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Research Article

# Predictors of Post-Partum Sepsis Directly Related to Pnuemonia Among Post-Partum Women at Finote Selam General Hospital, West Gojjam Zone, Amhara, Ethiopia, 2022

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## ABSTRACT

**Introduction:** Puerperal Sepsis (PS) is an inflammatory response to the infection of the female reproductive system caused by bacterial, viral, fungal or parasitic pathogens. It affects women during or within six weeks of childbirth. For these, identification of determinants of puerperal sepsis reduces the health and economic impact through early detection and intervention. Though studies were conducted on puerperal sepsis in Ethiopia, there is a lack of information on its determinants of puerperal sepsis directly related to pneumonia in the study area. Therefore, this study aimed to identify determinants of puerperal sepsis among post-partum women at Finote Selam General Hospital, Amhara, Ethiopia, 2022.

**Materials and methods:** Institutional based unmatched case-control study was conducted from May 10, 2022, to July 15, 2022, on post-partum women of 220 (55 cases and 165 controls with a 1:3 case-control ratio determined by the open epi version 3. Cases and controls were extracted by consecutive sampling. A structured face-to-face interviewer-administered questionnaire and checklist were used. Data were entered and analyzed using epi data version 4.4.2.1 and Statistical Package for Social Sciences (SPSS) version 25, respectively. Variables with a p-value ≤ 0.25 in the bi-variable logistic analysis were entered into a multivariable logistic regression model. Hosmer and Lemeshow's goodness-of-fit test and multi-collinearity were checked. Statistical significance was declared at p-value <0.05 along with, 95% Confidence Interval (CI).

**Results:** The result of multiple logistics regression revealed that the odds of developing PS directly related with post-partum pneumonia were caesarean delivery (Adjusted Odds Ratio (AOR)=2.802, 95% CI: 1.207, 6.502), hypertension (AOR=2.431, 95% CI: 1.257, 4.700), history of anemia (AOR=0.343, 95% CI: 0.145, 0.811 were determinants of post-partum pneumonia.

**Conclusion:** Majority of the determinants were obstetric related.

**Keywords:** Postpartum; Post-partum pneumonia; Determinants; Puerperal Sepsis

## INTRODUCTION

Puerperium is defined as the time following delivery during which pregnancy-induced maternal anatomical and physiological changes return to none pregnant state. Its duration is understandably inexact, but it is considered to be the period of the first six weeks following childbirth or abortion. Although much less complex compared with pregnancy, the puerperium has appreciable changes, some of which may be either bothersome or worrisome for the new mother. Significantly in this period, several problems can develop and some are severe and end up in death [1].

Worldwide 49 million individuals were affected by sepsis and approximately 11 million potentially avoidable deaths occurred due to sepsis. It affects individuals of any sex and any age but, there are significant differences in the burden of the disease. It extremely affects susceptible populations such as postpartum women and neonates. Globally, the death of postpartum women due to PS was 11/1000 women giving birth. Furthermore, the

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determinants of PS influenced neonatal sepsis [2,3].

A comprehensive project in 204 countries in the world showed that there were 20,569,889 incident cases of puerperal sepsis [4]. Moreover, PS is high in low and middle-income countries. A study conducted in Nigeria showed that the incidence of puerperal sepsis was 9.34% [5]. In addition, a study conducted in Tanzania showed that the prevalence of puerperal sepsis was 11.5% [6]. PS in Ethiopia ranges from 5% to 34%. And the lowest range was found in the Amhara region [7].

Findings in African countries identified that PS ranges from the first to fourth leading cause of maternal death [8]. In those countries, PS women end up with septicaemia 42.4%, pelvic peritonitis 17.6%, pelvic abscess 15.3%, endotoxic shock (09.4%), Deep Vein Thrombosis (DVT) 8.2% and renal failure 07.1% [9]. In Ethiopia, puerperal sepsis was the 4$^{th}$ leading cause of maternal mortality [10]. Moreover, in Ethiopia, 65% of maternal death occurred in the postpartum period and PS accounts for almost 82% of death [11].

In terms of economic impact, puerperal sepsis had both productive day loss and hospital costs concerning their length of stay in the hospitals [12].

Puerperal sepsis can be prevented by early diagnosis and treatment of urinary tract infections, diagnosis and treatment of anemia and malnutrition, diagnosis and treatment of diabetes mellitus, assessment of the risk factors for puerperal sepsis, timely diagnosis and treatment of pre-existing sexually transmitted infections, timely diagnosis and management of feato pelvic disproportion, identification and appropriate management of prolonged labor [13-15].

Nowadays, Ethiopia adopted a Sustainable Development Goal (SDG) that will be achieved in 2030. From the goals of SDG, the 3$^{rd}$ goal is good health and wellbeing. From the indicator of this SDG, the 1$^{st}$ one is to decrease maternal mortality to 70 per 100,000 live births. But before 2030 there was a plan to decrease the maternal mortality ratio from 412 to 199/100,000 life birth by 2020. This goal failed [16]. This was due to financial shortage, lack of national security, lack of continuous monitoring and evaluation and accountability [17]. Moreover, puerperal sepsis was one of the leading causes of maternal mortality [18].

To prevent long-term adverse consequences of PS, early diagnosis and early intervention are critical. But belief surrounding critical care interventions in pregnancy, during labor and post-partum is being challenged and future research is necessary to maximize beneficial options available for PS [19].

Studies investigated in Ethiopia and other countries have a controversy on the risk factors of PS. A study conducted in India and Tanzania indicates that moderate and severe anemia and urinary tract infections had a significant effect on PS [20]. A case-control study conducted in Pakistan showed that diabetes mellitus during pregnancy and before pregnancy significantly affects puerperal sepsis but in Ethiopia, diabetes mellitus had no significant effect on PS [21,22]. On the other side, a cohort study in Pumwani maternity hospital indicates that anemia and other comorbidities had no significant association with PS [23]. In Ethiopia, a study on puerperal sepsis showed that anemic women had more chance to develop puerperal sepsis; but, it was not affected by diabetes mellitus and hypertension. Again studies conducted in Ethiopia didn't consider some variables like personal-related determinants, medical problems and behavioral-related factors [24,25]. Further, more studies in the world didn't say anything about puerperal sepsis directly related to pneumonia even if post-partum pneumonia is high. Therefore, this study aimed to identify determinants of puerperal sepsis directly related to pneumonia by using primary data in combination with a chart review at Finote Selam general hospital, 2022.

## MATERIALS AND METHODS

### The study design

An Institutional based unmatched case-control study design was conducted.

### Study setting and period

The study was conducted at Finote Selam general hospital from May 10, 2022, to July 15, 2022. The hospital is found in Finote Selam town which is the administrative town of the west Gojjam zone. The town is located 176 km and 387 km far from Bahir Dar (the capital city of the Amhara region) and Addis Ababa (the capital city of Ethiopia), respectively. This town has a longitude and latitude of 10°42'N 37°16'E/ 10.700°N 37.267°E with an elevation of 1917 meters above sea level.

### Population

**Source population:** All postpartum women who gave birth at Finote Selam general hospital were source populations.

**Study population:** It includes cases and controls.

- ***Cases:*** Postpartum women who were diagnosed with PS directly related with pneumonia by a physician at Finote Selam general hospital during the study period were the study population for cases.
- ***Controls:*** Postpartum women who attended late postpartum and postnatal care and were not diagnosed with PS directly related with pneumonia after being screened for PS during the study period were the study population for controls.

**Sample size determination:** The sample size was determined using open epi version 3 for an unmatched case-control study to four potential determinants (delivered by instrument, delivered by Caesarean Section (CS), vaginal examination more than 4 times and multiparous) which were significant in previous studies with the consideration of the following assumptions: confidence level 95%, power 80 and cases to control the ratio of 1:3 [26]. Delivery by CS provided the largest sample size (208) and an additional 5% of the total sample size was added to compensate non-response rate and the final sample size became 220 (55 cases and 165 controls) (Table 1).

**Table 1:** Sample size calculation for determinants of puerperal sepsis among post-partum women at Finote Selam general hospital, west Gojjam zone, Amhara, Ethiopia, 2022.

| Variables | The proportion of control exposed | The proportion of cases exposed | Number of cases in the sample | Number of controls in the sample | Total sample |
|---|---|---|---|---|---|
| | | | | | Size |
| Delivered by instrument | 11.7 | 33.31 | 48 | 144 | 164 |
| Delivered by CS | 20.7 | 42.1 | 52 | 156 | 208 |
| Vaginal examination ≥ 5 times | 16.4 | 41.86 | 41 | 123 | 143 |
| Multiparous | 64.77 | 87.82 | 43 | 127 | 170 |

**Note:** CS: Caesarean Section

## Sampling procedure

From postpartum women who were admitted to Finote Selam general hospital, women who had been diagnosed with PS (55) directly related with pneumonia were selected by a consecutive sampling technique and three consecutive controls (165) were selected by consecutive sampling technique from postpartum women who needs late postpartum and postnatal care for each case until the required sample size was fulfilled.

## Eligibility criteria

**Inclusion criteria:** It includes cases and controls.

- ***Cases:*** All postpartum women who needed health care service at Finote Selam general hospital with PS during data collection were included.
- ***Controls:*** All postpartum women who needed late postpartum and postnatal care at Finote Selam general hospital and have no diagnosis of PS in current delivery was included.

**Exclusion criteria:** It includes cases and controls.

- ***Cases:*** Postpartum women who needed health care services at Finote Selam general hospital were excluded from the study if they were unable to communicate until the end of the study period.
- ***Controls:*** Postpartum women who needed late postpartum and postnatal care at Finote Selam general hospital and whose cards disappeared were excluded from the control group.

## Variables

**Dependent variable:** The dependent variable is puerperal sepsis directly related with pneumonia.

**Independent variable:** There are five groups of independent variables in the study which are as follows.

- ***Socio-demographic characteristics:*** Age, residence, occupation, marital status, nutritional status and Education.
- ***Obstetric determinants:*** It includes number of vaginal examination, mode of placental delivery, parity, Premature Rupture of Membranes (PROM), mode of delivery, Antenatal Care (ANC), duration of labor.
- ***Medical-related determinants:*** Hypertension, anaemia, urinary tract infection, malaria infection, diabetes mellitus.
- ***Health institution determinants:*** Length of stay in the hospital, referral status, hygienic practice.
- ***Behavioral characteristics of the respondents:*** Number of sexual partner, use of herbs.

## Operational definitions

**Puerperal sepsis:** It refers to post-partum women that have at least one of the infections (mastitis, breast abscess, Urinary Tract Infections (UTI), pneumonia, wound infection and uterine infection) with signs and symptoms of systemic infections (pyrexia more than 38°C, hypothermia less than 36°C, tachycardia more than 90 beats/minute, a respiratory rate of more than 20 breaths/minute and systolic blood pressure less than 90 mmHg) in the post-partum period [27].

**History of puerperal sepsis directly related with pneumonia:** When post-partum women claimed or documented as she was ever diagnosed or treated for PS directly related with pneumonia at least once after the last delivery.

**History of chronic hypertension:** When post-partum women claimed or documented as she was ever diagnosed or treated for hypertension at least once before 20 weeks of pregnancy.

**History of anemia:** When post-partum women claimed or documented as she was ever diagnosed or treated for iron deficiency anemia at least once.

**History of malaria:** When post-partum women claimed or documented as she was ever diagnosed or treated for malaria at least once.

**History of urinary tract infection:** When post-partum women claimed or documented as she was ever diagnosed or treated for UTI at least once before labor.

**Cases:** Postpartum mothers admitted with puerperal sepsis directly related with pneumonia after being diagnosed by a physician were included.

**Controls:** These are those late postpartum or postnatal care women who have no diagnosis of puerperal sepsis at Finote

Selam general hospital or other health institutions and after being screened for PS considered as controls.

**Mid-Upper Arm Circumference (MUAC):** Measurement of less than 21 cm is considered malnutrition [28].

**Late postnatal and postpartum care:** It is care provided for the women and the infant at six weeks ± 3 days in the postpartum period [29].

**Multiple sexual partners:** These are defined as having more than one sexual partner in the last 12 months preceding the pregnancy [30].

Post-partum pneumonia is a woman that develops pneumonia in the post-partum period.

### Data collection procedure

Data was collected from postpartum women attending health care services by using structured interviewer-administered questionnaires and chart review. Initially, it was prepared in English. The English version was translated to the Amharic language and back-translated to English to ensure consistency by two professionals. The questionnaires contain five major groups of variables: Maternal socio-demographic characteristics, obstetric-related determinants, medical-related determinants, behavioral-related determinants and health service-related determinants. The data was collected by two graduate nurses and supervised by one graduate midwife.

### Data quality control issues

The data collectors and supervisor were trained for one day on the objective, relevance of the study and confidentiality of information. The data was collected after a pre-test at Shegaw Motta general hospital. During the pre-testing, the questionnaire was assessed by 5% of respondents (12 respondents) at Shegaw Motta general hospital. After the pre-test clarity, completeness, how much time needed to complete and the sensitivity of the subject matter was assessed and necessary adjustments were done by the principal investigator. Cronbach's alpha coefficient was used to know the internal consistency of the questionnaire and it was 0.803. The data collection process was closely supervised by one graduate midwife. There were regular meetings among the investigator, data collectors and supervisor every Friday to discuss and solve problematic issues faced by the data collection producer.

### Data management and analysis

The collected data were entered into epi data version 4.4.2.1 and exported to a Statistical Package of Social Science (SPSS) version 25 for further analysis. Descriptive analysis was carried out to check the levels of missing values and expected frequency. Bi-variable logistic regression, with 95% (CI), was used to see the association between each independent variable and the outcome variable. Independent variables with a p-value of ≤ 0.25 were included in the multivariable logistic regression analysis to control confounding factors. Hosmer and Lemeshow's goodness-of-fit test was checked to check whether the model was fit or not and it was found to be insignificant (p-value=0.478) which indicates the model was fitted. Multi-collinearity was checked by using the variance inflation factor and it was found that the value of the variance inflation factor of variables was less than 4 which indicates that multi-collinearity is in the acceptable range. Finally, a multivariable logistic regression analysis was done to assess the determinants of puerperal sepsis. The level of statistical significance was declared at p-value <0.05 with, 95% CI. The backward stepwise technique method was used.

## RESULTS

### Socio-demographic characteristics of respondents

Overall 220 study participants (55 cases and 165 controls) were interviewed in the study and the response rate was 100%. Almost one-third of cases and 71(43%) controls were aged between 25 and 29 years old. The mean age of the total participants was 28.56 ± 4.93. Nearly one-third of cases and 131(79.4%) of controls were from urban areas. Of PS women, 23(41.8%) had no formal education, while 94(57%) of controls had a diploma and higher level of education. Around one-fourth of cases and 96(58.2%) of controls were self-employed (Table 2).

### Obstetric characteristics of the respondents

Of the overall participants (55 cases and 165 controls), more than one-third of and 68(41.2%) cases and controls were parity three and above respectively. Almost thirty-six percent of cases and nearly one-tenth of 18(10.9%) of controls were delivered by CS. Nearly one-third and one-tenth of 17(10.3%) of cases and controls were delivered after 24 hours' duration respectively. Nearly half of the cases and 105 105(63.6%) of controls had a history of PROM in the latest pregnancy. All of the cases and controls had ANC (Table 3).

**Table 2:** Socio-demographic characteristics of postpartum women directly related with pneumonia at Finote Selam general hospital, west Gjjam zone, Amhara, Ethiopia, 2022.

| Variables | Cases (n=55) | Controls (n=165) |
|---|---|---|
| | N(%) | N(%) |
| **Age** | | |
| <15-20 | 11(20) | 9(5.5) |
| 20-24 | 9(16.4) | 22(13.3) |
| 25-29 | 18(32.7) | 71(43) |
| 30-34 | 10(18.2) | 48(29.1) |
| 35 and above | 7(12.7) | 15(9.1) |
| **Residence** | | |
| Urban | 19(34.5) | 131(79.4) |

| | | |
|---|---|---|
| Rural | 36(65.5) | 34(20.6) |
| **Educational status of the women** | | |
| College and above | 12(21.8) | 94(57) |
| Secondary school | 5(9.1) | 34(20.6) |
| Primary school | 15(27.3) | 21(12.7) |
| No formal | 23(41.8) | 16(9.7) |
| **Occupation of the women** | | |
| Employed | 32(41.8) | 59(35.8) |
| Self-employed | 13(23.6) | 96(58.2) |
| Housewife | 10(18.2) | 10(6.1) |
| **Marital status** | | |
| Married | 48(87.3) | 154(93.3) |
| Divorced | 7(12.7) | 11(6.7) |
| **Mid-upper arm circumference** | | |
| ≥ 21cm | 38(69.1) | 150(90.9) |
| <21cm | 17(30.9) | 15(9.1) |

**Table 3:** Obstetric characteristics of postpartum women with PS directly related with pneumonia at Finote Selam general hospital, west Gjam zone, Amhara, Ethiopia, 2022.

| Variables | Cases(n=55) | Controls(n=165) |
|---|---|---|
| | N(%) | N(%) |
| **Parity** | | |
| One | 25(45.5) | 49 (29.7) |
| Two | 11(20) | 48(29.1) |
| Three and above | 19(34.5) | 68(41.2) |
| **Mode of delivery** | | |
| SVD | 27(49.1) | 141(85.5) |
| Instrument | 8(14.5) | 6(3.6) |
| CS | 20(36.5) | 18(10.9) |
| **Duration of labor** | | |
| <12 hours | 25(45.5) | 102(61.8) |
| 12-24 hours | 11(20) | 46(27.9) |
| ≥ 25 hours | 19(34.5) | 17(10.3) |
| **How labor started** | | |
| Spontaneous | 45(81.8) | 155(93.9) |
| Induced | 10(18.2) | 10(6.1) |
| **Premature rupture of membranes** | | |
| Yes | 28(49.1) | 60(36.4) |
| No | 27(50.9) | 105(63.6) |
| **Manually delivered placenta** | | |
| No | 27(49.1) | 143(82.7) |
| Yes | 28(50.9) | 22(13.3) |
| **No. of PV** | | |
| 01-Feb | 34(61.8) | 144(87.3) |
| ≥ 3 | 21(38.2) | 21(12.7) |

**Note:** No.: Number; PV: Per Vagina; SVD: Spontaneous Vaginal Delivery; CS: Cesarean Section

### Medical characteristics of the respondents

Of the total cases of 55 and controls of 165, 24(43.6%) cases had a history of hypertension, while more than one-tenth of controls had a history of hypertension. More than one-fourth of cases had a history of UTI but, only 10(6.1%) of controls had a history of UTI (Table 4).

### Behavioral characteristics of the respondents

Of the overall cases of 55 and controls of 165, almost one-fourth of cases and nearly one-fifth of controls had a history of multiple sexual partners. All cases and controls had no history of herbal usage (Table 5).

### Intuitional characteristics of respondents

Nearly forty-seven 26 of cases were referred from other health institutions, but only 29(17.6%) of controls were referred from other health institutions (Table 6).

### Determinants of puerperal sepsis directly related to pnuemonia

Bi-variable logistic regression was done between each independent variable and PS to identify candidate variables for multivariable logistic regression. Residence, level of education, mode of delivery, duration of delivery, history of prom, manual delivery of the placenta, no of PV/4 hour, history of hypertension, history of UTI, history of anemia, history of malaria, nutritional status and referral status were significant variables in bi-variable logistic regression. Those variables with a p-value of ≤ 0.25 in the bi-variable logistics analysis were entered into the multivariable logistic analysis. The backward stepwise method was used to identify the determinants of PS.

The result of multiple logistics regression revealed that the odds of developing PS were 2.802 (AOR=2.802, 95% CI: 1.207, 6.502) times higher among C/D as compared to vaginal delivery. Postpartum women having a history of hypertension had 2.431 (AOR=2.431, 95% CI: 1.257, 4.700) times higher odds of developing PS as compared to their counterparts. Mothers having a history of anemia had 0.343 (AOR=0.343, 95% CI: 0.145, 0.811) times higher odds of developing PS as compared with their counterparts (Table 7).

**Table 4:** Medical characteristics of postpartum women with and without PS directly related with pneumonia at Finote Selam general hospital, west Gojjam zone, Amhara, Ethiopia, 2022.

| Variables | Cases(n=55) | Controls(n=165) |
|---|---|---|
| | N(%) | N(%) |
| **History of hypertension** | | |
| No | 31(56.4) | 145(87.9) |
| Yes | 24(43.6) | 20(12.1) |
| **History of UTI** | | |
| No | 40(72.7) | 155(93.9) |
| Yes | 15(27.3) | 10(6.1) |
| **History of anemia** | | |
| No | 32(58.2) | 153(92.7) |
| Yes | 23(41.8) | 12(7.3) |
| **History of malaria** | | |
| No | 26(47.3) | 147(89.1) |
| Yes | 29(52.7) | 18(10.9) |

**Note:** UTI: Urinary Tract Infections

**Table 5:** Behavioral characteristics of postpartum women with and without PS directly related with pneumonia at Finote Selam general hospital, west Gojjam zone, Amhara, Ethiopia, 2022.

| Variables | Cases(n=55) | Controls(n=165) |
|---|---|---|
| | N(%) | N(%) |
| **History of multiple sexual partners** | | |
| No | 41(74.5) | 128(77.6) |
| Yes | 14(25.5) | 37(22.4) |
| **History of herbs** | | |
| No | 55(100) | 165(100) |

**Table 6:** Institutional characteristics of postpartum women with and without PS directly related with pneumonia at Finote Selam general hospital, west Gjjam zone, Amhara, Ethiopia, 2022.

| Variable | Cases(n=55) | Controls(n=165) |
|---|---|---|
| | N(%) | N(%) |
| **Hygiene practice observed from the assistant** | | |
| Hand washing | 4(7.3) | 7(4.2) |
| Wear glove | 39(70.9) | 150(90.9) |
| Not seen | 12(21.8) | 8(4.8) |
| **Duration of stay in the hospital** | | |
| ≤ one day | 20(36.4) | 138(83.6) |
| 2-3 days | 13(23.6) | 19(11.5) |
| ≥ 3 days | 22(40) | 8(4.8) |
| **Referral status** | | |
| No | 29(52.7) | 136(82.4) |
| Yes | 26(47.3) | 29(17.6) |

**Table 7:** Determinants of PS directly related to pneumonia among post-partum women at Finote Selam general hospital, west Gjjam zone, Amhara, Ethiopia, 2022.

| Variables | Case N(%) | Control N(%) | COR(95% CI) | AOR(95% CI) |
|---|---|---|---|---|
| **Residence** | | | | |
| Rural | 36(65.5) | 34(20.6) | 5.272(0.433, 1.642) | 2.251(0.998, 5.078) |
| Urban | 19(34.5) | 131(79.4) | 1 | 1 |
| **CS delivery** | | | | |
| Yes | 20(36.5) | 18(10.9) | 5.820(0.147, 0.645) | 2.802(1.207, 6.502)* |
| No | 27(49.1) | 141(85.5) | 1 | 1 |
| **Duration of delivery** | | | | |
| >=25 hour | 19(34.5) | 17(10.3) | 4.56(0.421, 2.532) | 3.747(1.272, 9.038) |
| 12-24 hour | 11(20) | 46(27.9) | 0.976(0.390, 2.690) | 0.643(0.234, 1.765) |
| <12 hour | 25(45.5) | 102(61.8) | 1 | 1 |
| **Hypertension** | | | | |
| Yes | 24(43.6) | 20(12.1) | 4.677(0.208, 0.722) | 2.431(1.257, 4.700)** |
| No | 31(56.4) | 145(87.9) | 1 | 1 |
| **Malaria** | | | | |
| Yes | 29(52.7) | 18(10.9) | 9.110(0.248, 0.990) | 1.121(0.263, 4.780) |
| No | 26(47.3) | 147(89.1) | 1 | 1 |
| **Anemia** | | | | |
| Yes | 40(72.7) | 145(87.9) | 2.719(1.177, 5.787) | 0.343(0.145, 0.811) |
| No | 15(17.3) | 20(12.1) | 1 | 1 |
| **Mid-Upper Arm Circumference (MUAC)** | | | | |
| <21 cm | 46(83.6) | 142(86.1) | 1.208(0.552, 2.796) | 2.095(0.537, 8.164) |
| >=21 cm | 9(16.4) | 23(13.9) | 1 | 1 |
| **Referral status** | | | | |
| Yes | 41(74.5) | 124(75.2) | 1.033(0.512, 2.084) | 3.902(1.620, 7.399) |
| No | 14(25.5) | 41(24.8) | 1 | 1 |

**Note:** AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; CS: Cesarean Section.

## DISCUSSION

This study identified the determinants of PS directly related with post-partum pnuemonia among postpartum women attending health care services at Finote Selam general hospital west Gojjam zone, Amhara, Ethiopia. The finding of this study revealed that CS delivery, having a history of hypertension and having a history of anemia was the determinants of puerperal sepsis.

The result showed that the odds of developing PS were higher among women delivered by CS as compared with mothers delivered through the vagina. The finding of this study is supported by a case-control study conducted in the West Shoa zone Oromia regional state, which conclude that postpartum women delivered by CS were four times at higher odds of developing PS as compared with women delivered through the vagina. And also this result agreed with the findings of the cross-sectional studies conducted in Sudan, Tanzania and Nigeria, they concluded that PS was statistically significantly associated with delivery by CS compared with vaginal delivery [31]. This might be due to the CS opening the skin which disrupts the natural defense mechanism of the body. Due to this microorganism have direct contact with the internal structure of the body leading to PS [32]. In addition to this operational producer might cause immunosuppression that decreases the defensive mechanism of the body both in vivo and in vitro in the post-operative period weakening the body's defense capacity [33].

Postpartum women having a history of hypertension were three times higher odds of developing PS as compared with their counterparts. This might be due to hypertension may result in cerebrovascular complications like stroke [34]. Due to the treatment of severe hypertension, the patient develops hypotension [35]. Both of these complications may result in a coma. During a coma, the patient may aspirate secretions and things may go down in the incorrect tube results aspiration pneumonia [36]. Finally, this aspiration pneumonia may show systemic infection that is PS. The finding of this study was contradicted by a case-control study conducted at East Wollega, which conclude that hypertension is not significantly affects PS. The reason might be the difference in the study setting.

Postpartum women having a history of anemia were five times higher odds of developing PS as compared with women having no history of anemia. This finding is in agreement with cross-sectional studies conducted in Ethiopia, Sudan and Tanzania and a prospective cohort study in Bangladesh, which concludes that there is an astatically significant association between PS and anemia [37]. The reason might be untreated anemia can make human bodies more susceptible to illness infection, since lack of iron affects the body's natural defense system (immune system) [38].

## CONCLUSION

This study found that hypertension, anemia and CS delivery were important determinants of PS directly related to post-partum pneumonia. In conclusion, this study at Finote Selam General Hospital, Amhara, Ethiopia, revealed significant determinants of post-partum pneumonia directly linked with puerperal sepsis. Caesarean delivery emerged as a notable risk factor, with a 2.802 odds ratio, emphasizing the impact of the mode of delivery on maternal health. Additionally, hypertension and a history of anemia were identified as significant determinants, further highlighting the multifaceted nature of factors contributing to post-partum pneumonia. The findings underscore the importance of obstetric-related elements in the development of puerperal sepsis and emphasize the need for targeted interventions in this regard. This study contributes valuable insights into the specific determinants of post-partum pneumonia in the Ethiopian context, offering a foundation for future research and public health strategies aimed at reducing the burden of puerperal sepsis among post-partum women in the region.

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## ETHICAL APPROVAL

Ethical approval was obtained from Debre Markos University. Written informed consent was obtained from respondents after giving them information about the study. Finally, the confidentiality, anonymity of all the responses was kept and used only for research purposes.

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