and Pakistan [21], a cross-sectional study at Gondar Referral Hospital, Ethiopia [3], and a cross- sectional study conducted at Dessie Referral Hospital, Ethiopia [24] where the probability of developing puerperal sepsis increases with increasing duration of labor. This is because of the fact that as labor prolonged, the number of vaginal examinations increases which increases the chance of ascending microorganisms that in turn lead to puerperal sepsis.

The incidence of puerperal sepsis was higher among mothers who underwent four or more vaginal examinations compared to those who underwent only one-time vaginal examination. This was similar to case-control study conducted in West Shoa, Ethiopia [6], a cross-section study conducted at Dessie Referral Hospital, Ethiopia [24], that indicated increased vaginal examinations was independent predictor of puerperal sepsis. This is due to the fact that frequent manipulation of the genital tracts will facilitate the ascension of microorganisms from the lower genital tract to the internal vaginal organ and thereby increase the probability to develop puerperal sepsis. However, a cross-sectional study conducted in Kenya showed that there was no significant association between frequent virginal examinations and puerperal sepsis [4]. This is because of the difference in study design and aseptic techniques followed by skilled attendants. In this study, lack of birth and emergency preparation plan was positively associated with the occurrence of puerperal sepsis. This is inconsistent with a cross-sectional study conducted in Kenya [4] and at Gondar referral hospital in Ethiopia which showed that there was no significant association between puerperal sepsis and birth preparation plan [3].

In this study, the number of ANC follow-up was significantly associated with puerperal sepsis. This was in line with a cohort study conducted in Pakistan [25], a cross-sectional study in Kenya [4], and a case-control study carried out at West Shoa, Ethiopia where lack of ANC follow-up was an independent determinant of puerperal sepsis. The possible reason is that those mothers with ANC follow-up more than four times can get more awareness about obstetric complications and decide on birth and emergency preparation plan, which can decrease the occurrence of puerperal sepsis.

### Limitations of the study

Since some variables like time of onset of labor, time of membrane rupture, how placenta removed, and observing health care providers hygienic practice activity needs strict follow-up, thereby the possibility of recall bias. In addition, as the study was conducted only at public hospitals, those mothers who went to private clinics may indicate different results as the quality of health services provided in private clinics and socio-economic status of women who have been served at private clinics may be different.

## Conclusion

This study indicated that place of residence, women's educational level, referral status, mode of delivery, place of delivery, duration of labor, number of vaginal examinations, birth and emergency preparation plan, and number of ANC follow-up were significantly associated with the development of puerperal sepsis. Therefore, facilitating infrastructure for rural dwellers, intensifying women's educational level, appropriate use of partograph to prevent prolonged labor and frequent vaginal examinations, awareness on birth and emergency preparation for women, through communicating mothers on full ANC follow-up is compulsory.

## Data availability

The data supporting this study cannot be publicly available at the present time. It will be made available from the corresponding author on a reasonable request.

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