Cesarean section delivery rates, determinants, and indications: a retrospective study in Dekemhare Hospital

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Objectives: Cesarean section delivery is at increasing rate worldwide. The present study was designed to explore the cesarean section delivery rate, and its common indications along with their socio-demographic determinants in Dekemhare Hospital, Southern region of Eritrea.

Methods and Materials: A retrospective study was utilized to retrieve data of all women who delivered in Dekemhare Hospital during 2019. Using a structured questionnaire, all information required was recorded using data files such as birth (vaginal and cesarean) files, pregnancy registration file, and neonatal data. All women who delivered by cesarean section, their indications were collected reviewing registration records of the operating theater where the procedure was conducted. To describe the results, both descriptive and analytical analysis were conducted using SPSS version 25. χ² test and multivariate logistic regression analysis were done to identify determinants of cesarean section. A significance level of 0.05 was used as a cut point of statistical significance.

Main Findings: The rate of cesarean section delivery was 10.1%. The top 6 indications of cesarean section were: malposition (26.3%), prolonged and obstructed labor (21.2%), mal-presentation (14.4%), previous/repeat cesarean section (10.2%), amniotic fluid disorders (9.3%), and fetal distress (5.9%). Mothers who were nulliparous [odds ratio (OR): 9.2; 95% confidence interval (CI): 1.8–14.3; P-value: 0.007], referral from other health facility (OR: 7.8, 95% CI: 3.7–16.5, P-value <0.0001), and who had delivered stillbirths (OR: 8.2; 95% CI: 1.7–38.9; P-value: 0.008) were more likely to deliver through cesarean section.

Conclusion: The rate of cesarean section in Dekemhare hospital is fairly optimal (10.1%). Prolonged and obstructed labor, mal-presentation and malposition were the most common indications. Nulliparous and referral mothers had higher risk of cesarean section. Decision-making for cesarean section should outweigh the benefits and risks of the intervention within the context of women’s entire reproductive life-cycle.

Keywords: Cesarean section, Retrospective, Hospital, Indications, Eritrea

Background

Globally, nearly 213 million mothers conceive and give birth yearly. Approximately 18.5 million deliver via cesarean section (C-section)[1]. The rate of C-section is considered as a proxy indicator in maternal health to monitor health services progress[2]. The World Health organization (WHO) has recommended 5%–15% population-based

C-section rate[2,3]. Nonetheless, a tremendous increase in C-section has been observed globally[4]. Similarly, the rate of C-section was shown to increase in Eritrea[5]. When medically justified, C-section can effectively prevent maternal and perinatal mortality and morbidity[6]. On the other hand, unnecessary C-section might bring negative economic and health-related consequences[7]. Extraordinarily, nonmedical indications constitute one-third of the total 18.5 million C-section performed annually, contributing heavily to the global excess of C-section[8]. The alarming high C-section rate warrants monitoring indications of all C-section in public and private facilities[11]. The increasing rate of C-section was not shown to improve health outcomes, yet, a number of global studies have explored poor quality of maternal health care[8,9]. Eritrea is not an exception in this regard: limited access to emergency obstetric care services; shortage of skilled service providers, particularly midwives, doctors and anesthetists; low contraceptive prevalence rate; low level of girl’s education; inadequate transport and communication facilities; harmful socio-cultural beliefs and practices; and economic constraints are among the key challenges to providing optimal maternal, newborn and child health[10]. Researches in clinical obstetrics is extremely rare in Eritrea. There is paucity of data regarding clinical indications for C-section in Eritrea. The present study was therefore designed to explore the indications of C-section along with their socio-demographic determinants in Dekemhare Hospital, Southern region of Eritrea.
Methods and materials

Study design, participants, and setting

A retrospective study was utilized. All women who delivered in Dekemhare Hospital during 2019 were included in the analysis. Dekemhare Hospital is a regional hospital, located 40 km Southeast of Asmara, the capital of Eritrea. The hospital has 5 main departments; the emergency department, pediatric department, internal medicine department, the out-patient department, and the maternal health department. The present study was conducted in the maternal health department. The maternal health department provides spontaneous and assisted vaginal deliveries, abortion care, and cesarean delivery services. Both elective and emergency C-section are conducted in the hospital. In addition to its service for Dekemhare subzone population, the hospital acts as a referral center for Segeneyti, Mai-ayni, and Tsonora populations.

Data collection method

There was no electronic databases in the study site. Hence, we used the following data files manually: (a) birth (vaginal and cesarean) files, (b) pregnancy registration file, (c) neonatal data. Women who delivered in 2019 were identified from the birth file. Service utilization and birth outcome data were available from pregnancy registration file (the original patient card and admission file). While information on socio-demographic variables were collected from the respective patients’ cards. The number and causes of maternal and neonatal deaths were gathered from the death certificate files.

All women who delivered by C-section, their indications were collected reviewing registration records of the operating theater where the procedure was conducted. Hence, all hospital records including patient admission file, in-patient registrar, operation theater registrar, and neonate registries were used to gather the most valid information. The principal investigators of the research were the hospital anesthetist and the physician performing C-section. Three trained data collectors gathered the required information using a structured questionnaire. The questionnaire was developed by the principal investigators deeming the objectives of the study. The questionnaire was validated by the help of a statistician and experts from the ministry of health. The WHO, International Classification of Disease version 10 (ICD-10)[11] was used to classify the indications of C-sections.

Outcome and exposure variables

The exposure variables include; socio-demographic variables of women, medical and obstetric characteristics and perinatal outcomes. While the outcome variable is the mode of delivery, that is, C-section versus vaginal delivery.

Socio-demographic characteristics

Information on the following maternal characteristics were extracted from the records: maternal age, ethnicity, religion, employment status, address, parity, gravidity, and antenatal care visits.

Medical and obstetric factors

Medical disorders including hypertension, diabetes mellitus and gestational diabetes, asthma, cardiac disease, renal disease other than a single urinary tract infection, autoimmune disease, infectious disease particularly hepatitis C and HIV status, neurological disease including epilepsy and serious skin disorders were recorded. Obstetric history such as previous abortion, previous fetal loss (perinatal death), and recurrent abortion, maternal and fetal complications during pregnancy were recorded. Fetal complications include congenital abnormalities, fetal distress and birth asphyxia, abnormal umbilical cord and preterm birth. Maternal complications include severe preeclampsia, significant antepartum hemorrhage, unstable lie or any infection requiring intravenous antibiotics. previous abortion more than 2 was classified as recurrent abortion.

Perinatal outcomes

Perinatal outcome measures included gestational age at delivery, birth weight, newborn sex, infant’s Apgar scores at 1 minute, stillbirths, any congenital abnormalities, and admission to the neonatal intensive care unit. Preterm birth is defined as the birth of a live baby at <37 completed weeks’ gestation. Stillbirth is defined as delivery of a baby showing no signs of life at or after 24 weeks’ gestation. Perinatal death include stillbirths and early neonatal deaths (defined as the death of a baby within the first 7 d of life). Congenital anomalies were identified from records of a physical examination of all babies after delivery and from neonatal discharge records.

Mode of delivery

The mode of delivery (either vaginal or cesarean) was the outcome or dependent variable of the study. C-section delivery was classified as elective/scheduled or emergency/urgent C-section. A scheduled C-section is planned electively. Emergency C-section occurred in labor or with no labor. Emergency C-section in labor are subclassified according to whether labor was of spontaneous onset or induced.

Data analysis

After data collection was completed, data were cleaned, and entered in to an excel program by the help of a computer programmer. Cleaned data were exported to Statistical Package for Social Sciences (SPSS) version 25 for analysis. First, socio-demographic and obstetric characteristics of the women were described. Indications of C-section were presented as frequency distribution of individual clinical conditions (ICD-10). ICD-10 codes for indication of C-section were grouped into 11 subclasses: Malposition, hypertensive disorders, mal-presentation, disorders of amniotic fluid, bleeding disorders, postdated pregnancy, prolonged and obstructed labor, fetal distress, previous C-section, cord prolapse, uterine rupture. Hypertensive disorder covers gestational hypertension, preeclampsia, and eclampsia. Amniotic fluid disorders includes oligo and poly-hydramnion, but the most common ones were due to oligohydrominon. Cephalo-pelvic disproportion and failed induction of labor were included in the category of prolonged or obstructed labor. C-section indications documented as cord prolapse, postdated pregnancy, and uterine rupture were recategorized under “other indications.”

To identify the specific risk-groups for C-section, the indications (of C-section) were divided further into 5 groups based on the underlying causes. The 5 common causes were classified as: previous/repeat C-section, absolute maternal indications (AMIs), maternal causes, fetal causes, and combined (fetal and maternal) causes. As indicated by Dubourg et al[12], AMIs include uncontrolled bleeding, unstable lie or presentations (transverse lie, face
or brow presentation), gross cephalo-pelvic disproportion and uterine rupture. Repeat C-section group include women with 1 or more C-section before current birth. Clinical conditions documented as maternal causes include hypertensive disorders, amniotic fluid disorders, and postdated pregnancy. Fetal causes include all causes of fetal distress and cord prolapse. Problems related to both mother and fetus such as prolonged or obstructed labor, and malposition were grouped as combined causes.

Further analyses focused on exploring the determinant factors of C-section delivery. At bivariate level, \( \chi^2 \) tests were performed to explore the relationship between the outcome and exposure variables. The exposure variables showing significant relationship with the outcome variable at the bivariate level were further analyzed in the binary logistic regression model to examine the independent effects of the exposure variables upon C-section delivery after controlling the confounding effects of all covariates in the model. The strength of association between exposure and outcome variables was measured as adjusted odds ratios (AOR) with 95% confidence intervals (CI) of odds ratios.

### Ethical Approval

Ethical approval for the study was obtained from the “Research and Ethical Committee” of the Ministry of Health. Approval from authorities of Dekemhare hospital was also attained before accessing the required files. Written informed consent from the mothers was not applicable due to nature of the study.

### Results

#### Characteristics of the study participants

All women (a total of 1166) who delivered in Dekemhare hospital during 2019 were included in the study. More than 9/10th of them were: unemployed (96.4%), Christians (90.4%), Tigrigna speakers (90.7%), and had at least 3 ANC visits (98.9%). The mean age of the women was 27.6 years and 16.6% of them were referral patients (Table 1).

#### Participants’ obstetric characteristics and delivery patterns

More than 2/5th (42.5%) of the women were multigravida with \( \geq 4 \) pregnancies. About 8% of the women had history of fetal loss and 15.4% had at least 1 previous abortion. Out of the 723 mothers whose cards had birth interval record, only 13.3% of them delivered below the recommended interpregnancy gap (ie, 2 y). Out of the total deliveries, the rate of C-section was 10.1% with majority of them (92.4%) being conducted under spinal anesthesia. Majority of the C-section (89%) was emergency type with 95.2% of the mothers had spontaneous labor started (Table 2).

### Table 1

| Variables                              | Frequency | Percent |
|----------------------------------------|-----------|---------|
| Age (mean ± SD = 27.6 ± 6.1) (y)       |           |         |
| \( \leq 19 \)                           | 90        | 7.7     |
| 20–24                                  | 319       | 27.4    |
| 25–29                                  | 319       | 27.4    |
| 30–35                                  | 303       | 26      |
| \( \geq 35 \)                           | 135       | 11.6    |
| Employment status                      |           |         |
| Unemployed                             | 1124      | 96.4    |
| Employed*                             | 42        | 3.6     |
| Patient address                        |           |         |
| Dekemhare subzone                      | 973       | 83.4    |
| Referred from other subzones\(^1\)     | 193       | 16.6    |
| Religion                               |           |         |
| Muslims                                | 112       | 9.6     |
| Christians                             | 1054      | 90.4    |
| Ethnic group                           |           |         |
| Tigrigna                               | 1058      | 90.7    |
| Others\(^2\)                           | 108       | 9.3     |
| ANC visits                             |           |         |
| Yes                                    | 1153      | 98.9    |
| No                                     | 13        | 1.1     |
| Medical history                        |           |         |
| No                                     | 1153      | 98.9    |
| Diabetic                               | 4         | 0.3     |
| Asthmatic                              | 3         | 0.3     |
| Others\(^2\)                           | 6         | 0.5     |

\(^1\)Teaching (n = 17), Medical (n = 4), Administrative (n = 12), Military (n = 8), Cleaner (n = 1).

\(^2\)Segenity (n = 120), Tsorona (n = 30), Mai-ayni (n = 22), Adi-keih (n = 12), Quatit (n = 9).

| Variables                              | Frequency | Percent |
|----------------------------------------|-----------|---------|
| History of abortion                    |           |         |
| No                                     | 986       | 84.6    |
| Yes                                    | 180       | 15.4    |
| History of fetal loss                  |           |         |
| Yes                                    | 91        | 7.8     |
| No                                     | 1075      | 92.2    |
| Gravidity                              |           |         |
| 1                                      | 256       | 22      |
| 2                                      | 234       | 20.1    |
| 3                                      | 180       | 15.4    |
| \( \geq 4 \)                           | 496       | 42.5    |
| Parity                                 |           |         |
| 0                                      | 280       | 24      |
| 1                                      | 237       | 20.3    |
| 2                                      | 199       | 17.1    |
| \( \geq 3 \)                           | 450       | 38.6    |
| Birth interval (n = 723)               |           |         |
| \( \leq 24 \text{ mo} \)               | 96        | 13.3    |
| > 24 \text{ mo}                       | 627       | 53.8    |
| Mode of delivery                       |           |         |
| Vaginal                                | 1048      | 89.9    |
| C-section                              | 118       | 10.1    |
| Type of C-section                      |           |         |
| Elective CS                            | 13        | 11      |
| Emergency CS                           | 105       | 89      |
| Emergency CS labor classifications     |           |         |
| Labor was spontaneous                  | 100       | 95.2    |
| Labor was induced                      | 3         | 2.8     |
| Labor was not started                  | 2         | 1.9     |
| Anesthesia for CS                      |           |         |
| Spinal                                 | 109       | 92.4    |
| General                                | 4         | 3.4     |
| Mixed                                  | 5         | 4.2     |
| Rh-negative mother                     |           |         |
| No                                     | 1103      | 94.6    |
| Yes                                    | 63        | 5.4     |

CS indicates cesarean section.

### Table 2

| Variables                              | Frequency | Percent |
|----------------------------------------|-----------|---------|
| History of abortion                    |           |         |
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| Rh-negative mother                     |           |         |
| No                                     | 1103      | 94.6    |
| Yes                                    | 63        | 5.4     |

CS indicates cesarean section.
Birth outcome

Of the total 1166 babies delivered, majority of them were live births (97.9%), term (94.7%), and had birth weight > 2500 g (91.2%). The proportion of the newborns gender was quite similar, however, 3.7% of them had been admitted to intensive care unit and 1.3% had congenital abnormality during birth (Table 3).

Indications of C-section

Based on ICD-10 classifications explained above, malposition (26.3%), prolonged and obstructed labor (21.2%), mal-presentation and unstable lie (14.4%), previous/repeat C-section (10.2%), amniotic fluid disorders (9.3%), and fetal distress (5.9%) were the top 6 common indications of C-section in our study (Fig. 1).

Distribution of C-sections based on underlying causes

Considering the underlying causes, of all C-sections conducted, about 13% were conducted due to maternal causes, one tenth were repeat C-section, almost 21% were for AMIs, about 9% were due to fetal causes and nearly half (47.5%) had combined causes (Fig. 2).

Determinants of C-section

Socio-demographic Factors

During the first bivariate analysis, the probability of using C-section was higher among referral [crude odds ratio (COR): 6.0, 95% CI: 4.0–8.9], Muslims (COR: 2.3, 95% CI: 1.4–3.8), and non-Tigrigna (COR: 0.5, 95% CI: 0.3–0.7) speaking women. In multilogistic regression analysis, only patients’ address was statistically affected the probability of high C-section rate. Women who arrived the hospital as referral patients were almost 8 times (AOR: 7.8, 95% CI: 3.7–16.5, P-value <0.0001) more risky to deliver through C-section than those who were from Dekemhare (Table 4).

Obstetric factors and neonate birth outcome

At the bivariate level, preterm babies (COR: 1.8, 95% CI: 1.1–3.2), mothers delivering early within 24 months (COR: 2.3; 95% CI: 1.1–4.6), stillbirth babies (COR: 5.3, 95% CI: 2.3–12.3), nulliparous mothers (COR: 2.1; 95% CI: 1.3–3.3) and newborns having congenital abnormality (COR: 3.3; 95% CI: 1.0–10.5) were found more likely to be delivered through C-section delivery. However after adjusting the confounding effects of the variables through block entry method, multivariate regression analysis revealed that only neonate outcome and parity were found significant. Stillbirth newborns were 8 times (AOR: 8.2, 95% CI: 1.7–38.9; P-value: 0.008) more likely to be delivered via C-section. Similarly, nulliparous mothers were 9 times (AOR: 9.2; 95% CI: 1.8–14.3; P-value: 0.007) more risky for C-section compared with multiparous (≥ 3) mothers (Table 5).

Discussion

C-section delivery rate

The C-section delivery rate in Dekemhare hospital in 2019 was 10.1%. The findings of C-section rate in our study is consistent with the global consensus of WHO recommendations for
However, several studies conducted in other settings reported higher rates of C-section\(^{13-16}\). Despite the existing awareness and regular feedback from global recommendations, there has been no detectable reduction in C-section rates. To the reverse, the rate of spontaneous delivery was shown to decrease, while C-section rate has increased in many studies around the globe\(^{17,18}\).

Common indications of C-section

Malposition, prolonged and obstructed labor, and mal-presentation were the main 3 indications of C-section. Malposition of the fetus and mal-presentation accounted for 26.3% and 14.4% of all C-sections, respectively. Among the mal-presentations, breech presentation and transverse lie were the most common indications in our study. Similar to our findings, breech presentation was found to be a common indication in other studies\(^{14,17}\). As has been reported in other studies\(^{13,18,19}\), prolonged labor was also a common cause of C-section (21.2%) in the current study. While many researchers report higher C-section rate for prolonged labor, others found active management of second stage of labor by augmentation as effective strategy to manage prolonged labor\(^{20,21}\). Previous/repeat C-section (10.2%) was the fourth indication in the current study. Contrastingly, most of the studies reviewed reported previous C-section as the first indication\(^{14,16,18,22}\). In the light of the increased findings of repeat C-section, the National Institute for Health and Clinical Excellence\(^{23}\) and the American College of Obstetricians and Gynecologists\(^{24}\) have clearly instructed that previous C-section should not be an indication in the absence of any obstetric emergencies. Hence, interventions such as vaginal birth after C-section should be promoted to reduce the extremely high incidence of repeat C-section.

Disorders of amniotic fluid particularly oligohydramnios was the indication for 9.3% of C-section in this study. Similar findings were reported from a population-based study in Bangladesh\(^{13}\). However, a study conducted in Pakistan argued that isolated oligohydramnios is not associated with adverse perinatal outcomes compared with women having normal amniotic fluid. Thus performing C-section solely due to oligohydramnios is not recommended as routine indication\(^{25}\). Majority of the patients with severe oligohydramnios in our setting came to our hospital in a state of prolonged rupture of membrane, hence the case is compounded with fear of fetal distress and infections. This might be the reason increasing the rate of C-section among oligohydramnios patients. The prevalence of C-section rate due to fetal distress is 20% at global level\(^{26}\). In our study C-section due to fetal distress was relatively low. Fetal distress accounted for only 5.9% of the C-section mothers. Studies conducted elsewhere reported higher cases of fetal distress.

![C-section specific causes](image)

Figure 2. Cesarean section (CS) specific causes, Dekemhare, Eritrea 2021. AMI indicates absolute maternal indications.

Table 4

| Variable                  | Mode of Delivery | C-section, n (%) | Vaginal, n (%) | COR (95% CI) | AOR (95% CI) | P     |
|---------------------------|-----------------|-----------------|---------------|--------------|--------------|-------|
| Maternal age (y)          |                 |                 |               |              |              |       |
| ≤ 19                      |                 | 7 (7.8)         | 83 (92.2)     | 1            |              |       |
| 20–24                     |                 | 31 (9.7)        | 288 (90.3)    | 1.3 (0.5-3.0)|              |       |
| 25–29                     |                 | 30 (9.4)        | 289 (90.6)    | 1.2 (0.5-2.9)|              |       |
| 30–35                     |                 | 27 (8.9)        | 276 (91.1)    | 1.2 (0.5-2.7)|              |       |
| ≥ 35                      |                 | 23 (17)         | 112 (83)      | 2.4 (0.9-5.9)|              |       |
| Patient address           |                 |                 |               |              |              |       |
| Dekemhare                 |                 | 62 (6.4)        | 911 (93.6)    | 1            |              |       |
| Referral                  |                 | 56 (29)         | 137 (71)      | 6.0 (4.0-8.9)** | 7.8 (3.7-16.5) | <0.0001 |
| Employment status         |                 |                 |               |              |              |       |
| Unemployed                |                 | 115 (10.2)      | 1009 (89.8)   | 1.4 (0.5-4.3)|              |       |
| Employed                  |                 | 3 (7.1)         | 39 (92.9)     | 1            |              |       |
| Religion                  |                 |                 |               |              |              |       |
| Christians                |                 | 97 (9.2)        | 957 (90.8)    | 1            |              |       |
| Muslims                   |                 | 21 (18.8)       | 91 (81.3)     | 2.3 (1.4-3.8)** | 2.1 (0.7-5.9) | 0.16   |
| Ethnicity                 |                 |                 |               |              |              |       |
| Tigrigna                  |                 | 97 (9.2)        | 961 (90.8)    | 0.5 (0.3-0.7)** | 2.0 (0.7-5.7) | 0.19   |
| Others                    |                 | 21 (19.4)       | 87 (80.6)     | 1            |              |       |
| ANC visit                 |                 |                 |               |              |              |       |
| No                        |                 | 2 (15.4)        | 11 (84.6)     | 1.5 (0.4-5.5)|              |       |
| Yes                       |                 | 116 (10.1)      | 1037 (89.9)   | 1            |              |       |

*Significant at P = 0.05, 0.01, 0.001, respectively.

ANC indicates antenatal care; AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; C-section, cesarean section.
distress as indication of C-section\textsuperscript{[13–15]}. On the other hand, some studies\textsuperscript{[26,27]} recommend maternal left lateral position, oxygen inhalation, and para-cervical amnio-infusion as successful interventions for restoring fetal heart rate rather than rushing to emergency C-section. In our set up, electronic fetal monitoring is unavailable, and the practice of para-cervical amnio-infusion is poor. Hence, to save the fetus as early as possible, C-section is more preferred than any other interventions in our setting.

**Determinants of C-section**

Being Muslim, non-Tigrigna speaker and referred from other health facility had marginal significance in increasing the likelihood of C-section. Likewise, preterm babies, stillbirths, mothers delivering at earlier interpregnancy gap, nulliparous mothers and newborns having congenital abnormality were more likely to deliver through C-section. However the only statistically significant predictors of C-section were patient’s address (being the mother referral), nulliparous, and neonate outcome (ie, being the newborn stillbirth). Mothers who have been referred from other health facilities were almost 8 times more likely to deliver through C-section. The fact that referral mothers travel long hours until they arrive Dekemhare hospital might have increased their risk for C-section. Increasing the distribution of emergency and obstetric care to the farthest areas is advisable to decrease the burden of referral patients in the hospital. Consistent with findings of other studies\textsuperscript{[28–30]}, the risk of C-section among nulliparous mothers was 9 times higher than those who had ≥3 children. Higher rate of C-section delivery among women who have no history of childbirth is somehow worrisome. Even though it is difficult to conclude neonate outcome as predictor for C-section, the rate of stillbirth was significantly high among C-section delivering mothers. As some studies indicated, advanced maternal age was associated with higher risk of C-section\textsuperscript{[13,28,31]}. Although statistical significance was not attained, the opposite trend has been observed in our findings, where younger women had higher risk of C-section. It is depicted that, personal preferences of women and the impact of obstetricians’ choices increases the rate of unnecessary C-section\textsuperscript{[32,33]}. Likewise, living condition factors such as socioeconomic status were reported as predictors of C-section\textsuperscript{[34]}. These variables are not covered in the current study, hence we recommend further studies to fill the gap.

**Strengths and limitations**

All mothers who delivered in the specified year vaginally or through C-section were included in the study. Various records of the patients were assessed to capture the indications of C-section.

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### Table 5

Association of obstetric and birth outcome factors with C-section delivery, Dekemhare, Eritrea 2021.

| Variable                        | Mode of Delivery | C-section, n (%) | Vaginal, n (%) | COR (95% CI) | AOR (95% CI) | P   |
|---------------------------------|------------------|------------------|----------------|--------------|--------------|-----|
| Parity                          |                  |                  |                |              |              |     |
| 0                               |                  | 47 (16.8)        | 233 (83.2)     | 2.1 (1.3–3.3)*** | 9.2 (1.8–14.3) | 0.007 |
| 1                               |                  | 20 (8.4)         | 217 (91.6)     | 0.9 (0.6–1.7)  | 1.8 (0.8, 4.2) | 0.17 |
| ≥2                              |                  | 12 (6.0)         | 187 (94.0)     | 0.7 (0.3, 1.3)  | 0.7 (0.2, 2.2) | 0.52 |
| Gestational age at birth        |                  |                  |                |              |              |     |
| ≥24 mo                          |                  | 14 (13.6)        | 104 (86.4)     | 1.4 (0.8–2.3)  |              |     |
| > 24 mo                         |                  | 26 (41.1)        | 40 (58.9)      |              |              |     |
| Birth weight                    |                  |                  |                |              |              |     |
| ≤2500 g                         |                  | 9 (9.4)          | 87 (90.6)      | 2.3 (1–4.6)* | 1.9 (0.7–4.6) | 0.14 |
| > 2500 g                        |                  | 26 (41.1)        | 60 (58.9)      |              |              |     |
| Neonate admitted to ICU         |                  |                  |                |              |              |     |
| No                              |                  | 112 (10)         | 1011 (90)      | 0.7 (0.3–1.5)  |              |     |
| Yes                             |                  | 6 (14)           | 37 (86)        |              |              |     |
| Neonate outcome                 |                  |                  |                |              |              |     |
| Alive                           |                  | 109 (9.6)        | 1032 (90.4)    |              |              |     |
| Stillbirth                      |                  | 114 (9.9)        | 1037 (90.1)    | 5.3 (2.3–12.3)** | 8.2 (1.7–38.9) | 0.008 |
| Fetal congenital abnormality    |                  |                  |                |              |              |     |
| No                              |                  | 3 (3.8)          | 117 (96.2)     |              |              |     |
| Yes                             |                  | 850 (95.4)       | 26 (4.6)       |              |              |     |

\*\*, **, ***Significant at \( P = 0.05, 0.01, 0.001 \), respectively.

AOR indicates adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; C-section, cesarean section; ICU, intensive care unit.
However, the study was not conducted without limitations. It was difficult to obtain some important variables such as socio-economic status, educational level, and body mass index. These variables had significant impact in the rate of C-section as reported in some studies\textsuperscript{11,13,14}. Likewise some variables such as birth interval/interpregnancy gap were not completely recorded.

**Conclusion**

The rate of C-section in Dekemhare hospital is fairly optimal (10.1%). Prolonged and obstructed labor, mal-presentation, and malposition were the most common indications of C-section delivery. The risk of C-section was high among nulliparous and referral mothers. Decision-making for C-section should outweigh the benefits and risks of the intervention within the context of women’s entire reproductive life-cycle and existing standards of care to avoid unnecessary and costly C-section deliveries.

**Ethical approval**

The proposal was approved by the Ministry of Health Scientific and Research Ethical Committee. Permission was taken from the hospital authorities to initiate data collection.

**Conflict of interest disclosures**

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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