INDICATIONS AND OUTCOMES OF CESAREAN DELIVERY IN PUBLIC HEALTH FACILITIES OF ADDIS ABABA, ETHIOPIA: A CROSS SECTIONAL STUDY

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ABSTRACT

BACKGROUND: Cesarean delivery (CD) is defined as the birth of a fetus, placenta, or membranes from the uterus through an abdominal incision after 28 weeks of gestation. It is a lifesaving intervention for mothers and babies when vaginal delivery is contraindicated. However, if not medically indicated or performed under suboptimal conditions, CD can lead to maternal and fetal complications.

OBJECTIVE: This study aimed to assess the indications, outcomes, and factors associated with maternal and neonatal outcomes of CD in Addis Ababa, Ethiopia.

METHODS: An institution-based cross-sectional study was conducted from January 1, 2022, to December 31, 2022, in three selected health facilities in Addis Ababa, Ethiopia. A total of 422 women who underwent CD were included in the study. Mothers and newborns were followed for the first seven days of life, until the time of discharge, or at the time of death—whichever occurred first was considered the endpoint for data collection. Descriptive statistics are presented using frequencies and pie charts. A chi-square test was performed to evaluate the relationships between dependent and independent variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS: Emergency cesarean deliveries accounted for 75.4% of all CDs performed. The leading indication for emergency CD was a non-reassuring fetal heart rate pattern (40.3%), followed by cephalopelvic disproportion (20.4%). Maternal complications were observed in 5.9% of the cases, while the neonatal mortality rate was 3%. Repeat CD, emergency CD, and antepartum hemorrhage were associated with maternal complications. Nulliparity, hypertensive disorders during pregnancy, gestational age, APGAR score, and the need for immediate neonatal resuscitation were significantly associated with neonatal death.

CONCLUSION: In this study, cesarean delivery was associated with significant maternal and neonatal morbidity and mortality. Targeting clinical factors related to these complications and ensuring optimal care during and after CD are critical for improving maternal and neonatal outcomes.

KEYWORDS: cesarean delivery, outcome, indication, maternal complication, neonatal death

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INTRODUCTION

In a woman's life cycle, parturition and pregnancy are significant milestones. Pregnant women may deliver their children via normal spontaneous vaginal delivery or through cesarean delivery (CD).[1,2] One of the key indicators of a country's health status is the magnitude of maternal and perinatal mortality and morbidity.[3] This is reflected in the quality of obstetric care. Although giving birth is a physiological process, there is a large risk to the life and well-being of both mothers and newborns.[2] Globally, approximately 10% of all deliveries are considered high-risk, some of which require cesarean section.[1, 2]

Cesarean delivery is defined as the birth of a fetus, placenta, or membranes from the uterus through an abdominal incision after 28 weeks of gestation.[2] The terms cesarean delivery or cesarean birth are preferred over cesarean section (CS). Primary cesarean refers to a CD performed on a woman without a prior cesarean birth, whereas repeat cesarean refers to a CD performed on a woman who had a cesarean birth during a previous pregnancy.[3–5] Global CS rates have risen dramatically over time, from approximately 7% in 1990 to 21% today. This rise, largely driven by advancements in obstetric practices as well as social, economic, and legal factors, far exceeds the WHO's recommended CD rate of 10% to 15%.[2, 6, 7] These trends are expected to continue during the current decade, with overuse and unmet needs coexisting at a projected global rate of 29% by 2030. The primary cesarean section rate has also increased globally for similar reasons.[2, 6, 7]

When medically justified, CD can effectively prevent maternal and perinatal mortality and morbidity.[7–9] However, there is no evidence showing the benefits of CD for women or infants who do not require the procedure.[10–13] If not medically indicated or performed under suboptimal conditions, CD can cause maternal and fetal complications such as infection, hemorrhage, maternal death, and increased neonatal morbidity and mortality.[14] These risks are greater for women with limited access to comprehensive obstetric care.[10] There is currently no internationally accepted classification system for CD that allows meaningful and relevant comparisons of CD rates across different facilities, cities, or regions.[5, 11]

Ethiopia, a nation in sub-Saharan Africa, significantly contributes to maternal and newborn morbidity and mortality.[10] To reduce this burden, the country is making significant efforts in multiple directions. This includes ensuring the availability of comprehensive obstetric care in health institutions and performing cesarean sections based on scientific indications, in line with WHO recommendations.[12] The country has made considerable efforts to expand access to comprehensive obstetric care, including cesarean delivery, as part of broader national strategies to improve maternal and neonatal health. These efforts align with Ethiopia's commitment to achieving the Sustainable Development Goals (SDGs), particularly Goal 3, which seeks to reduce maternal and neonatal mortality and promote well-being for all at all ages.[10, 12]

Despite these efforts, Ethiopia continues to face numerous challenges in improving obstetric care, including insufficient healthcare infrastructure, limited access to skilled birth attendants, and disparities in healthcare delivery across urban and rural regions.[15] While cesarean delivery is a critical intervention, its indications and outcomes in Ethiopia remain poorly understood due to a lack of local data and research.[1, 8, 15] Recognition of the factors that affect maternal and neonatal outcomes of cesarean section will help health professionals and pregnant women prepare accordingly.[8]

Due to the scarcity of local data, this study aimed to identify the common indications for CD and to fill this gap by exploring the maternal and neonatal outcomes and the factors influencing these outcomes at health facilities in Addis Ababa, Ethiopia. By identifying these patterns, the study seeks to provide valuable contributions to national data that can inform clinical practice on cesarean delivery and guide health policy on operative deliveries.

METHODS AND MATERIALS

Study Design and Area

An institution-based cross-sectional study was performed to assess the indications and outcomes of cesarean delivery (CD) and factors associated with maternal and neonatal outcomes. The study was conducted from January 1, 2022, to December 31, 2022, in selected health facilities in Addis Ababa, Ethiopia. The study areas were selected based on case burden. Yekatit 12 Hospital Medical College was selected because of its annual delivery rate of 10,000, with a CD rate of 40%. Among the health centers, the Janmeda and Kotebe health centers were selected, each with an annual delivery of 2,500 and a CD rate of 25%.

Study Population

The source population consisted of mothers who gave birth in the selected health facilities in Addis Ababa, Ethiopia. The study population included mothers who gave birth via CD in the selected health facilities during the study period.

The inclusion criteria were: mothers with a gestational age of 28 weeks or more who delivered via CD at the three health facilities and consented to participate in the study.

Sample Size and Sampling Procedure

The sample size was calculated with the assumptions of a 50% proportion, 5% level of significance, 5% margin of error, and a 10% nonresponse rate. The total sample size was 422. This assumption was used due to variability in CD rates in prior studies in other areas. Samples were proportionally allocated to each selected health facility, and 322, 50, and 50 samples were drawn from Yekatit 12 Hospital Medical College (Y12HMC), Janmeda Health Center, and Kotebe Health Center, respectively.

Systematic random sampling was used to select the study participants. The sampling interval (K) was calculated for each health facility by dividing the total number of cesarean deliveries from the previous year by the proportionally allocated sample size for that facility. The calculated sampling intervals were K = 12 for Y12HMC, K = 16 for Janmeda Health Center, and K = 20 for Kotebe Health Center. The first participant was selected using the lottery method, and subsequent participants were selected at regular intervals (every 12th, 16th, and 20th case, respectively) according to the sampling interval (K), until the required sample size was reached.

Data Collection Tool and Process

The structured questionnaire was developed based on a review of existing literature, relevant clinical guidelines, and expert consultations. The tool was adapted to suit the local context, ensuring consideration of local practices, medical terminology, and cultural relevance. It addressed the study's objectives by focusing on indications, outcomes, and factors associated with maternal and neonatal outcomes of CD. Key variables included sociodemographic information, obstetric history, maternal and neonatal outcomes, and clinical variables such as mode of anesthesia, birth weight, APGAR score, and prior cesarean deliveries.

The questionnaire was initially drafted in English and translated into Amharic. The Amharic version was reviewed for accuracy and contextual relevance by native speakers involved in the study.

A total of 10 trained data collectors were recruited based on their experience in data collection and familiarity with obstetrics and gynecology. They received a five-day training session covering the study objectives, ethical considerations, data collection procedures, and use of the questionnaire. Three supervisors were appointed to oversee the data collection process across all sites. Supervisors were responsible for quality control, checking completeness and consistency, resolving issues, and supporting the data collectors as needed.

Data Quality Assurance / Data Management

A pretest was conducted at Saint Peter Hospital using 5% of the total sample size. A double data entry process was implemented to minimize data entry errors. Supervisors regularly checked the data for completeness and accuracy. Frequency output

and sorting were used to identify missing values and outliers. Data profiling was conducted to detect inconsistencies, and data cleansing, including interpolation of missing values, was performed.

Operational Definitions

- Maternal Outcome – Any medical or surgical complication occurring during or after surgery and before discharge that requires therapeutic antibiotic use, therapeutic anticoagulant use, blood transfusion, relaparotomy, or results in maternal death (yes or no).[11]
- Neonatal Outcome – Death of the neonate in the first seven days of life and before discharge (yes or no).[11]
- Previous CD with X Factors – "Previous cesarean delivery plus X factors" refers to a pregnancy after a prior cesarean section, where "X factors" represent additional clinical considerations that may influence the likelihood of a successful vaginal birth after cesarean (VBAC). These factors may relate to either the current or previous pregnancy.[2]

Data Analysis

The data were double-entered into SPSS version 25. Descriptive statistics were used to summarize the data. Frequencies and proportions were calculated for categorical variables (e.g., marital status, indication for cesarean delivery). For continuous variables (e.g., maternal age, gestational age, birth weight), means, medians, and standard deviations were reported, depending on the distribution. Some continuous variables were categorized to enhance interpretation and comparison.

Chi-square tests were used to assess associations between dependent and independent variables. Two-tailed P values were calculated, and values less than 0.05 were considered statistically significant. Tables and graphs were used to present the results. Frequency output and sorting were employed to check for missing values and outliers.

RESULTS

Socio demographic characteristics of the study participants

Response rate of the study was 100%.The mean maternal age of the study participants was 26.98±4.74 years. The majority of the study participants were urban dwellers 399 (94.5%) and were married 412 (97.6%). most 188 (44.5%) of the study participants had attended secondary school, followed by 123 (29.1%) who had attended primary school. More than half of the study participants (54.5%) were housewives. (Table 1)

Table 1- Sociodemographic characteristics of mothers who gave birth via cesarean delivery, Addis Ababa, Ethiopia, 2022.

VARIABLES	FREQUENCY	PERCENTAGE
Age (in years)		
15-19	10	2.4
20-29	306	72.5
30-39	103	24.4
≥40	3	0.7
Marital status		
Single	10	2.4
Married	412	97.6
Place of residency		
Urban	399	94.6
Rural	23	5.5
Educational status		
No formal education	48	11.3
Primary school	123	29.1
Secondary	188	44.5
Above secondary	63	14.9
Occupation		
Government employee	67	15.9
Merchant	80	19
Daily laborer	45	10.6
Housewife	230	54.5

Reproductive and obstetrics characteristics of the study participants

In this study, 179 (42.4%) mothers were multiparous. Approximately 410 (97.2%) of the study participants had at least one antenatal contact (ANC) for their current pregnancy; however, 12 mothers (2.8%) had no ANC and. Only 23 (5.5%) mothers had a bad obstetric history. Thirteen mothers had a history of stillborn birth, and 10 mothers had early neonatal death. There was spontaneous onset of labor in 191

(45.3%) mothers. However, CD was performed on 101 (23.9%) mothers after labor induction, and 130 (30.8%) mothers had direct cesarean section for different obstetrics or medical indications.

Types and Indications of Cesarean Delivery

Of the total participants, 324 (76.8%) underwent primary cesarean delivery (CD) and 98 (23.2%) had repeat CD. Elective procedures accounted for 104 cases (24.6%), while 318 (75.4%;) were emergency CDs. The leading indication was non-reassuring fetal heart rate pattern (40.3%), followed by cephalopelvic disproportion (20.4%).Spinal anesthesia was used in 408 cases (96.7%), while general anesthesia in 14 cases (3.3%).(Table 2)

Table 2- Type and indication of CD in the study participants, Addis Ababa, Ethiopia, 2022

VARIABLES	FREQUENCY	PERCENTAGE
Type of CD		
Primary	324	76.8
Repeat	98	23.2
Indication of CD		
Elective	104	24.6
Emergency	318	75.4
Clinical indications of CD		
CPD	86	20.4
NRFHRP	170	40.3
Previous CD with x factors	80	19
Failed induction	16	3.8
Malpresentation	27	6.4
APH	4	0.9
Others	39	9.2
Type of anesthesia		
Spinal anesthesia	408	96.7
General anesthesia	14	3.3

Complications and management of mothers who gave birth via cesarean delivery

Hypertension during pregnancy was the most common obstetric complication diagnosed in 74 (17.5%) participants, followed by premature rupture of the membrane (PROM), in 58 mothers (13.7%). Approximately 25 mothers (5.9%) had at least one maternal complication that was diagnosed before discharge. The most common complication was postpartum hemorrhage (PPH), in 15 mothers (3.6%), of which 3 mothers required re-laparotomy and 13 mothers required blood transfusion. Puerperal sepsis was the second most common complication and was diagnosed in 7 mothers (1.7%). All the patients were managed with therapeutic antibiotics. There was no maternal death in our study. On the 7th postoperative day, 415 mothers (98.3%) were discharged, with an average hospital stay of 2.27 days ±0.776. (Figure 1)

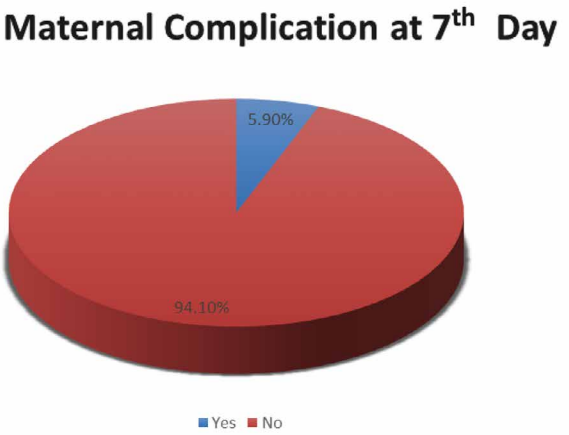

Figure 1: Proportion of mothers with respect to the 7th day outcome after CD; Addis Ababa, Ethiopia

Birth Outcomes of Newborns Delivered via Cesarean Section

Among the study participants, the majority of mothers (n = 299; 70.9%) delivered at term, between 37 and 41^{+6} weeks of gestation. Of the 422 cesarean deliveries, 18 involved twin pregnancies, yielding a total of 440 newborns. In terms of sex distribution, 226 (51.4%) were female and 214 (48.6%) were male.

Most newborns (n = 361; 82%) had a normal birth weight ranging from 2,500 to 3,999 grams. Furthermore, 93.2% of the infants had a 5-minute APGAR score of 8 or above, indicating good neonatal health at birth. However, 29 newborns (6.6%) required admission to the neonatal intensive care unit (NICU), with respiratory distress syndrome (RDS) identified as the leading cause (n = 17). Among NICU admissions, 22 infants (75.9%)

were diagnosed with neonatal hypothermia, of which 82% achieved temperature stabilization within six hours of admission.

Treatment modalities in the NICU included intravenous antibiotics for 15 newborns (51.7%) and continuous positive airway pressure (CPAP) for 7 cases (24.1%). By the seventh day of admission, 11 infants (37.9%) had been discharged, 5 (17.3%) remained in care, and 13 (44.8%) had succumbed to their conditions. The overall neonatal mortality rate among the 440 live births was 3% (Figure 2).

Relations ship of independent variables with maternal outcome for CD

A chi-square test was performed to evaluate the relationships between variables and maternal and neonatal outcomes.

The test results revealed that mothers with a prior history of CD had greater maternal complications than did those who had primary surgery. Similarly, mothers who underwent emergency CD were more prone to significant complications than were those who underwent elective CD. (Table 3)

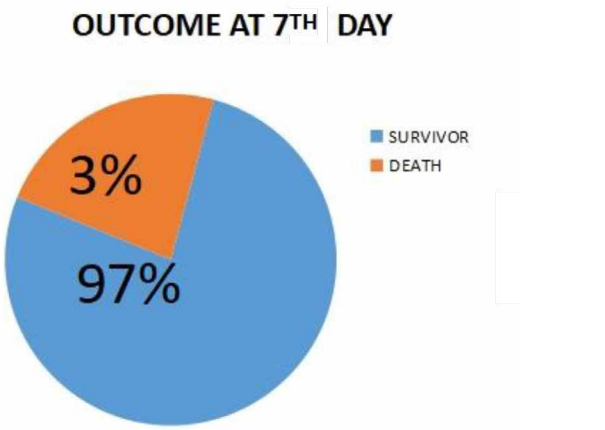

Figure 2: Proportion of new-borns with respect to the 7th day after CD; Addis Ababa, Ethiopia

Table 3- Relations ship between independent variables with maternal outcome for CD, Addis Ababa, Ethiopia, 2022. (n=422)

VARIABLES	MATERNAL COMPLICATION NO.	%	NO MATERNAL COMPLICATION NO.	%	x^2	Df	P-VALUE
PARITY					1.025	1	0.311
Nulliparous	11	44	216	54.4			
Multiparous	14	56	181	45.6			
ANC FOLLOW UP					0.845	2	0.656
Yes	25	100	385	96.7			
No			12	3.3			
*History of CD					4.195	1	*0.041
Yes	10	40	88	22.2			
No	15	60	309	77.8			
*Indication of CD					6.099	1	*0.014
Emergency	24	96	294	74			
Elective	1	4	103	26			
*APH					6.257	1	*0.012
Yes	4	16	18	4.5			
No	21	84	379	95.5			
ANESTESIA TYPE					1.817	1	0.178
SA	23	92	385	97			
GA	2	8	12	3			

Relationship between maternal variables and survival of new-borns after CD

The maternal characteristics revealed that parity was related with neonatal survival. Furthermore, maternal history of hypertension was also shown to be related with neonatal survival (Table 4).

Table 4- Relationship between maternal variables and survival of new-borns after CD in Addis Ababa, Ethiopia, 2022. (n=422 CD)

VARIABLES	DEATH		SURVIVOR		x2	df	P-VALUE
	NO.	%	NO.	%			
PARITY							
Nulliparous	6	46.2	221	54	5.872	1	*0.013
Multiparous	7	53.8	188	46			
HISTORY OF CD							
Yes	1	7.7	97	23.7	1.814	1	0.178
No	12	92.3	312	76.3			
INDICATION OF CD							
Emergency	11	84.7	307	74.3	0.619	1	0.431
Elective	2	15.3	102	25.7			
ANESTESIA TYPE							
SA	10	76.9	398	97.3	0.725	1	0.401
GA	3	23.1	11	2.7			
HYPERTENSION							
Yes	7	53.8	67	16.4	12.23	1	*0.001
No	6	46.2	342	83.6			

Relationship between infant variables and surviving newborns with CD

Among the neonatal variables, birth weight, 5th minute APGAR score, gestational age, and the need for neonatal resuscitation after delivery were found to be significantly related with neonatal survival. However, neither NICU admission diagnosis nor hypothermia at admission was found to be related with neonatal survival. (Table 5)

Table 5- Relationship between infant variables and surviving newborns with CD; Addis Ababa, Ethiopia, 2022. (n=161)

VARIABLES	DEATH		SURVIVOR		x2	df	P-VALUE
	NO.	%	NO.	%			
SEX							
Male	6	46.2	208	48.7	0.45	2	0.930
Female	7	53.8	219	51.3			
BIRTH WEIGHT							
<2500	8	61.5	30	7	47.51	1	*0.000
≥2500	5	38.5	397	93			
5th MIN APGAR SCORE							
≤7	11	84.6	16	3.7	43.24	1	*0.000
8-10	2	15.4	411	96.3			
GA (387)							
<37	5	55.6	12	3.5	57.43	1	*0.001
≥37	4	44.4	366	96.8			
NEONATAL RESUSITATION							
YES	12	92.3	16	3.7	66.05	1	*0.001
NO	1	7.7	411	96.3			

DISCUSSION

Non-reassuring fetal heart rate pattern (NRFHRP) was the most common clinical indication for CD, followed by cephalopelvic disproportion (CPD) and a prior history of CD. A similar order of indications was reported in a previous study conducted in Ethiopia.[16] Unlike in many other countries, the rate of repeat CD in our study was lower (23.2%).[17,18] This finding aligns with several other studies conducted in Ethiopia.[8, 19] This variation may be related to differences in trial of labor after cesarean delivery policies, which warrants further investigation. Additionally, consistent with studies from developing countries, our study found that the incidence of emergency CD (75.4%) was higher than elective CD.[16, 20, 21]

Maternal complications were observed in 5.9% of the study population. This rate is comparable to that reported by St. Paul's Hospital Millennium Medical College (5.2%)[1] but slightly lower than that of Ayder Comprehensive Specialized Hospital (8.5%).[17] However, the findings are similar to three other previous studies—two from Addis Ababa and one from southwest Ethiopia—which reported complication rates ranging from 4.7% to 9.7%.[15, 19, 22]

The lower incidence of post-CD maternal complications in this study may be attributed to the high antenatal care (ANC) coverage (97.2%), which is significantly higher than the national ANC coverage reported in the 2016 Ethiopian Demographic and Health Survey (62%) and consistent with ANC coverage in Addis Ababa (97%).[12, 22]

CD-related morbidity and mortality may result from the surgery itself as well as the type of anesthesia used. The debate between spinal and general anesthesia in terms of maternal and neonatal safety continues.[16, 17] In our study, spinal anesthesia was administered in 96.7% of all surgeries—significantly higher than the 49.7% reported by Felege Hiwot Referral Hospital.[4]

Elective CDs allow at least eight hours of preparation, offering time for both medical and psychological readiness, unlike emergency procedures. Consequently, our study found that emergency CD was significantly associated with maternal complications. Similar findings were reported in Faisalabad.[20, 21]

The national neonatal mortality rate decreased from 4.8% in 2000 to 2.9% in 2016, although regional disparities persist.[10] In this study, the neonatal survival rate was 97%, and the death rate was 3%, which aligns with findings from St. Paul's Hospital (2.8%) and West Tigray (2.4%).[1, 23]

Obstetric complications were significantly associated with infant survival. One explanation could be that neonates born to mothers with complications received better care, including antenatal dexamethasone administration and early NICU involvement.[9] Except for hypertensive disorders during pregnancy, which showed a significant association with neonatal death, other maternal complications did not.

Regarding neonatal variables, unlike findings from other studies where female neonates showed a survival advantage over males,[7, 14] our study did not find a significant relationship between neonatal sex and survival.

In our study, 57 mothers (13.5%) could not recall their last normal menstrual period (LNMP) or early pregnancy milestones. Given these limitations and discrepancies between antenatal and postnatal gestational age (GA) assessments, these cases were excluded from GA-survival analysis. This approach is consistent with similar studies from other developing countries.[1, 11] Among the remaining 365 participants, a significant association was found between GA and neonatal survival.

Many studies have shown that immediate neonatal resuscitation is a predictor of poor neonatal outcomes.[11, 24] Our findings corroborate this, as neonates requiring immediate resuscitation had a higher mortality rate.

Technological advances and improved NICU care have contributed to higher neonatal survival in recent decades.[5, 24] Among the 440 newborns in this study, 29 (6.6%) were admitted to the NICU.

Of these, 13 died, resulting in a NICU death rate of 44.8%. In comparison, St. Paul's Hospital reported a higher NICU admission rate (18.6%) but a lower NICU death rate (26.3%).[1] In our study, however, neither NICU admission diagnosis nor management was found to be significantly associated with neonatal outcomes.

In conclusion, NRFHRP was the leading indication for CD, followed by CPD and previous CD. Maternal complications were reported in 5.9% of cases, with postpartum hemorrhage being the most common. Factors such as previous CD, emergency CD, and antepartum hemorrhage were associated with maternal complications. Neonatal deaths occurred in 3% of cases. Factors associated with neonatal survival included nulliparity, hypertensive disorders, gestational age, birth weight, fifth-minute APGAR score, and immediate need for neonatal resuscitation.

The main limitations of the study include a homogenous sample population in terms of sociodemographic characteristics and the short inpatient stay duration, which limits long-term outcome assessment. Additionally, the data were not suitable for regression analysis to determine the strength of associations. Further longitudinal studies are recommended to better understand the impact of CD on maternal and neonatal outcomes.

DECLARATION

Ethics Approval and Consent to Participate:

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Review Board (IRB) of Yekatit 12 Hospital Medical College. Written informed consent was obtained from all participants before enrollment. Participant confidentiality was maintained throughout the study. Informed consent was obtained from parents/guardians or a legally authorized representative (LAR) for participants under the age of 16 or for those who were illiterate.

Consent for Publication:

All participants were informed that their data would be used solely for research purposes and that their identities would remain anonymous. Written informed consent for publication was obtained.

Availability of Data and Materials:

The data used in this study are available from the corresponding author upon reasonable request. All materials are publicly available or can be obtained from the corresponding author.

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