

# Post-cesarean section surgical site infection and associated factors in East Gojjam zone primary hospitals, Amhara region, North West Ethiopia, 2020

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# Abstract

## Background

Women after cesarean section have a five to twenty-times greater chance of getting an infection compared with women who give birth vaginally. Even though many efforts tried by the government and non-government organization in Ethiopia, a non-significant decline achieved and post cesarean section surgical site infection is still a problem. Scientific evidence on this is a step ahead for preventing and reducing post cesarean section surgical site infection. Therefore this study aimed to assess magnitude and risk factors of post cesarean section surgical site infection at primary hospitals of East Gojjam Zone, Northwest Ethiopia.

## Methods

Institution based cross sectional study with retrospective chart review was conducted from September 10–30 /2020 at primary hospitals of east Gojjam zone.

The data was entered in Epi data version 3.1 and exported to Statistical Package for Social Science Software version 26. Presence and degree of association of factors with outcome variable were computed through logistic regression analysis. Factors with P value  $\leq 0.2$  in bi variable logistic regression analysis were included in the multivariable logistic regression analysis and those variables with P-value of  $< 0.05$  in multivariable analysis were considered statistically significant.

## Result

From 622 medical records of women who underwent cesarean section, 77 (12.4%) of them were developed surgical site infection. Rural residence [(AOR = 2.30, 95%CI :( 1.295, 4.098)], duration of labor greater than 24hrs [(AOR = 3.48, 95%CI :( 1.495, 8.086)], rupture of

## Background

Cesarean section is an operative procedure by which a fetus, placenta, and membranes are delivered through an abdominal and uterine incision which is performed whenever abnormal conditions complicate labor and vaginal delivery that threatening the life or health of the mother or the baby[1]. In 1985 WHO declared that, the optimal threshold for cesarean section rate should be 10 -15%[2]. But recent studies reported that the rate of cesarean section is rising rapidly that leads to actual, potential, and life-long maternal and neonatal complications.

One of the short term morbidities which take place after CS is Surgical Site Infection (SSI). Globally, surgical site infections are potential complications associated with any type of surgical procedure, and is defined as infection which occurs within 30 days of a post-surgical procedure involving skin,

subcutaneous tissue, soft tissue or any other part of the body[3]. Mothers undergoing cesarean delivery have a 5 to 20-times greater chance of getting an infection compared with mothers who give birth vaginally[4]. Even though SSIs are among the most preventable hospital acquired infections (HAI), it is a cause of morbidity and mortality among women undergoing cesarean section with reported rates of 3–15% globally with great burden to health-care systems, a person and a community at large, increasing the length of hospitalization, readmission and costs of post-discharge care[5, 6]. High magnitude of surgical site infection following obstetric surgeries were reported in several African countries[7]. The magnitude of post CS infection in the region ranges from 4.9% in Ruanda[8] to 12.5% in Nigeria[9]. In Ethiopia, the highest proportion of post CS SSI was reported in Addis Ababa and Mizan Tapi which accounts 15% and 12.9% respectively[10, 11]. In Ethiopia also SSIs were indicated as the commonest cause of hospital acquired infection in Obstetrics and Gynecology than in general surgical wards[12]

Surgical site infection is known to cause both direct and indirect influences in individual, familial and health care system level[13]. For instance the direct burdens of SSI includes and is not restricted to postponed hospital stay, raised risk for readmission, prolonged antibiotic use, long term disability, and increased predisposition for depression and additional service charge including maternal death[14]. SSI also indirectly influences client's functional and mental capacity and health-care service satisfaction that results unproductivity. Patients who develop SSIs are more likely to spend their 60% of time in an intensive care unit, readmitted to hospital and more likely to die compared with patients without surgical site infections[2].

According to previous studies factors that were associated with SSI after CS includes:- Being older age[15, 16], rural residency[17, 18], prolonged labor (24 or more hours)[18-20], premature rupture of membrane[18, 19, 21-23], gestational age<37weeks[22, 24], being multi Paraous[25-27], multiple vaginal examination[11, 23], longer duration of operation[28-30], longer post-operative hospital stay[10, 31], chronic anemia[32] and preexisting co-morbidities like; diabetes mellitus, Hypertension and HIV AIDS[22, 23, 27, 29].

Ethiopian Federal Minister of Health highlighted several important measures to reduce SSI, called bundle of care. It includes appropriate use of antibiotics, appropriate pubic hair clip, maintain normal glucose level in women with diabetics and preventing hypothermia[13]. Alternative measures, such as antisepsis, avoid unnecessary vaginal examination during labor, prepare skin with antiseptic agent immediately prior to surgery, administer prophylaxis antibiotic prior to incision and avoid manual removal of placenta, preoperative preparation, a reduction in the duration of surgery and reduction in blood loss[33]. Even though many efforts were tried by the government and non-government organization in Ethiopia, a non-significant decline achieved and post cesarean section SSI is still a problem.

In Ethiopia admissions following CS due to SSI have been routine activities of health care institutions but there is limited scientific evidence on both the magnitude of the problem and factors associated with it making prevention mechanisms less effective. Even if there are some single centered studies in Ethiopia, the magnitude of SSI after CS greatly varies from hospital to hospital even from ward to ward which

makes difficulty to generalize. In addition to this, studies conducted in our country were focused on single centered specialized or referral hospital [19] with no study conducted at primary hospital level in Ethiopia in general and East Gojjam zone in specific. This study also used better sample size by adding some variables that were not incorporated before, like number of dose of antibiotics, post-operative hematocrit count and previous history of abortion. In general surgical site infection can serve as a measure of quality of hospital service[13] and this study aimed at determining the magnitude and risk factors that contribute for SSI following cesarean delivery at primary Hospitals in east Gojjam zone which is a step ahead for preventing and reducing the problem. This study, together with other studies performed in the country, will inform policy makers about the magnitude of SSI among mothers who deliver by CS and enable them to prioritize and put national policies and procedures in to action to combat the problem by considering factors associated with it.

## Methods

### Study design, setting and sampling

An institutional based cross sectional study based on one year retrospective chart review was conducted at primary hospitals of east Gojjam zone, Northwest Ethiopia from September 10-30/2020 among mothers who underwent cesarean section from June 01, 2019 up to May 30, 2020. East Gojjam zone is one of the zones in Amhara regional state with the capital city of Debre Markos. The zone is bordered on the south by the Oromia region, on the West by West Gojjam, on the North by South Gondar, and on the East by South Wollo. East Gojjam Zone has 10 governmental Hospitals with one referral and nine primary hospitals with a catchment population of 3.8 million, based on Census conducted by central statically agency of Ethiopia (CSA) in 2007 [34]. The minimum required sample size for the first objective was calculated by using single population proportion formula as  $n = (z \alpha/2) * p (1-p) / d^2$ , by assuming prevalence (p) =50% since there was no previous similar study at primary hospital level, 5% margin of error at 95% confidence interval and adding 10% for possible incomplete cards, finally multiplying by 1.5 for design effect it becomes 633.

The required sample size for second objective was calculated by considering various factors significantly associated with the outcome variable in previous studies assuming confidence interval level of 95%, Margin of error 5%, power 80%, and ratio of exposed to non-exposed as 1:1 using Epi-info software Stat Cal program and adding 10% for possible incomplete charts multiplied by 1.5 for design effect and taking the maximum value final sample size was taken as 633. Multistage systematic random sample technique was used to select medical record of mothers who undergo CS. East Gojjam Zone has 9 primary hospitals, from those 3 hospitals namely Shegaw Mota primary hospital, Dejen primary hospital and Bichena primary hospital were selected by lottery method. Number of medical records of women to be reviewed was proportionally allocated for each selected hospital, finally systematic random sampling technique using medical registration number as a sampling frame with calculated K value of two (k=2) by selecting the first chart using lottery method was used to recruit medical records of mothers for each selected hospital.

# Operational definitions

Surgical site infection definition in this study is based on the classification and definition of the term by Centre for Disease Control and Prevention 1992[35].

**Post cesarean section surgical site infection**- is defined as the infection occurred within the first 30 post-operative days and with at least one of the following sign and/ symptoms.

1. Purulent drainage from surgical site.
2. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat
3. Surgical site abscess
4. Surgical site infection diagnosed by the surgeon or attending physician.

## Data collection tool and procedure

The data was extracted from the selected medical records of mothers undergoing CS using pretested structured checklist developed after the review of similar literatures. The questionnaire has four parts: Socio-demographic variables, obstetric related factors, operation and anesthesia related factors and co-morbidity variables. Data collection was made by 6 midwives and 3 supervisors after 2 day training by the principal investigator. Two data collectors assigned for each hospital were traced and collected data from selected medical charts of women who undergo cesarean section from June, 2019 to May 30, 2020 using structured questionnaire and 1 supervisor for each hospital with the principal investigator supervise the whole data collection process. Surgical site infection was considered based on Centre for Disease Control and Prevention (CDC) criteria.

## Data quality control

To ensure the quality of data, data collectors and supervisors were carefully trained about the objective of the study, the meaning of each alternative answers and blank spaces and when to skip as necessary. 5% pretest was done one week before the actual data collection period to ensure the validity of the questionnaire and modification was made accordingly. The collected data were reviewed and checked for completeness and consistency by the principal investigator daily. Proper coding and categorization of data was made before analysis.

## Data processing and analysis

The collected data was checked for completeness, cleaned, coded and entered into Epi-data version 3.1 and was exported to statistical package for social science software (SPSS) version 26, for analysis. Descriptive statistics was computed and presented using text, frequency tables, graphs, percentage, mean and standard deviation followed by bivariable and multivariable logistic regression analysis to

determine statistical association between independent and outcome variable. Factors that had  $\leq 0.2$  significance level in the bivariable logistic regression analysis was fitted to multivariable logistic regression analysis. The strength of association of a particular variable was expressed as adjusted odds ratio (AOR) with a 95% confidence interval. A two-tailed t-test P value of  $<0.05$  was declared as a statistically significant. Moreover, variance inflation factor (VIF) and tolerance to check for multicollinearity and Hosmer and Lemeshow goodness of fit test to check for model fitness was used.

## Results

### Socio-demographic characteristics

From a total of 633 selected medical records of mothers undergoing cesarean section, 622 were eligible and reviewed in this study. The mean age of the mothers was 27.67 years with standard deviation (SD) of 6 in a range of 16 - 45 years. Majority (64.3%) of them was less than 30 years old and more than half (58.2%) of the study participants were from rural setting (**Table 1**).

### Obstetric related factors

Regarding parity, nearly half (49.2%) were multi Para and almost all the study participants (97.4%) had antenatal care follow up. Women with prolonged premature rupture of membrane also account for only 15.6% of the participants and nearly two third (63.3%) were less than 24hr labor duration before operation. 1-4 times vaginal examination was performed for more than three fourth of women (81.7%) (**Table 2**)

### Co-morbidity related factors

Among a total of 622 study participants almost all (99%) of the study participants were non-reactive for HIV and 4.3% of them had gestational hypertension (**Figure 1**).

### Operation and anesthesia related factors

Pre-operative antibiotics prophylaxis was provided for great majority (95.8 %) of the participants and post-operative antibiotics were given for all study participants as well as all women take multiple dose (minimum 3 dose) of antibiotics after CS was done. Majority of participants (95.7%) had preoperative HCT of greater than 30% and above three fourth of (80.1%) were less than 8 days of post-operative hospital staying (**Table 3**). The highest indication for cesarean section was non-reassurance fetal heart rate (NRFHR) (27.33%); cephalo-pelvic disproportion (CPD) (21.7%) followed by Malpresentation which accounted 15.43% and failed instrumental delivery was the lowest which accounted only 2.25%.

### Magnitude of post cesarean section surgical site infection

Amongst 622 mothers included in the study, 77(12.4%) of them developed post cesarean section surgical infection [95% CI: (9.8% - 14.9 %)] (**figure 2**).

### **Factors associated with post cesarean section surgical site infection**

During bivariable logistic regression analysis, those variables which had P-value  $\leq 0.2$  were considered in multivariable logistic regression. Out of thirty seven independent variables, ten variables, namely age, residence, parity, duration of rupture of membrane, duration of labor, length of hospital stay, hypertension, duration of operation, ante partum hemorrhage and preoperative HCT had shown an association in bivariable analysis with p-value  $\leq 0.2$ , and those variables were fitted into multivariable logistic regression analysis and in multivariable analysis rural setting, rupture of membrane greater than 12hrs, duration of labor greater than 24hrs, hypertension and preoperative HCT  $\leq 30\%$  were significantly associated with post cesarean section surgical site infection at p – value  $< 0.05$  with 95% confidence interval.

Women who were from rural area were 2.3 times more likely to develop post CS infection than those from an urban setting [AOR=2.30, 95%CI : ( 1.295, 4.098, P=0.005)]. The odds of developing post CS infection among women who had a history of rupture of membrane greater than 12hrs before surgery were 4.6 times higher than those who had intact membrane[(AOR=4.61, 95%CI:(2.336,9.094, P=0.000)]. Women who had duration of labor greater than 24 hours were 3.5 times [(AOR =3.48, 95%CI : ( 1.495, 8.086, P=0.004)] more likely to develop post CS infection than those who are not in labor. Similarly, hypertensive women were 3.1 times [(AOR =3.14, 95%CI: (1.294, 7.593, P=0.011)] more likely to have post CS infection than non-hypertensive women. The odds of developing post CS infection among women who had preoperative HCT level 30% and below were 3.2 times [(AOR =3.22, 95%CI :( 1.249, 7.8.309, P=0.016)] as compared to the counterpart (See additional file 1).

## **Discussion**

The aim of this study was to determine the magnitude and risk factors of post cesarean section surgical site infection in East Gojjam zone primary hospitals. The study found that 12.4% [95% CI: (9.8% - 14.9 %)] of mothers who had CS developed surgical site infection. The figure might have been underestimated as the study was exclusively based on medical records review and it did not involve post-discharge follow-up.

The finding of this study was in line with global prevalence rate which ranges from 3-15%[6], a study in Nigeria (11%) and Tanzania (10.9%) [18, 29]. The reason might be due to similar quality in surgical procedures like routine use of prophylactic antibiotics, study design and comparable sample size. This finding was also in line with other cross sectional studies conducted in Ethiopia at Mizan tape (12.9%), Jimma (11.4%) and Hawassa Ethiopia (11%)[10, 17, 20] This might be due to similar means of data collection (retrospective chart review), post cesarean section surgical site infection definition and similar health care delivery system.

The finding was higher than other studies done in Pakistan (5.8%), Rwanda (4.9%), India (4.1%), Nepal (2.66%) [8, 31, 36, 37] and a study done in Israel-3.7%[15]. The possible reason for this discrepancy might be as a result of poor dietary habit and poor personal hygiene due to low socioeconomic status in our country which predispose mothers to nosocomial infection as a postoperative complication and might be also due to difference in quality of care provision. The finding of this study was still more higher than a study done in Libya which ranges from 2.5-3.1% [16] which might be due to difference in surgical site infection definition that used the presence of certain bacteria as a criteria to diagnose SSI which is more specific unlike the current study. Another possible justification for the discrepancy in magnitude of post cesarean section surgical site infection as compared to some studies done in Ethiopia at Addis Ababa (8.4%) , Debre Tabor (8%) and Bahir Dar (7.8%) [23, 38, 39] might be due to difference in population and study area. Those studies were conducted at referral and specialized hospitals located in more developed urban areas as compared to a current primary hospital level study serving much more rural residents with poor awareness, personal hygiene, low socioeconomic status and poor quality service due to lack of specialized surgeons leading to increased magnitude of surgical site infections in this area [19].

On the other hand, the magnitude of post cesarean section surgical site infection in this study was less than a study done in Karachi tertiary care hospitals (24.3%)[40], Tanzania (48.2%)[41] and a prospective study conducted in Brazil (23.3%)[42]. This might be due to high prevalence of obesity and diabetes mellitus among Karachi women and lack of use of prophylactic antibiotics in this hospital which increases risk of infection after surgery[40] and due to difference in study setting and design. Studies in Tanzania and Brazil were done at tertiary hospital level with increased referral cases having higher risk of infection as a postoperative complication and those studies were used prospective cohort study design with post discharge follow up in contrast to the current cross-sectional study with secondary chart review and no post-operative discharge follow-up that women may develop post cesarean section surgical site infection after discharge and may seek treatment to the nearby health facilities other than the study area that might underestimate the current magnitude.

In this study mothers from rural setting were 2.3 times more likely to have post CS SSI than those women from urban areas which was similar to a study findings done in Saudi Arabia, Jimma; Ethiopia and Tigray; Ethiopia [17, 27, 43].The possible reason might be due to lack of awareness, poor dietary habit, poor personal hygiene, and low socioeconomic in rural areas which increases vulnerability to post cesarean section surgical site infection[19].

Women who had duration of labor greater than 24hrs prior to CS were 3.5 times more likely to have surgical site infection than those who were not in labor which was similar to findings done in Nigeria and Hawasssa; Ethiopia[18, 20]. The possible explanation could be, as duration of labor increase, frequency of vaginal examinations also increases which leads to ascending infection that might induce post-operative infection [11, 20, 23]. This implies that early detection of labor dystocia that might prolong labor must be detected early by midwives and surgeons necessary to reduce the time of exposure to infections prior to cesarean section.

Women who had premature rupture of membrane greater than 12hrs were 4.6 times more likely to develop post C/S infection than those who were not. This finding was consistent with the study conducted in Nigeria and Addis Ababa; Ethiopia[18, 23]. Normally during pregnancy, cervical mucus plug, fetal membranes and amniotic fluid all serve as barriers to infection. However when the membrane is ruptured, this protective effect is gradually reduced over time as amniotic fluid becomes no longer sterile. It is thought that the non-sterile amniotic fluid may act as a transport medium by which bacteria come into contact with the uterine and skin incisions leading to chorioamnionitis and may expose the mother for surgical site infection[44]. This implies that health education and guidance during the prenatal period should advocate preventing pregnant women suffering from infections, such as Vaginitis, in order to decrease morbidity from premature rupture of membranes.

Women with pregnancy induced hypertension were about 3 times more likely to develop SSI than those mothers without the problem. This finding was consistent with the findings of previous studies done in Israel and Tanzania[22, 29]. The possible explanation might be hypo perfusion of the wound caused by peripheral vasoconstriction effect of hypertension. In addition those mothers with such problems might have edematous wound edges responsible for further entry of organisms and establishment of infection. Vascular disruption and high oxygen consumption by metabolically active cells may lead to oxygen depletion and wound becoming quite hypoxic[39]. This implies that healthcare workers should monitor and manage hypertensive women before CS performed.

In this study, preoperative HCT  $\leq 30\%$  was significantly associated with post CS SSIs. Showing women with having HCT  $\leq 30\%$  were 3.2 times more likely to develop SSIs as compared to HCT  $> 30\%$ . This finding was in line with previous studies conducted in eight hospitals in Guangdong Province, China and Mizan tape; Ethiopia[10, 45]. Low HCT level reduces the oxygen tension in the wound site and increases the risk of SSI by compromising the activity of macrophages and delaying wound healing progress[46]. This implies that medical personnel should educate mothers during antenatal care and within the community about foods that are rich in iron that mothers must take during pregnancy and should also provide ferrous tablets to pregnant mothers during antenatal visits.

## Conclusions

This study concludes that magnitude of post-caesarean surgical site infection at primary hospitals of east Gojjam zone was found to be higher which was 12.40%. A list of factors including prolonged labor, prolonged rupture of membrane, rural setting, preoperative HCT count  $\leq 30\%$  and gestational hypertension were significantly associated with post CS SSI. Health care providers and zonal health policy makers should give emphasis on prevention of surgical site infection to reduce health care burden and associated maternal mortality related to it.

### Limitation of the study

Since it was a cross-sectional study cause and effect relationship may not be established. In addition to that the study was exclusively based on medical records review that lacks some variables and it did not

involve post-discharge follow-up so that magnitude of the problem may be underestimated.

## Abbreviations

**ACOG** : American College of Obstetrician and Gynecologists; **AOR** : Adjusted odd ratio; **ANC** : Antenatal care; **CDC** : Center for disease prevention and control; **CS** : Cesarean section; **GA** : Gestational age; **HAI** : Hospital acquired infection; **HCT** : Hematocrite; **HIV** : Human immune deficiency virus; **HTN** : Hypertension; **NGO** : Non- governmental organization; **PROM** : Premature ruptures of membrane; **SPSS** : Statistical Package for Social Science; **SSA** : Sub Saharan Africa; **SSIs** : Surgical site infections ; **WHO** : World Health organization

## Declarations

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### Author's contributions

**HA and HB:** draft proposal, lead data collection and analysis process wrote final research finding and prepare manuscript, **GM and LB:** Revised and edit proposal & thesis, support data collection and analysis, revised manuscript, **DT and TA:** Reviewed different literatures, revised proposal and manuscript and participated in data entry. All authors revised, consent and approved the final version of this research and manuscript.

### Consent for publication

Not applicable

### Competing interests

Authors declared no any conflicts of interest with respect to the research, authorship or publication of this article.

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### Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request

## Ethical considerations

Ethical approval was obtained from Wolkite University Ethical Review Committee. Permission was also obtained from East Gojjam zone health bureau and respective head of the maternity wards and record office head of the selected hospitals. All information was recorded anonymously and confidentiality was assured throughout the study period and after a while. After informed, written, voluntary and signed consent was obtained from medical directors and those responsible bodies, confidentiality of patient information was also ensured by data coding and omitting personal identifiers.

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## Tables

**Table 1:** Socio-demographic characteristics of women those who underwent cesarean section at primary hospitals of East Gojjam Zone, Northwest of Ethiopia, 2020.

Variables	Category	frequency	Percent
Age	<30	400	64.3
	≥30	222	35.7
Religion	Orthodox	578	92.9
	Muslim	44	7.1
Residence	Urban	260	41.8
	Rural	362	58.2
Marital status	Married	609	97.9
	Others <sup>a</sup>	13	2.1
Educational status	Educated	305	49
	Uneducated	317	51

Key: others <sup>a</sup> (single, divorced, widowed)

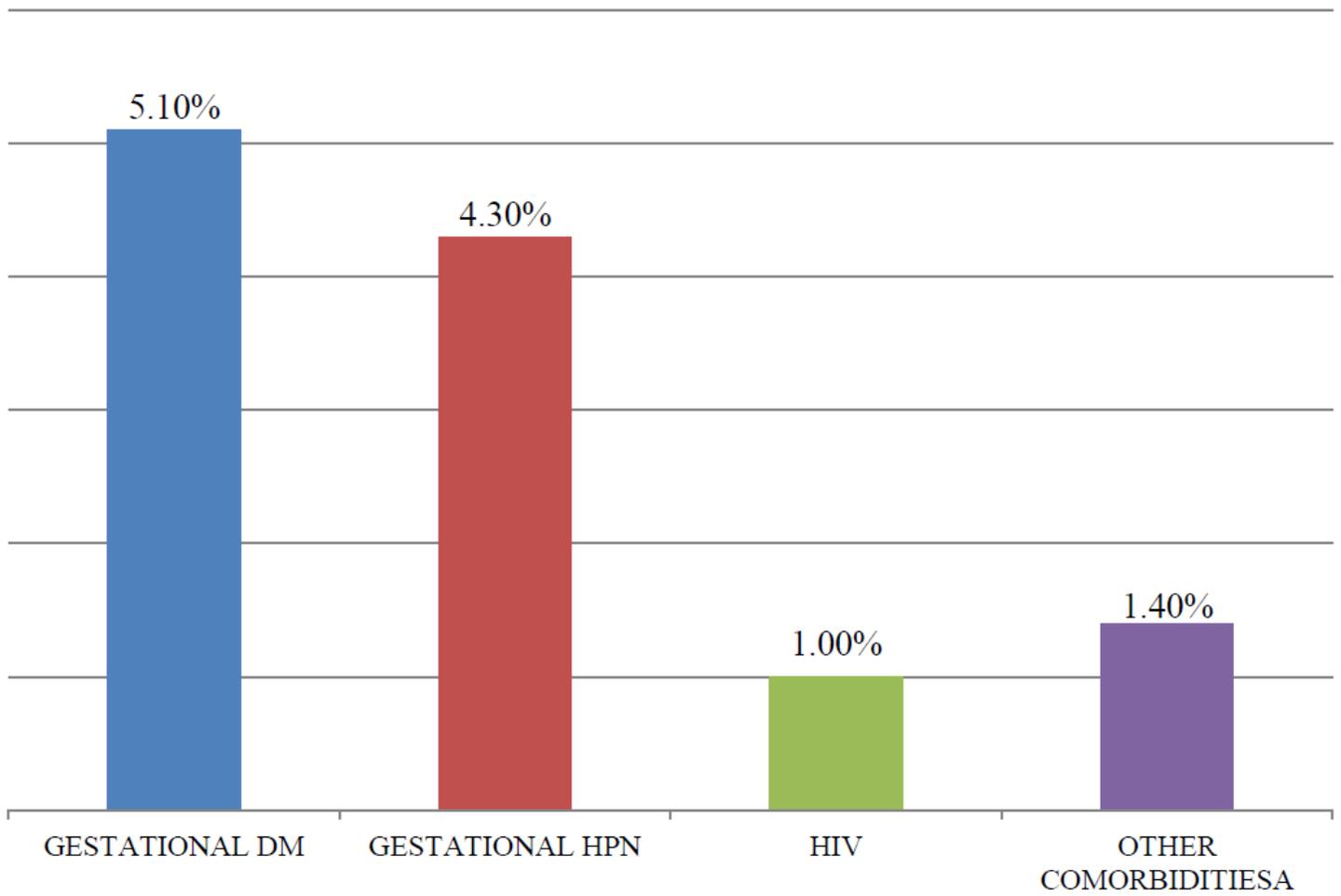
**Table 2:** Obstetric related factors of mothers who underwent cesarean section at primary hospitals of east Gojjam zone, North Western Ethiopia, 2020.

Variables	Category	Frequency	Percent
Parity	Primi-Para	282	45.3
	Multi Para	306	49.2
	Grand multi Para	34	5.5
ANC visit	No	16	2.6
	Yes	606	97.4
Duration of labor	Not in labor	122	19.6
	<24hrs	394	63.3
	≥24hrs	106	17
Gestational age	<37wks	39	6.3
	37_40wks	490	78.8
	>40wks	93	15
Number of vaginal examinations	Not done	88	14.1
	1-4	508	81.7
	≥5	26	4.2
Duration of membrane rupture	Intact	285	45.8
	Ruptured<12hrs	240	38.6
	Ruptured≥12hrs	97	15.6
Present of meconium	Yes	132	39.1
	No	206	60.9
Present of chorioamninitis	Yes	24	7.1
	No	314	92.9
History of abortion	Yes	42	6.8
	No	580	93.2
History of previous C/S	Yes	68	10.9
	No	554	89.1

Table 3: Operation and anesthesia related factors of mothers who underwent cesarean section at primary hospitals of east Gojjam zone, North West Ethiopia, 2020.

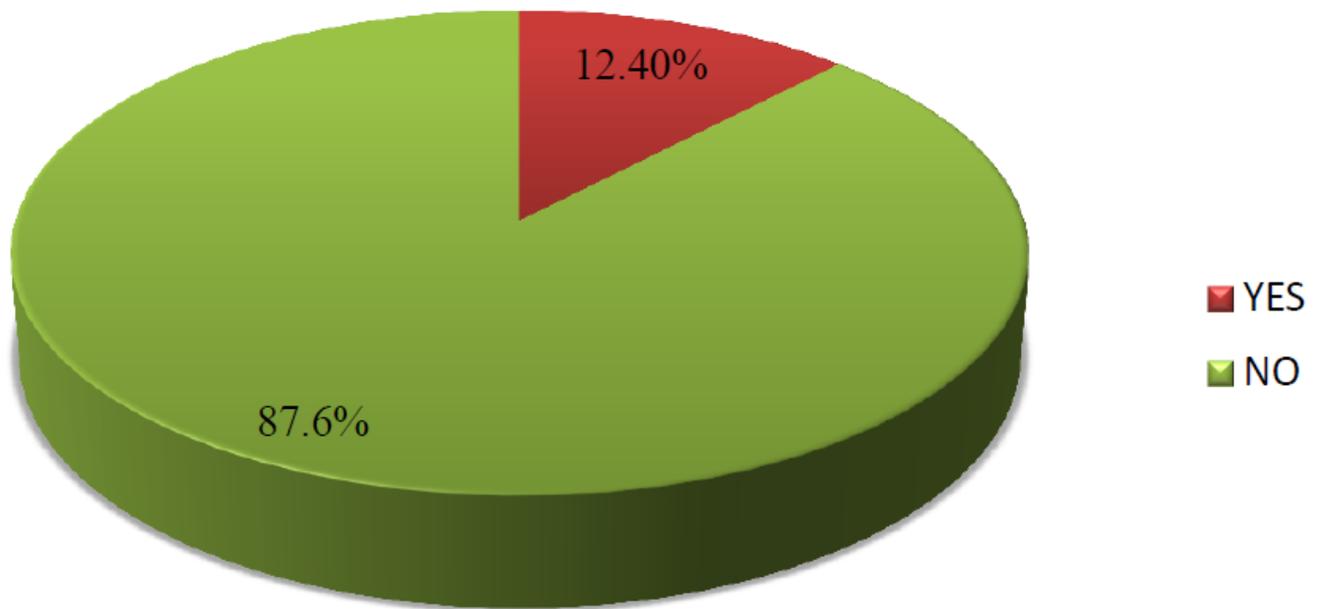
Variables	Category	Frequency	Percent
Who perform the operation	Emergency surgeon	584	93.9
	Gynecologist	38	6.1
Preoperative HCT	≤30%	27	4.3
	>30%	595	95.7
Type of CS	Emergency	593	95.3
	Elective	29	4.7
Type of anesthesia	Regional	565	90.8
	General	57	9.2
Duration of operation	<60minutes	502	80.7
	≥60minutes	120	19.3
Type of abdominal incision	Transverse	608	97.7
	Vertical	14	2.3
Prophylactic antibiotics	Yes	596	95.8
	No	26	4.2
Post-operative antibiotics	Yes	622	100
Number of dose of antibiotics	Multiple dose	622	100
Post-operative HCT	≤30%	43	6.9
	>30%	579	93.1
Length of hospital stay	<8 days	498	80.1
	≥8 days	124	19.9
Blood transfusion	Yes	55	8.8
	No	567	91.2

## Figures



**Figure 1**

Co Morbidity related factors of women who underwent cesarean section at primary hospitals of east Gojjam zone, North Western Ethiopia, 2020.



**Figure 2**

Magnitude of post cesarean section surgical site infection at primary hospitals of East Gojjam zone, North West Ethiopia, 2020.

## Supplementary Files

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