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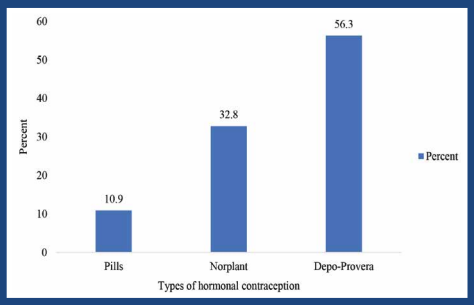

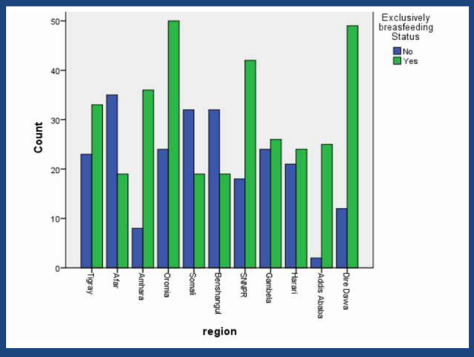

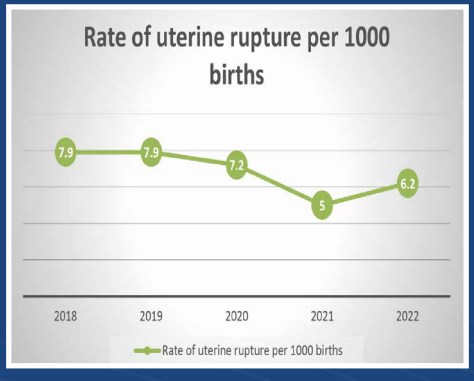

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FACTORS AFFECTING EXCLUSIVE BREASTFEEDING AMONG WOMEN WITH INFANTS UNDER SIX MONTHS IN ETHIOPIA: AN ANALYSIS OF THE 2019 ETHIOPIAN MINI DEMOGRAPHIC AND HEALTH SURVEY

Markos Abiso Erango[1], Gulilat Kurate Kutaye[1], Kabtamu Tolosie Gergiso[2]

ABSTRACT

BACKGROUND: Exclusive breastfeeding is a cost-effective intervention that reduces infant morbidity and mortality, supporting both physical and mental development. However, in Ethiopia, exclusive breastfeeding prevalence remains below WHO recommendations. This study aims to assess the prevalence of exclusive breastfeeding and identify the barriers hindering its practice among women with infants under six months of age in Ethiopia.

METHODS: This study utilized secondary data from the 2019 Ethiopian Mini Demographic and Health Survey, employing a cross-sectional design. A stratified, two-stage cluster sampling technique was used to select the study sample. In the first stage, 305 enumeration areas were selected, comprising 93 urban and 212 rural areas. In the second stage, households were randomly chosen, and a total of 573 women were included in the analysis. A multilevel logistic regression model was applied to identify the barriers significantly associated with exclusive breastfeeding practices.

RESULTS: The prevalence of exclusive breastfeeding was 59.86%, significantly below the World Health Organization's recommended threshold. A notable variation in exclusive breastfeeding prevalence was observed across Ethiopia's regional states, with an 8.30% difference. The random intercept binary logistic regression model was identified as the best fit for the data. Mothers aged 25–34 were 10.5% more likely to exclusively breastfeed than those aged 15–24 (OR = 1.105, P = 0.000). Mothers with secondary and higher education were 55.9% and 44.5% more likely to exclusively breastfeed compared to those with no formal education (OR = 2.559, P = 0.000; OR = 3.445, P = 0.000). Factors such as women's age, household wealth, education level, family size, place of delivery, antenatal care visits, residence, and delivery method were significantly linked to exclusive breastfeeding practices.

CONCLUSION: The findings highlight that exclusive breastfeeding rates are significantly below WHO recommendations. To address this, efforts should focus on educating mothers, especially those with no formal education, and encouraging breastfeeding among younger mothers. Increasing access to antenatal care, promoting facility-based deliveries, and providing breastfeeding support in healthcare settings are essential. Additionally, targeting regional disparities, supporting lower-income households, and encouraging family and community involvement will help improve exclusive breastfeeding practices.

KEYWORDS: Exclusive breastfeeding practice, barriers, multilevel model, EDHS, Ethiopia.

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INTRODUCTION

1.1 Background of the Study

According to the World Health Organization (WHO), exclusive breastfeeding (EBF) is the practice in which an infant receives only breast milk from the mother or a wet nurse for the first six months, with no other solids or liquids, except for drops or syrups containing vitamins, minerals, supplements, or medicines[1]. Breastfeeding provides essential nutrition and immunological protection for infants in the first six months, supporting both their physical and mental development. It offers short- and long-term health benefits for both mother and child, while also reducing formula feeding costs. Timely initiation and exclusive breastfeeding for the first six months can save over 820,000 children's lives annually, with the majority under six months of age[2,1].

Exclusive breastfeeding for the first six months protects infants from infections, supports healthy growth and early development, and strengthens the immune system—improving child survival and preventing chronic diseases. It is associated with better cognitive performance in childhood and adolescence and reduces the risk of obesity, type 2 diabetes, and premature death in later life. Furthermore, it reduces risks for both infants and mothers, including infections and long-term health issues such as cancer and heart disease, while also benefiting society by lowering healthcare costs and absenteeism[1,3].

Breastfeeding, when started within the first hour of birth and continued exclusively for six months with appropriate complementary foods, is crucial for child survival and well-being. Improving global breastfeeding rates could save over 820,000 children under five annually, with 87% being infants under six months[4].

Infants should be exclusively breastfed for the first six months to promote optimal growth and health. Breastfeeding is a vital public health strategy that reduces infant mortality, enhances maternal health, and lowers healthcare costs, particularly in developing countries where malnutrition and infections are major causes of child death. Inadequate breastfeeding and complementary feeding contribute to malnutrition and illnesses, hindering children's cognitive and physical development and affecting their future potential[4, 5]. Studies indicate that promoting exclusive breastfeeding can notably reduce neonatal and infant mortality, preventing around 1.4 million child deaths globally each year. The 2030 Agenda for Sustainable Development highlights breastfeeding-related goals crucial for child health. In Ethiopia, the rate of exclusive breastfeeding rose from 49% in 2005 to 58% in 2016, but the practice decreases as infants age, with many being introduced to other foods and liquids before six months—contrary to WHO recommendations[4, 6, 7, 8].

Exclusive breastfeeding practices are shaped by factors such as geography, residence, social influences like religion and culture, and the age and education of mothers and their husbands. Antenatal care, delivery location, and household income also play a crucial role, particularly in rural areas with food scarcity[9]. This study aims to identify the barriers to exclusive breastfeeding and explore key research questions related to risk factors, associations with socioeconomic and healthcare characteristics, regional variations, and contributing obstacles in Ethiopia.

2. Methods

2.1. Data Source and Study Design

The data for this study were obtained from the 2019 Ethiopia Mini Demographic and Health Survey (EMDHS), conducted by the Central Statistical Agency from March 21 to June 28, 2019. The survey was designed to provide estimates for key indicators at the national level, as well as separately for urban and rural areas and for each of the nine regions and two administrative cities, as part of the global Demographic and Health Survey project.

The sample was selected using a stratified, two-stage cluster design. Enumeration areas (EAs) were the first stage of sampling, with 305 EAs selected—93 from urban areas and 212 from rural areas. In the second stage, households were randomly selected, and the resulting household lists served as the sampling frame for identifying eligible households to be interviewed.

2.2. Study Variables

The outcome variable of this study was exclusive breastfeeding status, a dichotomous variable categorized as either "exclusive" or "not exclusive." This variable was coded as 1 for exclusive breastfeeding and 0 for non-exclusive breastfeeding.

Yi={1, if the ith mother is exclusively breastfeeding 0, if the ith mother is not exclusively breastfeeding Y_i = \begin{cases} 1, & \text{if the} i^\text{th} \text{mother is exclusively breastfeeding} \\ 0, & \text{if the } i^\text{th} \text{ mother is not exclusively breastfeeding} \end{cases}

The independent variables included in this study were demographic and socioeconomic factors such as the child's sex, birth order, breastfeeding initiation, mother's age, maternal education level, marital status, religion, place of residence, region, household wealth index, and family size. Additionally, obstetric and healthcare-related variables were included, such as antenatal visits, place of delivery, cesarean delivery, postnatal checkup within two months, and breastfeeding counseling by a healthcare provider within the first two days after birth.

2.3. Multilevel Logistic Regression Model

Multilevel modeling is a statistical method used to analyze relationships between dependent and independent variables when observations within groups are correlated. These models account for parameters that vary across multiple levels within the data[10].

Let yijy_{ij} be a binary response variable (0 or 1), with level-one units (children) nested within level-two units (regions), and xijx_{ij} as explanatory variables. The probability of the response being one, πij=P(yij=1)\pi_{ij} = P(y_{ij} = 1), is modeled using a logit link function, assuming a Bernoulli distribution for YijY_{ij}. The empty two-level model for a binary outcome defines group-dependent outcomes without additional explanatory variables, focusing on the population of groups (e.g., regions)[11,12].

This model includes random effects for both group and within-group variation, decomposing total variance into between-region and within-region components. The intraclass correlation coefficient (ICC) measures the correlation between individuals within the same region, while the random intercept model captures group differences in the average response, assuming a constant relationship between explanatory and response variables across groups[11].

logit(πij)=log⁡(πij1−πij)=β0j+∑h=1kβhxhij\text{logit}(\pi_{ij}) = \log\left(\frac{\pi_{ij}}{1 - \pi_{ij}}\right) = \beta_{0j} + \sum_{h=1}{k} \beta_h x_{hij}

Where:

- i=1,2,...,ni = 1, 2, \dots, n represents the number of children nested in the 11 regions;
- j=1,2,...,11j = 1, 2, \dots, 11 represents the region;
- The intercept term β0j\beta_{0j} is assumed to vary randomly and is given by the sum of an average intercept β0\beta_0 and group-dependent deviations: β0j=β0+u0j\beta_{0j} = \beta_0 + u_{0j}.

In the random coefficient model, both intercepts and slopes vary across regions, with group-specific regression of the logit of success probability on a level-one explanatory variable. This model includes random effects for both intercepts and slopes, assuming the random effects are independently and identically distributed across groups. Variance components—such as the random intercept variance,

random slope variance, and their covariance—are estimated. Model selection is conducted using methods like Maximum Likelihood Estimation (MLE), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC)[13].

Results

Descriptive Statistics

This study used a two-level hierarchical dataset, with 573 women nested within eleven geographical regions. The study aimed to examine barriers to exclusive breastfeeding (EBF) practices in relation to demographic, socioeconomic, obstetric, and healthcare-related factors. More than half of the women in the study, 337 (58.81%), lived in rural areas, with only 140 (24.23%) exclusively breastfeeding their infants. In contrast, 236 (41.87%) women resided in urban areas, and 203 (35.43%) of them practiced exclusive breastfeeding. Of the entire sample, 309 (53.93%) infants were female, while 264 (46.07%) were male. The prevalence of EBF practice was slightly higher in the 25–34 years age group, with 166 women (28.97%), and lower in the 35–49 years age group, with 21 women (3.64%). There were notable variations in the prevalence of EBF across the regional states of Ethiopia. The prevalence rates were 5.06% in Afar, 5.76% in Tigray, 6.29% in Amhara, 8.90% in Oromia, 4.88% in Somalia, 3.50% in Benishangul, 7.33% in SNNPR, 4.71% in Gambela, 4.36% in Harari, 3.83% in Addis Ababa, and 5.23% in Dire Dawa (Table 1).

Table 1, Distribution of Demographic, Socio-economic, Obstetric and health care related barriers on the prevalence of exclusive breastfeeding practice of mother's and infant's in the first 6 months of life in Ethiopia, EMDHS 2019 (n=573).

Variable	Categories	EBF status		x^2 (df)	P-value
		Yes (%)	No (%)		
Mother's age group in year	15-24	156(27.22)	70(12.22)	39.59 (2)	0.000
	25-34	166(28.97)	61(10.65)		
	35 and above	21(3.64)	99(17.27)		
Mother's Region	Tigray	23(4.01)	33(5.76)	43.32 (10)	0.000
	Afar	29(5.06)	35(6.10)		
	Amhara	36(6.29)	8(1.40)		
	Oromia	51(8.90)	24(4.18)		
	Somali	28(4.88)	32(5.58)		
	Benshangul	20(3.5)	31(5.41)		
	SNNPR	42(7.33)	18(3.14)		
	Gambela	27(4.71)	23(4.01)		
	Harari	25(4.36)	20(3.5)		
	Addis Ababa	22(3.83)	2(0.35)		
	Dire Dawa	30(5.23)	12(2.09)		
Place of residence	Urban	203(35.43)	33(5.76)	14.77 (1)	0.000
	Rural	140(24.43)	197(34.38)		
Educational level of mother's	No education	17(2.97)	133(23.21)	26.89 (3)	0.000
	Primary	108(18.85)	60(10.47)		
	Secondary	153(26.70)	35(6.11)		
	Higher	65(11.34)	2(0.35)		
Religion	Muslim	96(16.75)	63(10.10)	22.28 (3)	0.000
	Orthodox	134(23.38)	95(16.58)		
	Protestant	111(19.38)	67(11.70)		
	Others	2(0.35)	5(0.87)		
Marital status of mother's	Never in Union	2(0.35)	6(1.05)	7.11 (2)	0.000
	Currently in union	336(58.64)	210(36.65)		
	Widowed/Divorced	5(0.87)	14(2.44)		
Consultancy about EBF	No	123(21.46)	140(24.43)	2.30 (1)	0.000
	Yes	220(38.39)	90(15.71)		
Birth order of infant	1st	152(26.53)	46(8.03)	0.35 (2)	0.548
	2nd – 3rd	100(17.45)	85(14.83)		
	4th and above	91(15.88)	99(17.28)		
Sex of infants	Female	180(31.41)	129(22.51)	1.49 (1)	0.000
	Male	163(28.45)	101(17.63)		
Place of delivery 0.000	other than health facility		153(26.70)	142(24.78)	12.74 (1)
	Health facility	190(33.16)	88(15.36)		
Antenatal visits	Not	42(7.33)	108(18.85)	135.45 (2)	0.000
	1-3	101(17.63)	73(12.74)		
	4th and above	200(34.90)	49(8.55)		
Initiation of breastfeeding	<1 Hour of Birth	238(41.53)	94(16.40)	20.79 (1)	0.000
	>1 Hour of Birth	105(18.32)	136(23.73)		
Postnatal check within 2 months	No	131(22.86)	143(24.95)	31.20 (1)	0.000
	Yes	212(37.00)	87(15.18)		
Caesarean delivery	No	259(45.20)	72(12.56)	123.59 (1)	0.000
	Yes	84(14.66)	158(27.57)		
Household family size	<= 5,	203(35.42)	97(16.93)	8.84 (1)	0.000
	>5,	140(24.43)	133(23.21)		
Household wealth index	Poor	52(9.07)	162(28.27)	34.31 (2)	0.000
	Middle	193(33.68)	57(9.95)		
	Rich	98(17.11)	11(1.92)		

Education is a significant predictor of exclusive breastfeeding (EBF) practices, as evidenced by numerous studies. The percentage of women practicing EBF varied by education level: 17 women (2.97%) with no education, 108 women (18.85%) with elementary education, 153 women (26.70%) with secondary education, and 65 women (11.34%) with higher education. Additionally, the frequency of EBF practice was influenced by the infant's birth order: 152 first-born children (26.53%), 100 second- or third-born children (17.45%), and 91 children of fourth-born or higher (15.88%) practiced EBF

Characteristics of Infants and Mothers

Regarding the timing of breastfeeding initiation, 105 babies (18.32%) began nursing more than an hour after birth, while 238 babies (41.53%) started within the first hour of delivery. These figures emphasize the prevalence of exclusive breastfeeding (EBF) practices. In terms of family size, 140 women (24.43%) with families of more than five members and 203 women (35.42%) with families of five or fewer reported practicing EBF. Additionally, antenatal care (ANC) visits were associated with the prevalence of EBF: 42 women (7.33%) had not attended any ANC visits, 101 women (17.63%) had attended one to three visits, and 200 women (34.90%) had attended three or more ANC visits.

The prevalence of exclusive breastfeeding (EBF) practices also varied based on the place of residence. Among women who gave birth at health facilities, 190 (33.16%) practiced EBF, whereas among those who gave birth outside health centers, 153 (26.70%) practiced EBF. Regarding postnatal care (PNC) visits, the prevalence of EBF was higher among women who had PNC visits within two months of childbirth (212 women, or 37.00%) compared to those who did not have PNC visits within two months (131 women, or 22.86%). Lastly, counseling about EBF also influenced its practice: 220 women (38.39%) who received counseling from healthcare providers during the first two days after birth practiced EBF, while only 123 women (21.46%) who did not receive counseling practiced EBF.

Test of Association

The Chi-square test of association was used to examine the relationship between exclusive breastfeeding (EBF) practice and various socio-economic, demographic, obstetric, and healthcare-related factors. The results in Table 1 show that factors such as the child's sex, breastfeeding initiation, mother's age, maternal education level, marital status, place of residence, region, household wealth index, family size, antenatal visits, place of delivery, Caesarean delivery, postnatal checkup within two months, and counseling about EBF from healthcare providers during the first two days after birth were all significantly associated with EBF practice at the 5% level of significance. The Chi-square test revealed variation in women's characteristics across Ethiopian regions, with a Chi-square value of $x^2 = 43.3$, degrees of freedom (df) = 10, and a p-value of 0.000. This indicates regional heterogeneity, suggesting that the multilevel binary logistic regression model is an appropriate choice to account for the variation in women's characteristics across regions in Ethiopia. Additionally, Figure 1 below shows the percentage distribution of exclusive breastfeeding in Ethiopia. The plot further highlights regional variations in the prevalence of exclusive breastfeeding practice among mothers (see Figure 1).

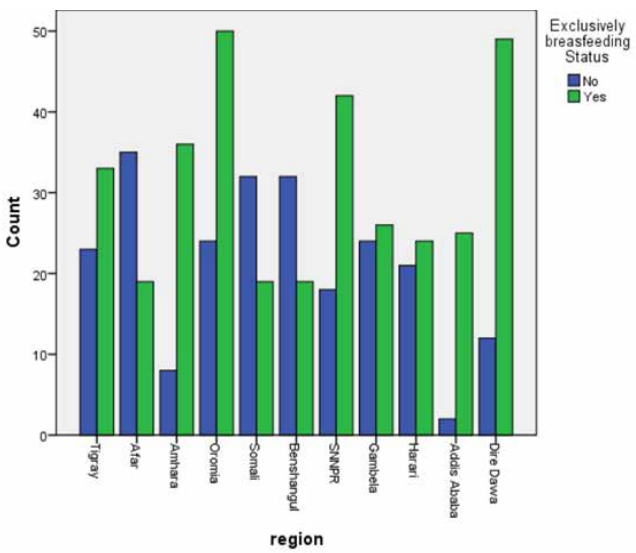

Figure 1: The plots of the percentage distribution of exclusive breastfeeding in Ethiopia Vs. region

Multilevel Logistic Regression analyses

A multilevel stepwise logistic regression was employed for this analysis. In the first stage, the null model was used to assess the overall probability of exclusive breastfeeding (EBF) practice without adjusting for any covariates. In the second stage, both multilevel and single-level analyses were conducted, focusing on fixed slopes and random intercepts. In the third stage, a multilevel logistic regression model with two levels random intercept and random slope (random coefficient) was applied. The empty model is considered as a parametric version of assessing heterogeneity of regions for EBF practice. The empty model estimates using Laplacian approximation, we can say that the log odds of EBF practice in an 'average' region (one with Uoj = 0) is estimated as $\beta o = -0.6104$. The intercept for region j is -0.6104 +Uoj, where the variance of Uoj is estimated as $\delta_{ou}^2 = 0.899$. The likelihood ratio statistic for testing the null hypothesis, that $\delta_{ou}^2 = 0$, can be calculated by comparing the two-level model, with the corresponding single-level model without the level 2 random effects. The LRT test statistic x^2 is 11.84, corresponding p-value (<0.001), with 1 degree of freedom, suggests that there is strong evidence that the between-region variance is non-zero.

The likelihood ratio test specifies the null and alternative hypothesis as follows; Ho: δ^2(region)= 0 (there is no regional variation in the EBF practice in Ethiopia, i. e single level logistic regression best fit the data) Versus Hl: δ^2(region)≠ 0 (there is regional variation in the EBF practice in Ethiopia, i. e multilevel logistic regression best fit the data). The likelihood ratio test statistics is 11.84, df = 1, with (P<0.001) hence, there is strong evidence to reject the null hypothesis and conclude there is regional variation in the EBF practice in Ethiopia at 5% of level of significance.

To create a random-intercept logistic regression model, we introduced a region-specific random intercept into the linear predictor, which relaxed the assumption of conditional independence among responses within the same region, given the covariates. The model's results indicated that factors such as the mother's age group, wealth index, education level, family size, place of delivery, antenatal care (ANC) visits, place of residence, and mode of delivery were all statistically significant. These findings suggest that these factors significantly influence exclusive breastfeeding (EBF) practices and contribute to the regional variations observed across Ethiopia.

The overall average odds of EBF are estimated to be -0.99 which is decreased by 0.38 as compared to an empty model (Table 2), indicating that many

Table 2: Result of Parameter Estimate of empty Model

Fixed part	Coef.	Std.Err.	Z-value	P-value|	95% CI
(βo) = Intercept	-0.6104	0.1863	-3.274	0.001	[-0.975, -0.245]
Random part	Variance	ICC (Rho (ρ)) = 0.2146			
(δuo^2) =Var (U_0j) level two variance	0.899				
Deviance-Based Chi-Square (($\chi 2$) = 11.84)) p-value(0.000)					
	Number of obs: 573, groups: region, 11				

variables that are included in this model has impacts on the EBF practice across the country. The result of intercept model displayed in (Table 3) also estimates that, the variance of random effect at the regional level Var (u_0j) = 0.8112, which is significant and indicating that there is a variation in the prevalence of EBF practice among regional state of Ethiopia.

There is reduction of variance between the empty multilevel model δ2_u0= 0.899 and the intercept variance of the random effect var (u_0j)= 0.8112. The reduction of the random effects of the intercept variance is due to the inclusion of fixed explanatory variables. That is, taking into account the fixed independent variables can provide extra predictive value on EBF practice in each region.

The results presented in Table 3 show that the intra-region correlation coefficient (ICC) was estimated at 0.2146, indicating that 21.46% of the total variability in exclusive breastfeeding (EBF) practices can be attributed to differences between regions. The remaining 78.54% of the variability is due to individual differences within regions.

The results revealed that mothers in the age group of 25–34 years were 10.5% more likely to exclusively breastfeed their infants compared to mothers in the 15–24 years age group (OR = 1.105, P = 0.000; 95% CI: 1.040, 1.173). Conversely, mothers in the 35–49 years age group were 74% less likely to exclusively breastfeed their infants compared to those in the 15–24 years age group (OR = 0.261, P = 0.000; 95% CI: 0.113, 0.605).

Regarding maternal education, mothers who completed secondary and higher education were 55.9% (OR = 2.559, P = 0.000; 95% CI: 0.891, 7.352) and 44.5% (OR = 3.445, P = 0.000; 95% CI: 2.584, 4.592) more likely to exclusively breastfeed their children compared to mothers with no formal education. Additionally, mothers who made antenatal care (ANC) visits of 1-3 times and 4 or more times were 64.5% (OR = 1.645, P = 0.000; 95% CI: 1.950, 2.532) and 67% (OR = 1.670, P = 0.000; 95% CI: 1.035, 2.699) more likely to exclusively breastfeed their child compared to those who did not make any ANC visits. In terms of place of delivery, mothers who delivered at a health center were 80% (OR = 1.20, P = 0.000; 95% CI: 1.014, 1.442) more likely to exclusively breastfeed their child compared to those who delivered elsewhere (see Table 3 below).

Table 3: Results of Multi level random intercept with fixed effects model

		Fixed effects(Measures of association)					
Variables	**Categories**	**β**	**Se(β)**	**Z value**	**P value**	**exp(β)**	**95%CI for exp(β)(β)**
Intercept		-0.99	0.286	-3.474	0.000	0.371	[0.212, 0.649]
Age group of mothers	19-24 (Ref)						
	25-34	0.102	0.031	3.290	0.000	1.105	[1.040, 1.173]
	35-49	-1.34	0.428	-3.139	0.000	0.261	[0.113, 0.605]
Educational level of mothers	No - edu (Ref)						
	Primary	0.628	0.154	4.069	0.000	1.874	[1.385,2.536]
	Secondary	0.738	0.162	4.566	0.000	2.091	[1.523,2.869]
	Higher	1.237	0.147	8.435	0.000	3.445	[2.584, 4.592]
Residence	Urban(Ref)						
	Rural	-1.68	0.363	-4.628	0.000	0.186	[0.091, 0.379]
Place of delivery	Home(Ref)						
	Health facility	.190	.090	2.111	0.000	1.20	[1.014, 1.442]
family size	<=5 (Ref)						
	>5	-0.62	0.113	-5.486	0.000	0.537	[0.431, 0.671]
Caesarean delivery	No (Ref)						
	Yes	-0.34	0.13	-2.615	0.000	0.711	[0.551,0.918]
Antenatal visits	Not (Ref)						
	1-3	0.498	0.220	2.263	0.024	1.645	[1.950, 2.532]
	4 and above	0.513	0.245	2.093	0.037	1.670	[1.035, 2.699]
Household wealth index	Poor(Ref)						
	Middle	0.098	0.031	3.161	0.002	1.103	[1.037, 1.172]
	Rich	0.565	0.149	3.791	0.000	1.759	[1.313, 2.356]
Random part (δ_{ou}^2)	Variance 0.8112			ICC (Rho (ρ))= 0.065			
Deviance-Based Chi-Square ((χ2) = 599.4804))				p-value (0.000)			
Number of obs: 573, groups: region, 11							

3.5 Results of Multi level random coefficient model

It is possible to extend the model such that the effect of level-1 covariates varies across regions. In the random intercept model, we allowed only the intercept to vary across regions while fixing the explanatory covariates. However, the relationship between the explanatory and dependent variables can differ between groups. In this extended model, we tested the variables that significantly impact exclusive breastfeeding (EBF) in the intercept model by observing their respective regional effects. Consequently, regional-level variables that are expected to vary by region, such as household wealth index and place of residence, were examined (see Table 4).

Table 4, Results of Multi level random coefficient model

Variables	Categories	Fixed effects(Measures of association) β	Se(β)	Z value	P value	exp(β)
Intercept		-0.612	0.256	-2.390	0.017	0.542
Age group of mothers	19-24(Ref)					
	25-34	0.102	0.024	4.250	0.000	1.107
	35-49	-1.569	0.232	-6.75	0.000	0.208
Educational level of mothers	No - edu (Ref)					
	Primary	0.521	0.177	2.940	0.003	1.683
	Secondary	0.675	0.191	3.536	0.000	1.964
	Higher	1.080	0.217	4.973	0.000	2.947
Residence	Urban (Ref)					
	Rural	-1.244	0.176	-7.055	0.000	0.288
Place of delivery	Home(Ref)					
	Health facility	0.312	0.132	2.360	0.018	1.366
family size	<=5 (Ref)					
	>5	-0.775	0.224	-3.467	0.000	0.461
Caesarean delivery	No (Ref)					
	Yes	-0.582	0.217	-2.679	0.007	0.559
Antenatal visits	Not (Ref)					
	1-3	0.666	0.116	5.729	0.000	1.946
	4 and above	0.233	0.115	2.026	0.043	1.262
Household wealth index	Poor(Ref)					
	Middle	0.098	0.031	3.161	0.002	1.103
	Rich	0.289	0.097	2.990	0.003	1.335
Random part		Variance Component		S.D		ICC (Rho (ρ))= 0.12
(σo2) =Var (U0j)	0.4430	0.6656				
(σ12) =Var (U1j)	0.7285	0.8535				
(σ22) =Var (U2j)	0.1161	0.3407				
σ10 = Cov(U1j,U_0j)	0.544	0.737				
σ02 = Cov(U0j,U_2j)	0.167	0.408				
σ12 = Cov(U1j,U_2j)	0.194	0.440				
Deviance-Based Chi-Square ((χ2) = 583.31))		p-value (0.000)				

Number of obs: 573, groups: region, 11

Comparison among Multilevel Logistic Regression Models

The model fit statistics (Deviance = 273.7, AIC = 337.9, and BIC = 446.5) for the random intercept model are considerably smaller than those of the other multilevel models, indicating that the random intercept model provides the best fit for the data. The deviance-based chi-square test for random effects in the random coefficient model was not statistically significant (p = 0.3708), and this model also had larger AIC and BIC values compared to the random intercept model. Therefore, the random intercept model with fixed effects is the best-fitting model for the dataset (see Table 5).

Table 5: Comparison of Multilevel Logistic Regression Model

Fitted Model	Empty Model	Random Intercept Model	Random Coefficient Model
-2*Log Likelihood	861.353	289.8906	273.8
Deviance-Based Chi-Squared Value	11.84	599.4804	583.31
P-value	0.000	0.000	0.3708
		Model Fit Diagnostics	
Deviance	861.4	273.7	289.9
AIC	865.4	337.9	351.7
BIC	874.4	446.5	528.2

Discussion

In this study, the prevalence of exclusive breastfeeding (EBF) practice was 59.86%. This finding is consistent with previous studies conducted in Ethiopia, which also reported a prevalence of 59.86%[14]. However, it is lower than findings from studies in Malawi, Zimbabwe, and Ghana, where the prevalence rates were 76%, 78%, and 68.6%, respectively[15,16]. On the other hand, the prevalence in this study was higher than figures reported in studies from India (48.5%)[17], Mexico (28%)[18], and China (29.5%)[19]. This discrepancy in the prevalence of EBF may be attributed to differences in study period, study design, age distribution of infants, socio-economic status, socio-cultural factors, and health service utilization across study areas. The current study found that place of residence was significantly associated with EBF practice, which aligns with previous studies conducted in Ethiopia[20], Saudi Arabia[21], and Cambodia[22]. This may be due to urban women—often engaged in permanent or temporary employment—spending a significant amount of time away from their children. However, this finding contrasts with a study from Indonesia[23] , which found that women residing in urban areas were more likely to practice EBF than those in rural areas.

Additionally, this study showed that maternal education level was significantly associated with EBF practice, with higher education positively linked to increased EBF rates. This result is consistent with findings from studies in Ethiopia[15,24] and Myanmar[25], which revealed that maternal education has a positive effect on EBF practice. A possible explanation is that more educated mothers are likely to be more aware of the benefits of EBF through reading informational materials and understanding counselling messages more effectively than mothers with lower or no education.

The current study also found a significant association between the household wealth index and EBF practice. This finding is consistent with studies in Ghana, India, and Maharashtra[16, 25, 26]. A possible explanation is that wealthier women may have greater access to breastfeeding-related information and improved negotiating power for flexible work hours, enabling them to stay at home and exclusively breastfeed. Conversely, the lower use of EBF among women in the poorest wealth index group may be due to lack of awareness and stressful living environments.

The study also revealed that women who attended antenatal care (ANC) visits during their most recent pregnancy were more likely to practice EBF than those who did not attend ANC. This finding is consistent with prior studies conducted in Ethiopia[27,28,29], Egypt[30], Malawi[13], Myanmar[24], and India[31]. ANC visits provide opportunities

for health professionals to educate mothers on the benefits of exclusive breastfeeding, which may encourage them to adopt this practice.

Additionally, this study found that family size was significantly associated with EBF practice. Women with larger families were less likely to practice EBF compared to those with smaller families. This finding is consistent with studies conducted in Ethiopia[32] and India[31]. A possible explanation is that mothers with larger families may be busier managing multiple family members, which can divert their attention from exclusively breastfeeding their infants.

Furthermore, our study revealed that the mode of delivery was a significant factor associated with EBF practice. Women who gave birth by cesarean section were less likely to practice EBF than those who delivered vaginally. This finding aligns with studies conducted in Ethiopia[31,32]. One possible explanation is that cesarean deliveries, which may result in postoperative pain and discomfort, could make it more difficult for mothers to engage in exclusive breastfeeding compared to those who had vaginal deliveries.

Additionally, place of delivery was found to be a significant factor associated with EBF practice. Women who gave birth in health facilities were more likely to exclusively breastfeed their infants than those who gave birth at home. This result is consistent with earlier studies in Ethiopia[19,31,27,32], as well as studies in Malawi13and Myanmar[24]. A possible explanation for this finding is that women delivering in health facilities are more likely to receive counselling from health professionals, who emphasize the importance of exclusive breastfeeding for the first six months of life[19].

Conclusions

This study highlights key factors influencing exclusive breastfeeding (EBF) in Ethiopia, including socio-economic, demographic, obstetric, and healthcare-related aspects. Urban women, those with higher education, and those with access to healthcare are more likely to practice EBF, while rural women, older mothers, those with no education, and lower-income households face more barriers. EBF rates remain below WHO recommendations, requiring efforts to educate mothers, increase antenatal care attendance, promote facility-based deliveries, and address regional disparities. Targeting these factors and involving families and communities will help improve EBF practices.

Availability of Data and Material

The dataset for this study was sourced from the publicly available 2019 Ethiopian Mini Demographic and Health Survey (EMDHS) at https://dhsprogram.com/data/available-datasets.cfm. The data used for the final analysis can be requested from the corresponding author upon reasonable request. Permission to use the publicly available EDHS data, which excludes personal identifiers, was granted by the Measure DHS International Program.

Consent for Publication

Not applicable.

Competing Interests

The authors declare that they have no conflicts of interest.

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FACTORS INFLUENCING MENARCHE AGE AND MENSTRUAL PROBLEMS IN ADOLESCENT GIRLS IN ADDIS ABABA, ETHIOPIA

Seid Arage[1], Dawit Worku[1], Ahmed Muhye[2]

ABSTRACT

INTRODUCTION: Menarche, the onset of menstruation, is a significant turning point for teenage girls globally. The age of menarche and associated menstrual health challenges have far-reaching implications for the physical, emotional, and social well-being of young women. Despite the importance of this topic, there is limited research on the factors influencing teenage girls' menarche age and menstruation issues in Addis Ababa, Ethiopia. This study aimed to address this gap by exploring the determinants of menarche age and the prevalence of menstrual problems in this population.

METHODS: An institution-based cross-sectional study was conducted among 380 randomly selected adolescent high school girls from government and private schools in Addis Ababa. Data were collected via a self-administered, semi-structured questionnaire and analyzed using SPSS version 20. Statistical significance was set at $p < 0.05$.

RESULTS: The mean menarche age was 13.42 ± 1.35 years. Attending private schools (AOR = 2.0; 95% CI: 1.28–3.12; p = 0.001) and higher family income (AOR = 4.0; 95% CI: 22.02–72.01; p = 0.002) were significant predictors of earlier menarche. Lower menarcheal age increased the risk of menstrual pain (AOR = 6.92; 95% CI: 3.7–12.89; p = 0.001) and school absenteeism (AOR = 2.74; 95% CI: 1.34–5.62; p = 0.005). However, maternal education (AOR = 0.56; 95% CI: 0.37–1.84; p = 0.006), smaller family size (AOR = 0.65; 95% CI: 0.40–1.05; p = 0.08), physical activity (AOR = 1.60; 95% CI: 0.01–2.56; p = 0.06), and vegetable intake (AOR = 0.99; 95% CI: 0.67–1.47; p = 0.97) were not associated with menarche age.

CONCLUSION: These findings highlight the complex, multifaceted factors influencing the onset of puberty and the menstrual experiences of adolescent girls in Ethiopia. Comprehensive interventions addressing sociocultural, economic, and educational barriers are crucial to empower girls and promote their overall health and educational outcomes.

KEYWORDS: Adolescent girls; Menarche; Menstrual pain; Ethiopia

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INTRODUCTION

Menarche, the onset of menstruation, marks a critical transition in the lives of adolescent girls, influencing their physical, emotional, and social well-being. Over the past several decades, the global average age of menarche has declined, now ranging between 12 and 13 years, due to factors such as improved nutrition, environmental influences, and changing physical activity levels[1,2]. While earlier menarche can have health implications, including increased risks of reproductive cancers and metabolic disorders, its impact varies across different populations[3].

In Africa, the age of menarche varies significantly across countries and socioeconomic groups[4]. Studies from sub-Saharan countries such as Ghana, Nigeria, and Kenya report an average menarche age between 12 and 14 years, similar to global trends, but with rural populations often experiencing a later onset due to nutritional and environmental factors[4,5]. Additionally, menstrual health challenges—including dysmenorrhea, menorrhagia, irregular cycles, and inadequate access to hygiene products—are widespread across the region and contribute to school absenteeism and social stigma[6, 7].

Ethiopia, with its diverse socioeconomic and cultural landscape, provides a unique case for studying these challenges. Studies indicate that Ethiopian girls experience menarche between 13 and 15 years of age, influenced by nutritional status, physical activity, and cultural practices[8, 9, 10]. Similar to other sub-Saharan African countries, menstrual health problems are prevalent, exacerbated by poverty, limited healthcare access, and persistent social taboos[11, 12].

Despite the significance of this issue, research on menarche age and menstrual health problems among adolescent girls in Addis Ababa is limited. This study aimed to explore the determinants of menarche age and the prevalence of menstrual health challenges among adolescent girls in Addis Ababa, Ethiopia. By identifying key factors, the findings can inform public health policies and interventions to improve menstrual health and well-being among Ethiopian adolescents.

Method

Study Setting

The study was carried out in Addis Ababa, the capital city of Ethiopia. With 10 sub-cities, the metropolis is home to an estimated 4.6 million people, with an annual growth rate of 3.8%[13]. According to the 2015/2016 Addis Ababa City Government Education Bureau report, the city's schools are categorized into primary (grades 1–8), secondary (grades 9–10), and preparatory (grades 11–12). There were 217 secondary schools (66 governmental and 151 private) in the city, with a total of 105,440 first-cycle high school students, of whom 58,147 (55%) were female. On average, each classroom had 47 students in government schools and 30 students in private schools[14].

Study Design

The study employed an institution-based cross-sectional design.

Source and Study Population

The source population consisted of all female students in Addis Ababa who attended grades 9 and 10 during the 2017/18 school year. The study population included female adolescents who were enrolled in grades 9 and 10 in daytime classes at the randomly selected schools during the same academic year.

Eligibility Criteria

The study included all female students attending regular classes. Students who had not begun menstruation and those absent during data collection were excluded.

Sample Size Determination and Sampling Procedure

The sample size was determined using the single population proportion formula, assuming a 95% confidence level, 5% margin of error, and 55%

prevalence of menarche between ages 13 and 14, based on a previous study[4]. The estimated sample size was 380, and with a 10% non-response rate considered, the final sample size was 418.

A stratified random sampling technique was employed. Both government and private schools offering grades 9–10 (secondary first cycle) were considered. From the total of 217 schools, two private and two government schools were randomly selected. The total sample of 418 participants was proportionally allocated based on school type, reflecting a 1:4 student ratio (22% private and 78% government). Accordingly, 84 students were selected from private schools and 334 from government schools. Sections from each selected school were chosen randomly via the lottery method. Student lists were obtained from class teachers, and participants were randomly selected from each section.

Study Variables

Dependent Variable:

- Mean age at menarche

Independent Variables:

- Personal factors: grade level, school type (private/government), sleep duration, physical activity, dietary habits
- Family factors: family size, parental education, and socioeconomic status

Data Collection Tool and Procedures

A structured, self-administered questionnaire was used for data collection. The questionnaire was adapted from existing literature on similar studies. It was prepared in English and pretested on 20 students at a different school to ensure clarity and consistency.

Two diploma nurses with prior data collection experience were hired as data collectors. The principal investigator supervised the process. Questionnaires were reviewed for completeness and consistency immediately after data collection, and issues were addressed on the spot.

Data Entry and Analysis

Data were entered into SPSS version 20 for management and analysis. Descriptive statistics and logistic regression were used to summarize and assess the data. The mean age at menarche was the dependent variable, and sociodemographic variables were analyzed as independent factors. A 95% confidence interval and p-value < 0.05 were considered statistically significant.

Data Quality Management

Two female diploma nurses with previous experience were trained for one day before data collection. A pretest was conducted to ensure the appropriateness and clarity of the tool.

Ethical Considerations

Ethical approval was obtained from the Addis Ababa University Department of Obstetrics and Gynecology Research and Publication Committee. Permission was also secured from the school administration. During data collection, confidentiality was maintained, students' rights were respected, and a comfortable environment was provided to encourage honest participation.

Results

Socio-demographic characteristics of the study participants

Out of the 418 questionnaires distributed, 38 were discarded due to incomplete information regarding the month of birth and/or month and year at menarche. Consequently, 90% response rate data were analyzed. The age of study participants extended from 13 years to 19 years, with a mean age of 16.38 ± 1.11 years. Majority of the students, 222 (58.4%), were in grade 9, while 158 (41.6%) were in grade 10. Most of the participants, 304 (80%), attended governmental schools, and 76 (20%) attended private schools.

The family size varied, with 109 (28.7%) having 1-4 members, 233 (61.3%) having 5-8 members, and 38 (10.0%) having more than 8 members. The

educational status of the parents showed that 183 (52.1%) of fathers and 219 (60.8%) of mothers had education up to grade 8, while 168 (47.9%) of fathers and 141 (39.2%) of mothers had education grade 9 and above. Regarding the socioeconomic status, based on the wealth index, indicated that 96 (26.4%) and 49 (13.5%) of the families were in the low and high-income class category, respectively (Table 1).

Table 1: Socio-demographic profile of the study participants, Addis Ababa, Ethiopia.

Variable	Subgroups	Number (%)
Age	<15	49(12.9)
	≥15	331(87.1)
Grade	9	222(58.4)
	10	158(41.6)
Ethnicity	Oromo	93(24.5)
	Amhara	150(39.5)
	Tigray	33(8.7)
	Gurage	96(25.3)
	Others	8(2.1)
Religion	Orthodox	294(77.4)
	Islam	54(14.2)
	Protestant	29(7.6)
	Catholic	3(0.8)
Live with	Both parents	211(55.5)
	Only Mother	66(17.4)
	Only Father	11(2.9)
	Brother/sister	21(5.5)
	Other relatives	69(18.2)
	Alone/Friends	2(0.6)
Family size	1-4	109(28.7)
	5-8	233(61.3)
	>8	38(10.0)
Father's educational status	Up to grade 8	188(49.5)
	grade 9 & above	172(45.3)
Mother's educational status	Up to grade 8	229(60.3)
	grade 9 & above	151(39.7)
Mother's job	House wife	183(48.2)
	Private work	105(27.6)
	Gov. employer	87(22.9)
Father's job	Private works	257(67.6)
	Gov. employer	97(25.5)
	Daily laborer	46(12.1)
Wealth status (index)	High income	54(14.2)
	Low income	102(26.8)
	Middle income	224(58.9)

Age at menarche

The mean age at menarche among the participants was 13.42 ± 1.35 years, with a median age of 13.45 years. This was 13.64 ± 1.32 years for girls attending governmental schools, while it was 12.56 ± 1.13 years for private schools, showing a mean age difference of 1.08 years. Half of the girls reached menarche at the age of 12 or 13 years. Assuming no grade repetition, 329 (86.5%) of the girls began menstruating while in primary school, with about 50% starting at grade 7 or below. The 25th percentile of age at menarche was 12.5 years, and the 75th percentile was 14.33 years. The onset of menstruation was fairly distributed throughout the academic calendar, with a slight peak in September (13.7%).

Menstruation history and menstruation related health problems

The time period of menstrual days fluctuated between two to eight in 87.2% of the girls, while 12.8% experienced periods lasting more than eight days. The menstrual cycle length was normal (21-35 days) in 77.9% of the girls, with 51.8% having cycles every 21-28 days and 26.1% having cycles every 28-35 days. However, 17.1% had irregular menstrual cycles, with 7.1% experiencing periods longer than 35 days and 10% experiencing cycles shorter than 21 days.

Awareness about menstruation before menarche was reported by 89.2% of the girls. A total of 349 (91.8%) had at least one person who advised them about menstruation, with mothers (34.5%), sisters (19.7%), and teachers (17.4%) being the most common sources of information. Fathers and brothers were the least consulted, with only 9 (2.4%) of the girls communicating with their fathers about menstruation.

The participants were asked to identify their preferred sources of advice regarding menstruation. The majority (52.9%) indicated their mothers, followed by 14.2% who chose their sisters, and 12.1% who preferred their friends. Only 7.9%

opted to seek information from teachers, health professionals, or through reading.

The emotional reactions of adolescents at the time of menarche varied significantly. Approximately 49.5% of the adolescents reported a neutral feeling, while 6.8% felt joyful. A notable 24.7% experienced confusion and uncertainty about what to do. Additionally, 11.1% of the adolescents cried, and 5% felt embarrassed. Extreme emotional reactions, such as fainting, were reported by 1.8% of the adolescents.

The study revealed that menstruation was associated with various health problems, abnormal emotional reactions, absenteeism from school, and perceived negative impacts on academic performance. About 62.1% of the adolescents reported experiencing health problems at the time of menarche. The most common adverse event was abdominal pain or backache, affecting 45% of the girls, followed by irregular bleeding in 13.6% of the girls. Other adverse health events included depression, headaches, and other symptoms with varying proportions. The severity of pain was also assessed, with 26.3% of students experiencing severe pain that led to school absenteeism, and 17.9% experiencing moderate pain that required medication for restricted activity due to the pain.

Absenteeism from school was reported by 38.4% of the girls. The primary reason for school absenteeism was adverse health problems associated with menarche, accounting for 85.6% of the cases. Additionally, the absence of facilities such as private toilets, changing rooms, and water was cited as reasons for school absenteeism by 14.4% of the girls (3.4%, 8.2%, and 2.7%, respectively). Furthermore, 21.4% of the girls believed that menstruation-related problems negatively affected their academic performance. During adverse events related to menstruation, the majority (63.6%) of the girls sought help from their families, while only 21.1% sought help from health institutions or professionals. Additionally, 12.1% used self-prescribed drugs, and 3.2% utilized traditional healers' support.

Table 2. Menstruation history and menstruation related health problems in Addis Ababa, Ethiopia

Variable	Subgroups	Number (%)
Menarche	<13	131(34.5)
	13-15	200(52.6)
	> 15	49(12.9)
Menstrual pattern	Regular	315(82.9)
	Irregular	65(17.1)
Number of days of menstrual pattern	2-7 days	331(87.2)
	> 8 days	49(12.8)
Academic season when menarche started	1st semester	126(33.2)
	2nd semester	190(50)
	End of 2nd semester vacation	64(16.8)
Reactions when you experienced menses for the first time	Neutral feeling	188(49.5)
	Joyful	26(6.8)
	Confused	94(24.7)
	Cry	42(11.1)
	Embarrass	19(5)
	Fainting	7(1.8)
	Hide it	4(1.1)
Menstrual knowledge before menarche	Yes	339(89.2)
	No	41(10.8)
Preferred source of information	Family members	255(67.1)
	Friends	46(12.1)
	Teacher and reading	30(7.9)
	Media	49(12.9)
Health problem during menstruation	Yes	236(62.1)
	No	144(37.9)
Health problems (n=236)	Irregularity	32(13.6)
	Excess flow	22(9.3)
	Abdominal/back ache	106(44.9)
	Headache	28(11.9)
	Mood change/ depression	28(11.9)
	Sleep disorder	20(8.5)
Severity of pain	Mild	212(44.2)
	Moderate	68(17.9)
	Severe	100(26.3)
Menstruation related absenteeism	Yes	146(38.4)
	No	234(61.6)
Reason for absenteeism (n=146)	no private toilet	5(3.4)
	no change room	12(8.2)
	no water	4(2.7)
	due to health problems	125(85.6)
Perceived effects of menstruation on school performance	Yes	81(21.4)
	No	299(78.6)

Association between sociodemographic factors and age at menarche

The binary logistic regression analysis revealed that several sociodemographic factors were significantly associated with age at menarche. Specifically, type of school (private vs. government), wealth index (high vs. low/middle), family education (above grade 9 vs. up to grade 8), and sleeping hours (≥ 10 hours vs. < 10 hours) were found to have p-values less than the commonly used significance level of 0.025. Given the multiple statistically significant associations identified in the initial binary logistic regression, a subsequent multivariable logistic regression analysis was warranted to further examine the independent effects of these sociodemographic factors on age at menarche, while controlling for potential confounding variables. Accordingly, this study identified significant differences in the age at menarche among respondents based on socio-demographic variables.

Notably, adolescent girls attending government schools had 0.50 times (or 50% lower odds) of experiencing menarche at early age compared to students attending private schools (AOR= 0.5; 95% CI: 0.32-0.78; p=0.001). Similarly, girls from middle (OR= 2.1; 95% CI: 018.32-72.08; p=0.003) and high-income (AOR= 4.0; 95% CI: 22.02-72.01; p=0.002) families experienced menarche at a younger age compared to those from low-income families. Furthermore, students who slept for 10 hours or more had 2.22 times higher odds of experiencing menarche at early age compared to students who slept for less than 10 hours (AOR= 2.22; 95% CI: 1.21-4.07; p=0.001).

Other variables such as parents' educational level, family size, physical exercise, and frequency of consuming fruits and vegetables, did no show significantly significant association with age at menarche (p>0.05) (Table 3).

Table 3: Association between sociodemographic factors and age at menarche in Addis Ababa, Ethiopia.

Independent variable	Subgroups	Ages of Menarche		AOR	95%CI	P value
		< 13	≥ 13			
Type of school	Private	10(12.6)	66(87.4)		1	
	Government	341(13.6)	265(86.4)	0.50	0.32-0.78	0.001*
Wealth index	Low income	14(13.5)	88(86.5)		1	
	Middle income	30(13.6)	194(86.4)	2.1	18-43	0.003*
	High income	7(12.8)	47(87.2)	4.0	22-72	0.002*
Mothers' education	Up to grade 8	219(95.6)	10(4.4)		1	
	Above grade 9	141(96.0)	10(4.0)	0.56	0.37-1.84	0.006
Fathers' education	Up to grade 8	183(97.3)	5(2.7)			
	Above grade 9	165(95.9)	7(4.1)	0.47	0.30-0.73	0.001*
Family size	≤ 3 members	38(34.9)	71(65.1)		1	
	>3 members	241(88.9)	30(11.1)	0.65	0.40-1.05	0.08
Diet	Vegetable diet 2/3/week	148(59.7)	100(40.3)	0.99	0.67-1.47	0.976
	No vegetable diet/week	56(42.4)	76(57.6)		1	
Exercise	Yes	117(95.1)	6(4.9)	1.60	0.01-2.56	0.06
	No	250(97.3)	7(5.4)			
Sleeping hours	≥ 10 hours	78(91.8)	7(8.2)	2.22	1.21-4.07	0.01*
	< 10 hours	279(94.6)	16(5.5)		1	

*p < 0.05 is considered significant

Association between menarcheal age and menstrual characteristics of respondents

Previous unawareness about menstruation was associated with school absenteeism, perceived negative impact on school performance, and emotional reactions at the time of menarche. Students who did not know about menses before menarche had 2.74 times higher odds of being absent from school during menstruation days compared to those who knew about menses before menarche (AOR= 2.74; 95% CI: 1.34-5.62; p=0.005). Moreover, menstrual characteristics, including frequency, duration, and related health problems, had association on school absenteeism and perceived academic impact. Girls whose menstrual periods lasted more than eight days or more were more likely to be absent from school compared to those with shorter periods. This extended duration also significantly affected their academic performance or grades.

Table 4: Factors associated with school absenteeism during menstruation days in Addis Ababa, Ethiopia.

Independent variable	Subgroup	School absenteeism		AOR	95%CI	P value
		Yes	No			
Knew about menses before menarche	Yes	119(35.1)	220(64.9)		1	
	No	27(65.9)	14(34.1)	2.74	1.34-5.62	0.005
Menstrual health problem	Yes	131(56.0)	103(44.0)	6.92	3.7-12.89	0.001
	No	17(11.6)	129(88.4)		1	
Duration of menses	< 8 days	39(26.0)	111(74.0)		1	
	≥ 8 days	211(91.7)	19(8.3)	4.14	2.15-7.98	0.001
Severity of pain	Severe	97(85.1)	17(14.9)	6.25	2.10-10.67	0.001
	moderate	67(69.8)	29(30.2)	4.25	2.19-8.24	0.001
	Mild	23(13.5)	147(86.5)		1	

*p < 0.05 is considered significant

Discussion

This study aimed to identify factors influencing age at menarche and menstrual problems among adolescent girls in Addis Ababa, Ethiopia. The mean age at menarche was similar to findings from previous studies conducted in Mekele[7], Gondar[8], North Wollo[10], Sawla town[4], and the Amhara region[12]. The results were also comparable, with no more than a one-year difference, to studies from other countries, including Sudan[9], Ghana[15], Malaysia[16], Iran[17], and Portugal[18].

A notable finding was the significant difference in menarche age between private and government school girls. Girls attending private schools, who typically came from higher socioeconomic backgrounds, experienced earlier menarche than their government school counterparts. This aligns with previous studies suggesting that better nutrition and socioeconomic advantages contribute to earlier onset of puberty[19]. Additionally, larger family sizes were associated with delayed menarche, likely due to financial strain on nutritional resources, which is a common pattern in low-income Ethiopian households[20–25].

A novel finding of this study was the inverse association between sleep duration and age at menarche. Girls who slept less than nine hours per night experienced earlier menarche compared to those who slept more than ten hours. This relationship may be explained by the role of sleep deprivation in increasing psychosocial stress, which can activate the hypothalamic-pituitary-gonadal axis and accelerate puberty[5,26–28]. The potential impact of sleep-related hormonal changes on puberty warrants further longitudinal research to explore the mechanisms linking sleep and reproductive development.

This study reaffirmed that menstrual health problems, including dysmenorrhea, irregular cycles, and abdominal pain, are highly prevalent among adolescent girls, consistent with findings from prior studies[5,8,29]. The high rates of school absenteeism due to menstrual issues—particularly among government school girls—highlight the need for improved school-based menstrual health support. Differences in school infrastructure, hygiene facilities, and access to menstrual products may contribute to these disparities.

Additionally, 44% of girls reported a negative emotional response to their first period, with confusion, embarrassment, and even fainting being common. The reliance on family members, especially mothers, as the primary source of menstrual knowledge emphasizes the need to equip parents with accurate and supportive education to help girls navigate menarche with confidence.

Strength and Limitation

This study had a high response rate and explored various sociodemographic variables. However, the findings may not be representative of rural adolescent populations. Recall bias regarding age at menarche was another limitation, although menarche is generally considered a salient life event and can often be remembered with reasonable accuracy over short periods. The absence of official birth registration may also lead to underreporting of actual age. The cross-sectional design limits the ability to establish causal relationships between variables. Furthermore, the sensitive nature of menstrual health may have introduced social desirability bias, despite efforts to minimize it.

Conclusion

This study revealed that the mean age at menarche among adolescent girls in Addis Ababa was comparable to other regions in Ethiopia and several international contexts. However, socioeconomic disparities, particularly school type (private vs. government), parental education, and family income, played a significant role in influencing menarche timing. Additionally, insufficient sleep was identified as a novel factor associated with earlier puberty onset, highlighting the influence of lifestyle factors on reproductive health. Menstrual health challenges, including dysmenorrhea, irregular cycles, and school absenteeism, were highly prevalent—especially among government

school students—highlighting the urgent need for targeted interventions.

Recommendations

- Integrate comprehensive menstrual education and teacher training into both government and private school curricula.
- Ensure the availability of affordable or free sanitary products and adequate school sanitation facilities, especially in government schools.
- Promote balanced nutrition and healthy sleep habits to support normal pubertal development.
- Empower parents, particularly mothers, with accurate information to support their daughters' menstrual health and reduce stigma.

Declarations

Ethical Consideration

Ethical clearance, with a waiver for parental permission, was obtained from Addis Ababa University, Department of Obstetrics and Gynecology Research and Publication Committee (Date: November 19, 2018; Minute Nº: DRPC 2018/11/19-2). School directors were informed about the study objectives, and oral permission was obtained. A waiver of consent was granted for adolescents aged 14–17. Confidentiality was maintained by omitting names and addresses from the questionnaires. Participants were informed of their right to withdraw at any time or skip questions.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

The study was designed, prepared, and edited by Seid Arage and Dawit Worku. The manuscript was prepared by Ahmed Muhye. All authors have read and approved the final manuscript.

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INCIDENCE AND MATERNAL-PERINATAL OUTCOMES OF UTERINE RUPTURE IN HIWOT FANA COMPREHENSIVE SPECIALIZED UNIVERSITY HOSPITAL: A RETROSPECTIVE CROSS-SECTIONAL STUDY

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ABSTRACT

BACKGROUND: Uterine rupture remains a significant public health concern in many developing countries, including Ethiopia. Understanding its incidence and associated maternal and perinatal outcomes is essential for developing effective prevention and management strategies.

OBJECTIVE: To assess the incidence, trends, and maternal and perinatal outcomes of uterine rupture among women who gave birth at Hiwot Fana Comprehensive Specialized University Hospital.

METHODS: A retrospective, facility-based cross-sectional study was conducted from October 1 to 31, 2023, including all women who gave birth at Hiwot Fana Comprehensive Specialized University Hospital between January 1, 2018, and December 31, 2022. Data were collected by reviewing medical records using a structured and pretested checklist. The information was coded, cleaned, and entered into EpiData version 4.6, then exported to SPSS version 26 for statistical analysis. The results were summarized and presented in tables and figures.

RESULTS: Out of 24,608 deliveries recorded during the study period, 168 cases of uterine rupture were identified, corresponding to an incidence rate of 6.8 per 1,000 births. Over the five-year period, there were no significant changes in the trend of uterine rupture incidence. Among the 153 cases with complete information, there were 119 stillbirths (90.8%), 113 cases of severe hemorrhage (73.9%), 79 hysterectomies (51.6%), 13 bladder ruptures (8.5%), 9 cases of obstetric fistula (5.9%), and 5 maternal deaths (3.3%).

CONCLUSION: Although relatively infrequent, uterine rupture is associated with substantial adverse maternal and perinatal outcomes. Regular audits to evaluate the timeliness and quality of obstetric care are essential to prevent such complications and maternal and perinatal deaths.

KEYWORDS: Uterine rupture, incidence, trends, maternal deaths, perinatal deaths, Ethiopia

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INTRODUCTION

Although the estimated 287,000 global maternal deaths in 2020 represent a 34% reduction since 2000[1], this still highlights the long journey ahead to achieve the global target of fewer than 70 maternal deaths per 100,000 live births by 2030 [2]. Moreover, low- and middle-income countries account for 74% of the global maternal mortality burden[1]. In many low-resource settings, such as Ethiopia, direct obstetric causes—including hemorrhage, hypertensive disorders of pregnancy, and uterine rupture—are the leading contributors to maternal deaths[3].

Uterine rupture, defined as the loss of uterine wall integrity during pregnancy, labor, or shortly after delivery, remains one of the top five direct causes of maternal death in Ethiopia[4]. Beyond its impact on maternal morbidity and mortality, uterine rupture also poses serious risks to fetal health, contributing to 52% of perinatal mortality cases[5]. Factors such as obstructed labor, previous uterine scars, short interpregnancy intervals, multigravidity, lack of antenatal care, long distances from health facilities, weak referral systems, and home deliveries have been identified as major contributing factors[6].

Although uterine rupture continues to be one of the leading causes of maternal death with severe adverse outcomes, its incidence over time and patterns of maternal and perinatal outcomes are not well studied in eastern Ethiopia. Moreover, this study may assist the regional health bureau in implementing a strategic plan to minimize the incidence of uterine rupture during antenatal care and the perinatal period through quality obstetric care. This study reports the incidence, as well as the maternal and perinatal outcomes, of uterine rupture among women who gave birth at a university hospital in eastern Ethiopia.

Methods

Study setting and design

A retrospective, facility-based cross-sectional study was conducted at Hiwot Fana Comprehensive Specialized University Hospital, located in eastern Ethiopia, approximately 526 kilometres from Addis Ababa. As the primary referral and academic medical centre in the region, the hospital serves a population of over five million. During the study period, the hospital was staffed by 22 gynaecologists and obstetricians, including seven subspecialists, as well as 35 residents and 60 midwives. The study was conducted in the Department of Obstetrics from 1 to 31 October 2023.

Sample size, populations and sampling procedures

The sample size was calculated using a single population proportion formula, with the incidence of uterine rupture set at 9.5%[(7)], a 95% confidence level, a margin of error of 4%, and a nonresponse rate of 5%. This study considered only five years of maternal data to minimise data loss. However, since the number of cases in the source population over the past five years was less than the calculated sample size (227), all women with uterine rupture were included in the study.

The source population consisted of all women who gave birth in the hospital during the study period, while the study population included all women who experienced uterine rupture. Women with incomplete data on maternal and perinatal outcomes (including maternal death, surgical procedures, blood loss, and fetal/neonatal status at discharge) were excluded.

Operational definition

Uterine rupture: A tear in the uterine wall, diagnosed by physicians using signs, symptoms, and ultrasound during pregnancy, labour and delivery, and the postpartum period[8].

Adverse maternal outcomes: Defined as any of the following conditions: severe blood loss, ruptured bladder, obstetric fistula, hysterectomy, or maternal death[9].

Adverse perinatal outcomes: Refers to stillbirth, low birth weight, preterm birth, perinatal asphyxia, or neonatal death confirmed by physicians[10].

Severe haemorrhage: Bleeding necessitating transfusion of two or more units of whole blood[11].

Data collection

Data were collected through a review of women's medical records using a pretested checklist adapted from various sources in the literature[7,12–14]. Information on socio-demographic characteristics, obstetric and reproductive health-related conditions, referral status, and maternal and perinatal complications was gathered by four trained midwives under the supervision of a senior resident in obstetrics and gynaecology.

Data quality

A two-day training session was conducted for data collectors and supervisors to familiarise them with the study objectives and data collection procedures. To ensure data quality, a pretest was carried out on 5% of the study population at Jugol General Hospital. The completeness and consistency of the collected data were reviewed daily by the supervisor and the principal investigator, with corrective actions taken as necessary. Additionally, double data entry was performed to minimise errors.

Data processing and analysis

The data were coded and entered into EpiData version 4.6, then cleaned and exported to SPSS version 26 for analysis. The results are presented as frequency distributions in tables, graphs, and figures. The dependent variables were uterine rupture (yes or no) and maternal and perinatal outcomes (adverse or not adverse). Adverse maternal and perinatal outcomes included severe blood loss, ruptured bladder, obstetric fistula, hysterectomy, maternal death, stillbirth, and neonatal death.

Results

Socio-demographic characteristics

Over the five-year period, there were 24,608 births at the hospital, of which 168 involved uterine rupture. A total of 153 cases with available data on maternal and perinatal outcomes were included in the study. The mean age of the women was 27.76 ± 5.25 years. More than one-third (35.3%) had attended four or more antenatal care visits, and 66 women (43.1%) had a parity of five or more. Additionally, over three-fourths (117, 76.5%) of the uterine rupture cases occurred in women with no previous uterine scar.

In terms of perinatal outcomes, vertex presentation was observed in 117 cases (76.5%), while normal birth weight (2,500–3,900 grams) was recorded in 115 cases (75.2%) (Table 1).

Table 1: Socio-demographic and Obstetric characteristics of women with uterine rupture at HFCSUH, 2023 (n=153).

Variables	Categories	Frequency (n)	Percentage (%)
Marital status	Single	4	2.6
	Married	149	97.4
Maternal age	< 20 years	21	13.7
	20- 34 years	106	69.2
	≥35 years	26	17
Parity	Null	3	2
	1-3	52	34
	4-5	32	20.9
	>5	66	43.1
ANC visit	No	9	5.9
	1	12	7.8
	2	50	32.7
	3	28	18.3
	≥4	54	35.3
Fetal presentation	Vertex	117	76.5
	Breech	8	5.2
	Face/brow	4	2.6
	Unknown	24	15.7
Birth weight (grams)	< 2500	17	6.7
	2500-3900	115	45.5
	≥4000	21	8.3
Pervious uterine scar (C/S)	Yes	36	23.5
	No	117	76.5
Mode of delivery	Spontaneous vaginal delivery	2	1.3
	C/S (Laparotomy)	149	97.4
	Other(destructive)	2	1.3
Augmentation/ induction of labor	Yes	1	0.7
	No	152	99.3
Types of pregnancy	Singleton	151	98.7
	Multiple	2	1.3
Obstructed labor	Yes	47	30.7
	No	106	69.3
Referral status	Self-referral	8	5.2
	From other Hospital	124	81.0
	From health center	21	13.7

Incidence and trends of uterine rupture

The incidence of uterine rupture during the study period was 6.8 per 1,000 births (168 out of 24,608 deliveries). Overall, there was no significant decline in the trend of uterine rupture, with 7.9 cases per 1,000 deliveries in 2018 and 6.2 cases per 1,000 in 2020 (Figure 1).

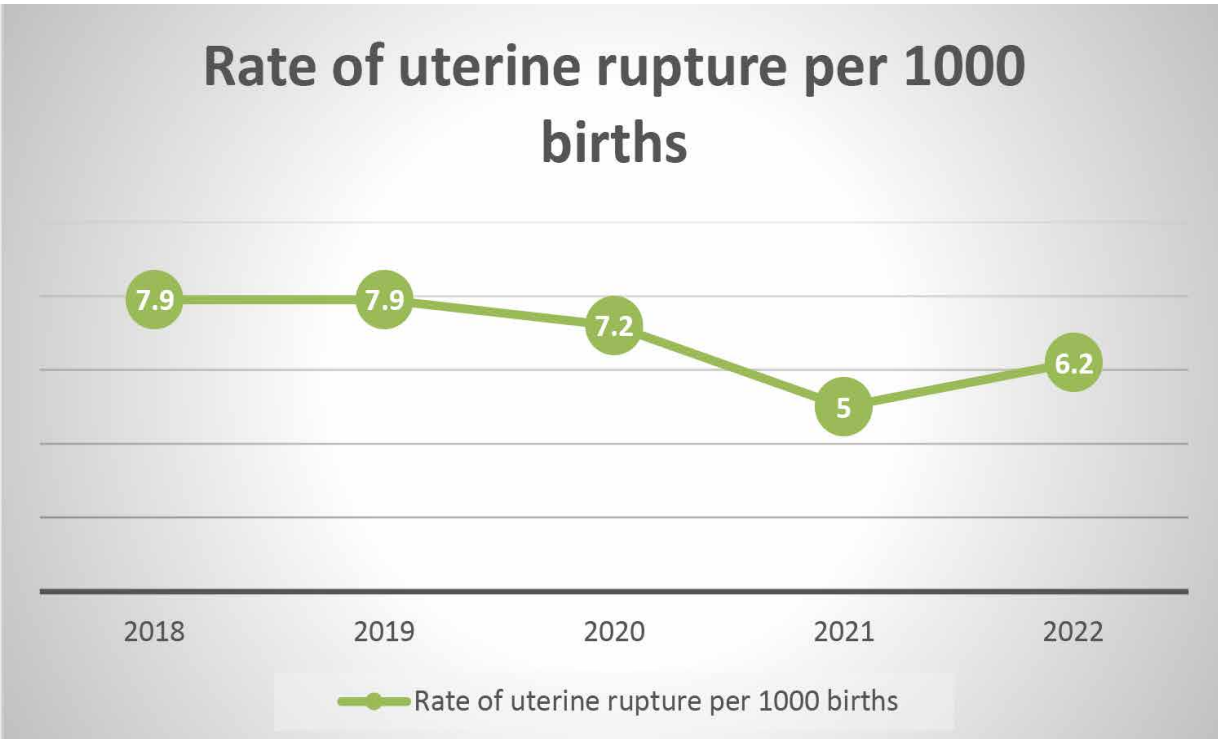

Figure 1: Trend of uterine rupture at HFCSUH from 2018 to 2022

Maternal and perinatal outcomes

Approximately three-fourths (73.9%) of the women experienced severe blood loss, defined as the transfusion of at least two units of blood. Additionally, 13 women (8.5%) had bladder rupture, and 9 (5.9%) developed obstetric fistula. Hysterectomy was performed in 79 cases (51.6%), and 5 women (3.3%) died, resulting in a case fatality rate of 3.3%. Nearly nine out of ten births (90.8%) resulted in stillbirth, and among the newborns who were alive at birth, 4 (28.6%) died before discharge (Table 2).

Table 2: Maternal and perinatal outcomes of CUR at HFCSUH from 2018 to 2022 (n=153).

Variables		Frequency (n)	Percentage (%)
Severe blood loss	Yes	113	73.9
	No	40	26.1
Bladder rupture	Yes	13	8.5
	No	140	91.5
Hysterectomy	Yes	79	51.6
	No	74	48.4
Type of hysterectomy	Total abdominal hysterectomy	66	43.1
	Subtotal Abdominal hysterectomy	13	8.5
	Repair without bilateral tubal ligation	61	39.9
	Repair with bilateral tubal ligation	13	8.5
Vesico vaginal fistula	Yes	9	5.9
	No	144	94.1
Maternal death	Yes	5	3.3
	No	148	96.7
Fetal condition at birth	Alive	14	9.2
	Stillbirths	139	90.8
Neonatal condition at discharge	Alive	10	71.4
	Dead	4	28.6

Discussion

This study evaluated the incidence and trends of uterine rupture, as well as the associated maternal and perinatal outcomes, over a five-year period at HFCSUH in eastern Ethiopia. The findings revealed an incidence of 6.8 per 1,000 live births. Despite improvements in healthcare services in Ethiopia, such as antenatal care, contraceptive use, and institutional delivery, there has been no significant change in the trend of uterine rupture over the past five years in the region[15,16]. Furthermore, 77% of cases occurred in women without prior uterine scarring, suggesting limited progress in healthcare utilisation among pregnant women in eastern Ethiopia. This may be attributed to one or more of the "three delays": delays in seeking healthcare, delays in transportation, or delays in receiving care at a facility[17].

This finding is lower than reports from teaching hospitals in southern[14] and southwestern Ethiopia[18], but higher than those from Brazil[19] and the WHO multicountry study[13]. Differences in study design, access to healthcare, demographic factors[20], urban–rural disparities, delays in seeking or reaching care, and quality of care may account for these variations[21–23].

The high burden of adverse maternal and perinatal outcomes is concerning. Three out of four women experienced severe haemorrhage, and nine out of ten had stillbirths. Although not unexpected—given the frequent late arrival of patients—it underscores the urgent need for enhanced outreach programmes and stronger referral systems. As a university medical centre, the hospital routinely sends residents to support lower-level facilities in managing emergency obstetric conditions, including timely referrals when necessary[24]. Strengthening the referral system through early communication, accompanied transfers, and family education about the urgency of obstetric emergencies is vital to preventing maternal mortality[25,26]. Furthermore, assessing the timeliness and appropriateness of care upon arrival at the hospital is essential[27].

Although the incidence of uterine rupture appears relatively low compared to other settings[14], the absence of a significant decline over time and its strong association with adverse outcomes remains troubling. To reduce maternal and neonatal mortality, it is critical to identify and address common bottlenecks, such as home-based labour, weak referrals, poor quality of care, and treatment delays. The authors emphasise the importance of auditing these cases to uncover modifiable factors at the individual, health system, and provider levels, enabling the implementation of tailored interventions.

A limitation of this study is its retrospective design. Variables such as maternal weight, height, BMI, and educational status were not recorded in the medical files and could not be assessed. Although a sample size calculation was performed during the proposal stage, all uterine rupture cases over the five-year period were included. Additionally, factors influencing the incidence and maternal–perinatal outcomes of uterine rupture were not analysed in this study.

Conclusion

Although the incidence of uterine rupture is relatively low, it is associated with high rates of adverse maternal outcomes, such as hysterectomy, bladder rupture, obstetric fistulas, and maternal death. Moreover, 90% of the pregnancies result in stillbirth, significantly affecting the psychosocial well-being of the women affected. Auditing the timeliness and appropriateness of care is essential to prevent uterine rupture and mitigate its severe maternal and perinatal consequences.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki[28]. Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University, Ethiopia (Ref. No: IHRERC/175/2023). Prior to the study, voluntary, written, and signed informed consent was obtained from the medical director of HFCSUH, as well as the heads

of the obstetrics and gynaecology departments and the maternity ward. Medical records were reviewed in a private room, and no personal identifiers were collected. All information obtained from medical records and individuals was handled anonymously and kept strictly confidential.

Consent for publication

Not applicable.

Declaration of conflicting interest

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Availability of data and material

All data generated or analysed for this objective are included in this article, and non–person-identifying data can be accessed from the corresponding author upon reasonable request.

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Abbreviations

ANC: Antenatal care

C/S: Caesarean section

HFCSUH: Hiwot Fana Comprehensive Specialized University Hospital

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Author contributions

FA: Conceptualisation; Investigation; Methodology; Formal analysis; Writing – review & editing.

TGE: Conceptualisation; Supervision; Investigation; Methodology; Review & editing; Read and approved the final manuscript.

BB: Methodology; Data curation; Formal analysis; Writing – original draft; Read and approved the final manuscript.

AKT: Conceptualisation; Supervision; Methodology; Review & editing; Read and approved the final manuscript.

Statements and declarations

Not applicable.

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

Tizita Abraham[1], Ephrem Mamo[2], Ananya Solomon[1], Alferid Abrar[1], Birhanu Kebede[1]

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)

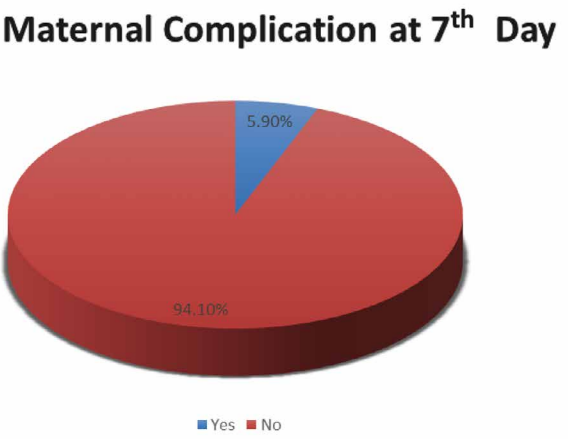

Figure 1: Proportion of mothers with respect to the 7th day outcome after CD; Addis Ababa, Ethiopia

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).

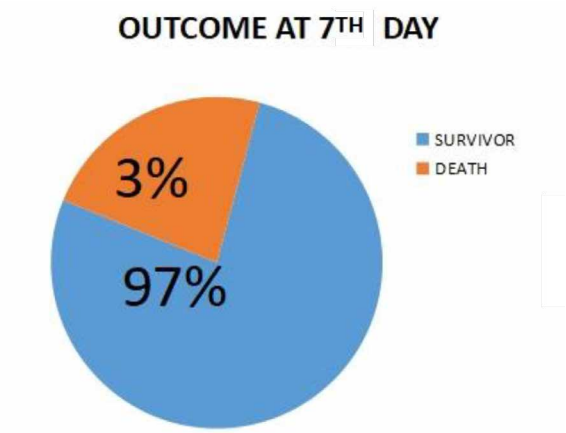

Figure 2: Proportion of new-borns with respect to the 7th day after CD; Addis Ababa, Ethiopia

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)

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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THE EFFECTS OF HORMONAL CONTRACEPTIVES ON SERUM ELECTROLYTES, BLOOD PRESSURE, AND BODY MASS INDEX: A COMPARATIVE CROSS-SECTIONAL STUDY IN SOUTHWEST ETHIOPIA

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ABSTRACT

BACKGROUND: Hormonal contraceptives are commonly used for family planning; however, their potential effects on health parameters such as serum electrolyte levels, body mass index (BMI), and blood pressure remain unclear. Therefore, this study aimed to assess the effects of hormonal contraceptives on serum electrolyte levels, body mass index, and blood pressure among users and non-users in Southwest Ethiopia.

METHODS: This comparative cross-sectional study included 290 women, with participants randomly selected from each group (hormonal contraceptive users and non-users). Data were collected using a structured questionnaire. SPSS version 21 was used for analysis, and the results were summarized using figures and tables. An independent t-test was employed to assess the variability between the two study groups regarding serum electrolyte levels, body weight, and blood pressure. Statistical significance was set at $p < 0.05$.

RESULTS: Hormonal contraceptive users had a significantly higher body mass index (BMI) compared to non-users ($p = 0.034$). Additionally, both systolic ($p = 0.011$) and diastolic blood pressure ($p = 0.007$) were significantly elevated in hormonal contraceptive users. The mean sodium level was slightly higher in hormonal contraceptive users (141.5 ± 2.4) than non-users (140.1 ± 2.3), but not significantly ($p = 0.149$). No significant differences were found for potassium (4.6 ± 0.5 vs. 4.7 ± 0.5, $p = 0.234$), calcium (8.1 ± 0.6 vs. 8.3 ± 0.5, $p = 0.310$), or chloride (103.1 ± 2.5 vs. 102.3 ± 1.7, $p = 0.067$).

CONCLUSION: Hormonal contraceptives do not significantly affect serum electrolyte levels but can increase blood pressure and body mass index. These increases may pose cardiovascular risks, especially in women with pre-existing conditions, and could lead to long-term weight-related health effects.

KEYWORDS: hormonal contraceptives, blood pressure, body mass index, serum electrolytes, Southwest Ethiopia

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INTRODUCTION

Contraception, initiated many years ago[1], encompasses planned strategies to prevent fertilization, employing a variety of approaches including devices, sexual practices, barrier methods, and hormonal contraception methods[2]. Hormonal contraception, a prominent method, harnesses the physiological impacts of estrogen and progesterone agonists. These hormones exert multiple biological effects, inhibiting ovulation and altering cervical mucus to make it scanty, thick, and highly viscous, thereby preventing pregnancy[3]. Hormonal contraceptives are derived from steroids[4]. Specifically, they are based on steroid hormones such as estrogen and progesterone, which play roles in regulating the volume and electrolyte composition of the body[5]. These synthetic compounds mimic the actions of natural hormones, possessing glucocorticoid and/or mineralocorticoid properties. They influence ion transport within epithelial cells of the renal tubules, primarily regulating electrolyte and water balance. It's noted that corticosteroid use is linked with retaining sodium and water while promoting potassium loss[6].

Hormonal contraceptives influence various biochemical profiles in women, including lipid profiles, metabolites, and electrolytes[7, 8]. These contraceptives can lead to disturbances in serum electrolyte levels, alterations in body weight, and changes in blood pressure[9-11]. Specifically, hormonal contraceptives can cause significant derangement in the serum levels of sodium, chloride, potassium, and bicarbonate concentrations[12].

Electrolyte imbalances, such as hyponatremia, dyskinesia, dysglycemia, hypomagnesemia, and hypophosphatemia, are prevalent in both patients and the general population. They are linked with elevated morbidity and mortality rates and represent some of the most frequent clinical challenges encountered[13]. These imbalances can lead to reduced serum levels of magnesium, a vital cofactor in over 300 enzyme systems that regulate various biochemical reactions[14]. Calcium, the primary divalent cation, is predominantly stored in bones and teeth, with its extracellular fraction utilized for various physiological functions including blood clotting, hormone secretion, and muscle contractions[15].

Hormonal contraceptives can also lead to increased blood pressure and risk of osteoporosis[16]. The renin-angiotensin-aldosterone system is implicated, as estrogen administration stimulates the hepatic synthesis of plasma renin substrate[17, 18]. Hormonal contraceptives containing estrogen can cause or worsen hypertension, and women who have used these contraceptives have developed high blood pressure as a result[19].

While few studies in Ethiopia have explored the effects of hormonal contraceptives on blood pressure[10, 20] and body weight[10], their impact on serum electrolyte levels remains unexamined. This gap is particularly significant for Ethiopian women of reproductive age (18-49 years) because hormonal contraceptives are widely used, yet potential biochemical effects—such as electrolyte imbalances that could influence cardiovascular, renal, and neuromuscular health—remain underexplored in this population. Understanding these effects is essential for informing clinical practice and ensuring the safe use of hormonal contraceptives in low-resource settings, where routine biochemical monitoring may be limited.

Methodology

Study Area, Period, and Populations

A hospital-based comparative cross-sectional study was conducted at MTUTH and GSGH from September 1 to October 15, 2021. The source population comprised all women aged 18–49 years, with the study population including those randomly selected who met the eligibility criteria. Hormonal contraceptive users included those using oral contraceptive pills, injectables (Depo-Provera), or Norplant. Non-users included women who had never used hormonal contraceptives, those who discontinued use over six months prior, and those using IUCDs, emergency pills, or who had

undergone tubal ligation. The six-month cutoff was applied to minimize residual hormonal effects, as physiological changes typically normalize within a few months after discontinuation.

The study included all women aged 18 to 49 years who had used hormonal contraceptives for at least one month. Women were excluded if they were taking medications known to affect serum electrolyte levels, blood pressure, or body weight—such as corticosteroids, diuretics, antihypertensive drugs, or hormonal therapies other than contraceptives. Additional exclusion criteria included women with serious clinical conditions (e.g., cancer, HIV, or tuberculosis), those who were critically ill or mentally incapable of communication, those with endocrine disorders (e.g., known thyroid diseases or goiter), and pregnant women.

Sample Size Determination

The sample size was determined using Epi Info version 7 StatCalc. Based on a prior study conducted in Jimma[20], the mean diastolic blood pressure (DBP ± SD) for hormonal contraceptive users and non-users was 74.9 ± 6.7 mmHg and 77.9 ± 9.2 mmHg, respectively. Using 80% power, a 95% confidence level, and a 2:1 ratio of hormonal contraceptive users to non-users, the calculated sample size was 285. With a 10% allowance for non-response, the final adjusted sample size was 314.

Sampling Procedure

A systematic random sampling technique was used, whereby every eligible woman who presented during the data collection period was invited to participate.

Operational Definitions

- Hormonal contraceptive users: Women using oral pills, injectables (Depo-Provera), or Norplant within the last six months.
- Non-users: Women who had never used hormonal contraceptives, stopped use over six months ago, or used IUCDs, emergency pills, or tubal ligation.
- Electrolyte imbalance: Serum levels outside normal reference ranges—sodium (<135 or >145 mmol/L), potassium (<3.6 or >5.5 mmol/L), calcium (<8.8 or >10.7 mg/L), and chloride (<96 or >106 mmol/L)[21].
- BMI: Calculated as weight in kilograms divided by the square of height in meters (kg/m²).
- Hypertension: Systolic blood pressure ≥140 mmHg and/or diastolic ≥90 mmHg. Normotension: systolic 90–120 mmHg and/or diastolic 60–80 mmHg.
- Mentally incapable: Individuals unable to understand the study or give informed consent due to cognitive or psychiatric conditions.

Data Collection

Socio-demographic variables collected included age, educational level, marital status, residence, occupation, and religion. Contraceptive-related variables included type and duration of hormonal contraceptive use. Obstetric variables included gravidity and parity. Clinical measurements included serum electrolyte levels (sodium, chloride, potassium, calcium), body weight, and blood pressure.

Data were collected using a structured, pre-tested questionnaire through interviews conducted by six BSc midwives. Anthropometric and clinical measurements were also obtained.

Anthropometric Measurements:

Body weight was measured using a digital standing scale (Detecto, UK) while participants wore light clothing and no headwear. The scale was calibrated to zero before each use, and accuracy was verified using a known object. Weight was recorded to the nearest 0.1 kg.

Clinical Measurements:

Blood pressure was measured on the left arm while participants were seated using an Arm-Omron digital BP monitor. Two readings were taken five minutes apart, and the average of the last two was recorded.

Blood Sample Collection and Analysis:

Five millilitres of venous blood were collected using serum separator tubes. Samples were centrifuged

for 10 minutes at 3000 rpm at room temperature by trained professionals. Serum was analyzed for electrolytes. Samples were collected in a non-fasting state and processed within two hours.

Statistical Analysis

Data were entered into EpiData Manager version 4.0.2.101 and exported to SPSS version 21 for cleaning and analysis. EpiData was used for its validation features to minimize entry errors. SPSS was chosen for its statistical analysis capabilities. Data were presented using proportions, tables, and mean values with standard deviations. Independent t-tests were used to compare means of serum electrolytes, body weight, and blood pressure between users and non-users. Normality was assessed with the Shapiro-Wilk test and visual inspection; Levene's test was used to assess homogeneity of variances. A p-value < 0.05 was considered statistically significant.

Ethics Statement

Ethical clearance was obtained from the Mizan-Tepi University Postgraduate Research Review Committee (PGC/049/2021) on August 13, 2021. A support letter was secured for the study hospitals. Informed written consent was obtained from all participants. For individuals unable to read or write, the study's purpose was explained and consent was obtained from their legal representatives. All procedures adhered to international ethical guidelines for health-related research involving humans.

Results

Socio-demographic characteristics

In this study, 290 respondents participated, consisting of 192 hormonal contraceptive users and 98 nonusers, resulting in a response rate of 92.4%. Most respondents were in the age category of 18-27 years old (64.1%), married (86.6%), and housewives (54.8%). More than three-fourths (78.3%) of participants resided in urban areas, while 21.7% lived in rural areas (Table 1).

Table 1: Socio-demographic characteristics of the study participants in Public Health Hospitals, Southwest Ethiopia, 2021.

Variables	Categories	Total	Nonusers	Users
Age (years)	18-27	186 (64.1)	63 (33.9)	123 (66.1)
	28-37	99 (34.1)	33 (33.3)	66 (66.7)
	38-47	5 (1.7)	2 (40.0)	3 (60.0)
Marital status	Single	28 (9.7)	10 (35.7)	18 (64.3)
	Married	251 (86.6)	84 (33.5)	167 (66.5)
	Divorced/separated/widow	11 (3.8)	4 (36.4)	7 (63.6)
Religion	Orthodox	175 (60.3)	59 (33.7)	116 (66.3)
	Protestant	99 (34.1)	32 (32.3)	67 (67.7)
	Muslim	12 (4.1)	5 (41.7)	7 (58.3)
	Catholic	4 (1.4)	2 (50.0)	2 (50.0)
Educational status	Unable to read and write	57 (19.7)	19 (33.3)	38 (66.7)
	Able to read and write	12 (4.1)	4 (33.3)	8 (66.7)
	Primary school (1-8)	102 (35.2)	35 (34.3)	67 (65.7)
	Secondary school (9-12)	86 (29.7)	29 (33.7)	57 (66.3)
	College and University	33 (11.4)	11 (33.3)	22 (66.7)
Occupational status	Employed	72 (24.8)	24 (33.3)	48 (66.7)
	Student	30 (10.3)	10 (33.3)	20 (66.7)
	Housewife	159 (54.8)	54 (34.0)	105 (66.0)
	Merchant	12 (4.1)	4 (33.3)	8 (66.7)
	Others*	17 (5.9)	6 (35.3)	11 (64.7)
Ethnicity	Bench	46 (15.9)	16 (34.8)	30 (65.2)
	Kaffa	204 (70.3)	69 (33.8)	135 (66.2)
	Amhara	22 (7.6)	7 (31.8)	15 (68.2)
	Oromo	13 (4.5)	5 (38.5)	8 (61.5)
	Sheka	5 (1.7)	1 (20.0)	4 (80)
Residence	Rural	63 (21.7)	21 (33.3)	42 (66.7)
	Urban	227 (78.3)	77 (33.9)	150 (66.1)

Reproductive health characteristics and type of hormonal contraception

Most hormonal contraception users (93.2%) and non-users (95.9%) reported conceiving less than four times in their lifetime. Hormonal contraceptive users showed a trend toward more instances of four or more pregnancies compared to non-users ($p = 0.235$), and no significant difference in menarche age was observed between the two groups ($p = 0.343$) (Table 2).

Table 2: Reproductive health characteristics of the study participants in Public Health Hospitals, Southwest Ethiopia, 2021.

Variables	Categories	Hormonal contraception		P-value
		Nonusers	Users	
Gravidity	0 – 4 pregnancies	94 (95.9)	179 (93.2)	0.235
	≥ 4 pregnancies	4 (4.1)	13 (6.8)	
Menarche age	< 14 years	46 (46.9)	79 (41.1)	0.343
	≥ 14 years	52 (53.1)	113 (58.9)	

Types of hormonal contraceptives

Among the hormonal contraception users, the majority (56.3%) utilized Depo-Provera, while 32.8% of the study subjects opted for Norplant (Fig. 1).

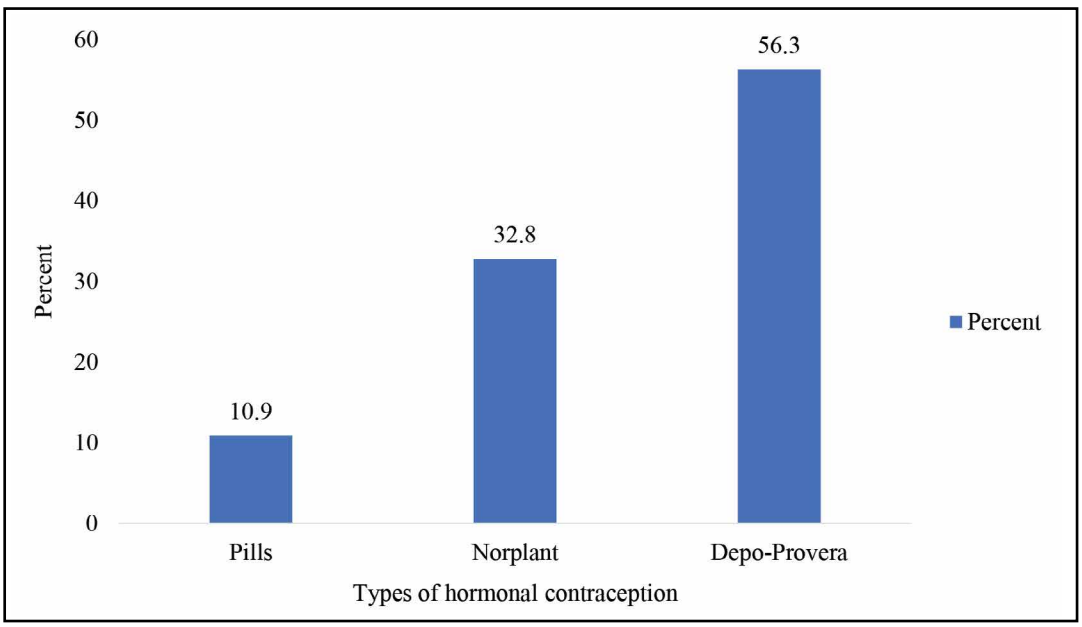

Figure 1: Types of hormonal contraception among study participants in Public Health Hospitals, Southwest Ethiopia, 2021.

Serum electrolytes

The mean sodium level was slightly higher in hormonal contraceptive users (141.5 ± 2.4) compared to non-users (140.1 ± 2.3), but this difference was not statistically significant (p = 0.149). For potassium, the mean value was similar between the groups (non-users: 4.7 ± 0.5, users: 4.6 ± 0.5, p = 0.234). Calcium levels were also similar (non-users: 8.3 ± 0.5, users: 8.1 ± 0.6, p = 0.310). Chlorine levels showed a trend toward significance (non-users: 102.3 ± 1.7, users: 103.1 ± 2.5, p = 0.067), but no significant difference was found (Table 3).

Table 3: Comparing serum electrolytes between hormonal contraceptive users and non-users in Public Health Hospitals, Southwest Ethiopia, 2021.

Types of electrolytes	Hormonal contraceptive				P-value
	Nonusers		Users		
	Mean ± SD	95% CI	Mean ± SD	95% CI	
Sodium	140.1 ± 2.3	[139.6, 140.6]	141.5 ± 2.4	[141.2, 141.8]	0.149
Potassium	4.7 ± 0.5	[4.6, 4.8]	4.6 ± 0.5	[4.5, 4.7]	0.234
Calcium	8.3 ± 0.5	[8.2, 8.4]	8.1 ± 0.6	[8.0, 8.2]	0.310
Chlorine	102.3 ± 1.7	[102.0, 102.6]	103.1 ± 2.5	[102.8, 103.5]	0.067

Body mass index and blood pressure

Hormonal contraceptive users had a significantly higher body mass index (BMI), systolic blood pressure, and diastolic blood pressure compared to non-users. Specifically, users had a mean BMI of 22.5 ± 2.8 (p = 0.034), systolic blood pressure of 113.6 ± 11.3 (p = 0.011), and diastolic blood pressure of 73.7 ± 7.2 (p = 0.007), all showing statistically significant differences when compared to non-users, who had lower values in each of these measures (Table 4).

Table 4: Comparing of BMI and blood pressure between hormonal contraceptive users and non-users in Public Health Hospitals, Southwest Ethiopia, 2021.

Types of electrolytes	Hormonal contraceptive				P-value
	Nonusers		Users		
	Mean ± SD	95% CI	Mean ± SD	95% CI	
BMI	21.8 ± 3.0	[21.2 to 22.4]	22.5 ± 2.8	[22.1, 22.9]	0.034
Systolic blood pressure	111.6 ± 9.6	[109.7, 113.5]	113.6 ± 11.3	[112.0, 115.2]	0.011
Diastolic blood pressure	72.4 ± 6.6	[71.1, 73.7]	73.7 ± 7.2	[72.7, 74.7]	0.007

Discussion

This study aimed to assess the impact of hormonal contraceptives on serum electrolyte levels, BMI, and blood pressure among users and non-users at MTUTH and GSGH in Southwest Ethiopia. Hormonal contraceptive users had significantly higher BMI ($p = 0.034$), systolic blood pressure ($p = 0.011$), and diastolic blood pressure ($p = 0.007$) compared to non-users. However, no statistically significant differences were found in serum electrolyte levels between the groups, including sodium ($p = 0.149$), potassium ($p = 0.234$), and calcium ($p = 0.310$). Chloride levels showed a trend toward significance ($p = 0.067$), but this difference was not statistically significant.

BMI serves as a crucial measure for characterizing height-to-weight proportions in adults, reflecting an individual's level of fatness and serving as a risk indicator for various health conditions[22]. In this study, hormonal contraceptive users exhibited a significantly higher BMI compared to non-users. This finding aligns with research by Muluken and colleagues[10], which also reported a significant increase in BMI among Depo-Provera users. The rise in BMI among users could be linked to increased appetite and higher dietary intake, possibly stemming from modifications to the hypothalamic appetite control centre[10].

This study also demonstrated a significant increase in both systolic and diastolic blood pressure among hormonal contraceptive users compared to non-users. This finding is consistent with previous studies indicating that hormonal contraceptives can elevate blood pressure[23, 24]. This effect may be attributed to the regulatory influence of progesterone and estrogen on vascular tone, mediated by factors such as nitric oxide, prostacyclin, angiotensin, and the sympathetic nervous system[25]. Estrogen is known to influence the renin-angiotensin-aldosterone system, potentially leading to fluid retention and increased vascular resistance. Progesterone can affect vascular smooth muscle by promoting vasoconstriction and influencing endothelial function[26]. Together, these hormonal changes may contribute to the elevated systolic and diastolic blood pressure observed in users.

In terms of serum electrolytes, hormonal contraceptive users did not show significant differences compared to non-users. Sodium primarily regulates extracellular fluid volume and cell membrane potential by exchanging with potassium across cell membranes[21]. Chloride, mainly found in extracellular fluid, is regulated by the kidneys. In this study, hormonal contraceptive users showed insignificantly higher serum levels of sodium and chloride compared to non-users, consistent with prior research indicating no significant effect of oral contraceptives on these electrolytes[27]. Potassium, an intracellular ion[21], also showed a non-significant reduction in serum levels among hormonal contraceptive users, consistent with findings from other studies suggesting minimal impact of hormonal contraceptives on serum electrolytes[12].

The difference in serum calcium levels between hormonal contraceptive users and non-users was also found to be insignificant, consistent with findings from previous research by Hasanat and colleagues[14]. The lack of significant differences in serum electrolyte levels suggests that hormonal contraceptives do not significantly affect these parameters. This was expected, as electrolyte balance is tightly regulated by homeostatic mechanisms. Clinically, the findings indicate that hormonal contraceptives do not cause meaningful changes in serum sodium, potassium, calcium, or chloride levels. However, further research with larger sample sizes or different populations may provide more insight into potential long-term effects. Longitudinal studies are needed to evaluate the extended impact of hormonal contraceptives on body composition, cardiovascular health, and electrolyte balance.

The cross-sectional nature of this study limits the ability to draw causal conclusions. The lack of stratification by contraceptive type and adjustment for key confounding factors such as lifestyle and genetic influences limits the generalisability and strength of the findings. Since data were collected

at a single point in time and baseline BMI at contraceptive initiation was unavailable, it is difficult to attribute BMI differences solely to contraceptive use. Additionally, including women with as little as one month of contraceptive use may not adequately reflect long-term effects. Finally, the hospital-based sample may not be fully representative of the broader population.

Conclusions

This study showed that hormonal contraceptives do not significantly alter serum electrolyte levels among users. However, their use is associated with significant increases in BMI and blood pressure. These findings serve as a preliminary investigation and highlight the need for further well-designed research into the effects of hormonal contraceptives on various health outcomes. It is also important that users are adequately informed about the full range of possible side effects, enabling them to make informed decisions and consider alternative options when necessary.

Declarations

Availability of data and materials: The dataset used in this study is available from the corresponding author upon reasonable request.

Consent for publication: Not applicable.

Conflict of interest: The authors declare no conflicts of interest.

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Authors' contributions:

TY, HA, and WW: Conceptualisation; methodology; software; validation; formal analysis; investigation; visualisation; data curation; writing – original draft; writing – review and editing.

NS, MH, GFA, MSA, and AFA: Methodology; investigation; data curation; project administration; funding acquisition; resources; supervision; writing – original draft; writing – review and editing.

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THIRTY DAYS' POSTOPERATIVE COMPLICATIONS AFTER GYNECOLOGIC SURGERIES AT TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA: A COMPARATIVE CROSS-SECTIONAL STUDY

Binyam Esayas Abuye[1], Esayas Berhanu[1], Yirgu Gebrehiwot[1], Husnia Hussen[1], Dawit Dessalegn[1]

ABSTRACT

BACKGROUND: Any deviation from the normal postoperative course is referred to as a postoperative complication. It is estimated that 11% of patients in low- and middle-income countries experience these complications following elective surgery. The objective of this retrospective comparative cross-sectional study was to determine 30-day postoperative complications and associated factors among patients who underwent gynecologic surgeries at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.

METHODS: A retrospective comparative cross-sectional study was carried out to assess 30-day postoperative complications in patients who underwent gynecologic surgeries over a three-year period, from January 2021 to December 2023. Data were gathered through a structured questionnaire. The chi-square test was used to compare categorical variables. To identify independent factors linked to the outcome variable, both binary and multivariable logistic regression analyses were conducted, with a significance level set at $p < 0.05$ and a 95% confidence interval (CI).

RESULTS: The study included a total of 355 patients who underwent gynecologic surgery. Of these, 118 had benign conditions, while 237 were diagnosed with malignancies prior to surgery. The median age for patients undergoing surgery for oncologic reasons was 48 years (IQR 40–60), whereas the median age for those with benign conditions was 37 years (IQR 30–45). The overall rate of postoperative complications was 31%.

Nineteen point six percent of histopathology-confirmed benign patients had postoperative complications, whereas 41% of histopathology-confirmed malignant cases had postoperative complications. The most frequently reported complication among patients undergoing benign surgical procedures was surgical site infection (SSI). In contrast, for patients with malignant conditions, the most prevalent complication was the need for intraoperative or postoperative blood transfusion, followed by surgical site infections. Overall, 58 (16%) patients required intraoperative blood transfusions. Postoperative readmission rates were 2.4% for benign cases and 6.4% for malignant cases, with SSI being the leading cause of readmission. Multivariable analysis revealed that being underweight (AOR 3.82, 95% CI 1.39–10.50), overweight (AOR 1.73, 95% CI 1.02–2.94), and having a postoperative diagnosis of malignancy (AOR 3.23, 95% CI 1.96–5.34) were significantly associated with an increased risk of postoperative complications.

CONCLUSION: Postoperative complication rates after gynecologic surgeries are similar to those found in other global studies. This suggests that complications following these surgeries—particularly in patients with malignancies—are not uncommon, with a reported mortality rate of 1.6%. The study adds valuable new insights to the existing literature by focusing on postoperative complications following gynecologic surgeries. It underscores the importance of improving surgical techniques and postoperative care, which can inform clinical practices and guide future research aimed at enhancing care quality in this field.

KEYWORDS: Postoperative complication; Gynecologic surgeries; Oncology

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INTRODUCTION

Postoperative complications refer to any deviation from the expected recovery process following surgery. While all surgical procedures carry inherent risks, the likelihood of complications varies based on multiple factors. Surgeons aim to reduce risks and carry out surgeries without complications; however, despite their best efforts, complications can still occur, affecting patient outcomes. The Clavien-Dindo classification system is widely used to evaluate these complications[1–3].

In low- and middle-income countries, postoperative complications following elective surgery are estimated to occur in 11% of cases[2]. In contrast, studies suggest that the 30-day postoperative complication rate after gynecologic surgery ranges from 0.2% to 26%[2,5–7]. For instance, a study in the USA reported overall complication rates of 7.9% for benign gynecologic surgeries and 19.4% for malignant cases[8]. Among the most frequent complications identified in the literature are postoperative infections, particularly surgical site infections[2,9–11]. Several factors, such as the Eastern Cooperative Oncology Group (ECOG) performance status, age, American Society of Anesthesiologists (ASA) score, and comorbidities, have been associated with these complications[3,11].

In recent years, there has been a noticeable trend of increased postoperative complications in patients with malignant gynecologic conditions compared to those with benign ones. These complications, including blood transfusions, infections, and readmissions, are notably more frequent in cases of ovarian cancer and other gynecologic cancers. For instance, studies conducted in the USA have found that the complication rate for malignant cases is significantly higher (19.4%) than for benign cases (7.9%)[8]. Additionally, surgical site infections (SSIs) and readmission rates are also elevated in oncologic surgeries[12–16].

This shift can be attributed to the increased complexity of surgeries for malignant conditions, which often involve more extensive procedures such as cytoreductive and debulking surgeries, both of which carry higher risk (17). Additionally, the higher rate of complications is likely associated with factors such as the patient's overall health, the advanced stage of cancer, and the requirement for multiple treatments throughout the course of care[18].

Different studies on 30-day postoperative readmission rates after gynecologic surgery indicate that rates vary from 4% to 20.6%, with higher rates associated with malignant cases compared to benign cases[12–16].

While numerous studies have assessed postoperative outcomes after gynecologic oncology surgery in developed countries and have sought to create predictive models for complication rates, no such studies have been conducted in Ethiopia[6,8,12,13]. The context of gynecologic oncology care is unique, as patients may require both medical and surgical interventions, regardless of a cancer diagnosis. Understanding the rate of postoperative complications and their causes is crucial for evaluating the quality of surgical care. To enhance patient care in gynecologic oncology, it is essential to identify the rate of complications and associated factors. Thus, we conducted a retrospective comparative cross-sectional study focusing on all patients who presented with postoperative complaints. The objective of this study was to assess 30-day postoperative complications after gynecologic surgeries at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia.

Methods

Study Setting:

The study was conducted at Tikur Anbessa Specialized Hospital, a university teaching hospital located in Addis Ababa, the capital of Ethiopia.

Study Design:

A retrospective comparative cross-sectional study was conducted. Patients who underwent surgeries for gynecologic oncology were compared with those who underwent surgeries for benign gynecologic conditions.

Study Population:
The study included women diagnosed with and treated for gynecologic diseases at Tikur Anbessa Specialized Hospital during the specified timeframe.

Eligibility Criteria:
The inclusion criteria consisted of patients who underwent gynecologic oncologic and benign surgeries between January 2021 and December 2023 and experienced postoperative complications within 30 days. Only patients with complete medical charts were included in the study, while those with incomplete chart information were excluded.

Sample Size Determination:
The sample size was calculated using Epi Info software, based on the prevalence of postoperative complications reported in a previous study conducted in Ethiopia (24), which found a prevalence of 32.6%. A confidence level ($Z\alpha/2$) of 1.96, corresponding to a 5% alpha value, and a power level ($Z\beta$) of 80% ($\beta = 0.84$) were applied. Using these parameters, the total sample size was determined to be 337.

Sampling Procedure:
Although the sample size was calculated based on the assumptions above, all patients treated during the study period were included in the study.

Data Collection Methods:
Data were collected using a structured questionnaire adapted from existing literature and modified to extract relevant information from patients' files. The data collection was conducted by doctors specializing in obstetrics and gynecology, who received half-day training on the study's objectives and the data collection tool. The principal investigator ensured the completeness of the data at each stage. The collected data were cleaned, coded, and entered into SPSS for analysis.

Variables
Dependent Variable:
- 30-day postoperative complication rate

Independent Variables:
- Age
- BMI
- ASA (American Society of Anesthesiologists) grade
- Length of preoperative hospital stay
- Final diagnosis (oncologic vs. benign)
- Receipt of neoadjuvant chemotherapy

Operational Definitions:
Postoperative complication: Any deviation from the normal postoperative course, as defined by the revised Clavien-Dindo surgical complication classification[1]. Patients with any such deviation were classified as having a postoperative complication; those without were classified as having no complication.
30-day postoperative period: The time period following surgery during which complications are monitored. A 30-day window was chosen under the assumption that most patients return at least once for follow-up and that most surgery-related complications occur within this timeframe[19].
Blood transfusion: A transfusion initiated during surgery and continued postoperatively was considered a postoperative complication.
BMI classification: Underweight (<18.5), normal weight (18.5–24.9), overweight (≥25.0), and obese (≥30.0)[20].
ECOG Performance Status: Scale ranges from 0 (fully active) to 5 (dead), with intermediate scores reflecting levels of restricted activity and self-care (21).
ASA Score: A subjective assessment of overall health classified as:
1 – Healthy patient
2 – Mild systemic disease
3 – Severe systemic disease (not incapacitating)
4 – Incapacitating disease (constant threat to life)
5 – Moribund (not expected to survive 24 hours with or without surgery)[22]

Neoadjuvant chemotherapy (NACT): Chemotherapy administered before surgery or radiation to shrink a tumor. Also known as primary or induction chemotherapy[23].

Data Analysis:

The completed checklists were reviewed for completeness, cleaned, coded, and entered into SPSS version 23 for analysis. Descriptive statistics were used to summarize the cohort data using frequencies, percentages, means, medians with interquartile ranges (IQRs), and standard deviations. The Shapiro–Wilk test was used to assess data normality. Categorical variables were compared using the chi-square test. Both binary and multiple logistic regression analyses were performed to identify factors associated with complications, with statistical significance set at $p < 0.05$. Adjusted odds ratios (AORs) and 95% confidence intervals (CIs) were calculated for predictors of 30-day postoperative complications. Results were presented in the form of text, graphs, figures, and tables.

Ethical Considerations:

To ensure patient safety and privacy, ethical approval and a waiver of informed consent were obtained from the Department of Research and Publication Committee (DRPC), under IRB number DRPC 2024/08/22_2. This waiver allowed for the use of existing patient records without direct interaction, thereby minimizing risk. All data were handled with strict confidentiality in compliance with ethical standards for research involving human subjects.

Results

A total of 355 patients who underwent gynecologic surgery were analyzed during the study period, with 118 classified as benign and 237 as malignant cases preoperatively. The median age of patients with malignant conditions was significantly higher, with a median of 48 years (Interquartile Range [IQR] 40–60), compared to 37 years (IQR 30–45) for those with benign conditions. Notably, 62% of oncologic patients were postmenopausal, while only 20.8% of benign patients fell into this category (table 1&2).

Table 1 : Sociodemographic Characteristics of Patients in the Study on 30-Day Postoperative Complications following Gynecologic Surgery at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia from January 2021 – December 2023 G.C.

Variables		Frequency	Percent(%)
Age			
	<20	6	1.7
	20-30	56	15.8
	31-40	108	30.4
	41-50	85	23.9
	51-60	51	14.4
	>60	49	13.8
Menopausal status			
	Premenopause	204	57.5
	Postmenopause	151	42.5
Parity			
	Nulliparous	106	29.9
	Primiparous	63	27.7
	multiparous	186	52.4
Religion (n= 114)			
	orthodox	68	59.6
	protestant	25	21.9
	Muslim	12	10.5
	catholic	1	0.9
	Other *	8	7

* those described as others are Jehovah witness, only Jesus and Adventist religion followers

Table 2: Clinical characteristics of Patients in the Study on 30-Day Postoperative Complications Following Gynecologic Surgery at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia from January 2021 – December 2023 G.C.

Variables		Frequency	Percent(%)
Medical illness			
	No medical illness	226	63.7
	HTN	40	11.3
	DM	7	2.0
	HIV	54	15.2
	other	28	7.9
BMI			
	normal	206	58
	underweight	19	5.4
	overweight	99	27.9
	obese	7	2
	Unknown	24	6.8
ECOG performance (n= 342)			
	0	319	93.2
	1	20	5.8
	3	3	0.9
Pre-Operative diagnosis			
	ovarian cancer	104	29.3
	cervical cancer	74	20.8
	vulvar cancer	22	6.2
	endometrial cancer	20	5.6
	uterine sarcoma	11	3.1
	Gestational trophoblastic neoplasm	5	1.4
	vaginal cancer	1	0.3
	benign tumor	118	33.2
ASA grade			
	1	76	21.4
	2	242	68.2
	3	37	10.4

Preoperative and Postoperative Complications in Gynecologic Surgery

Preoperative transfusions were administered to 10 patients, with 4 (2.1%) in the oncologic group and 6 (3.6%) in the benign group receiving transfusions. Serum albumin levels indicated that 30% of oncologic patients experienced hypoalbuminemia compared to 1.7% of benign cases. Additionally, 12.3% of oncologic patients received neoadjuvant chemotherapy (NACT), with a median interval of 3 months to surgery afterward.

Postoperatively, 23.2% of presumed oncologic cases were found to have benign histopathology. Among benign surgeries, the most common procedures included myomectomy (48 patients) and total abdominal hysterectomy (TAH, 31 patients), with 20.3% experiencing complications, primarily anemia and surgical site infections (SSI). In contrast, among the 104 patients with presumed ovarian cancer, 40.3% developed complications, including blood transfusions, SSIs, and other issues like deep vein thrombosis and fascial dehiscence. For vulvar cancer, 45.4% of patients experienced postoperative complications. Patients diagnosed with gestational trophoblastic neoplasia also had complications, with one requiring blood transfusion and others experiencing SBO or SSI.

Table 3: A 30-Day Postoperative Complications following Gynecologic Surgeries at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia from January 2021 – December 2023 G.C.

Type of Post OP complication	Total (N=110)	Percent
Surgical site infection	31	28,2%
Deep vein thrombosis	1	0.9%
Mortality	3	2.7%
Cardiac disease	1	0.9%
Acute urinary retention	1	0.9%
Postoperative blood transfusion	37	33.6%
Small bowel obstruction	4	3.6%
Fascial dehiscence	3	2,7%
Urinary tract infection	4	3.6%
Acute kidney injury	1	0.9%
Anemia	14	12.75
Hospital acquired infection	7	6.3%
Pelvic peritonitis	1	0.9%
Electrolyte abnormality	2	1.8%

Overall, the study reported a 31% postoperative complication rate, with a median onset of complications occurring around 8 days for malignant cases and 7.5 days for benign cases. Among histopathologically confirmed malignancies, 41.2% developed complications compared to 19.6% of benign cases. The most frequent complications in benign surgeries were SSIs, while malignant cases primarily experienced postoperative blood transfusions. Unfortunately, there were three postoperative deaths among malignant cases within the 30-day follow-up period (table 3).

Regarding blood transfusions, 58 patients (16.3%) required intraoperative transfusions, with 8.3% of benign and 23.5% of malignant patients receiving transfusions. The median intraoperative blood loss was 250 ml for benign cases and 400 ml for malignant cases, with an average of two units of blood transfused for both groups. The postoperative readmission rate was 4.5% overall, with 2.4% for benign cases and 6.4% for malignant cases, primarily due to SSIs.

Univariate analysis revealed several significant associations with complications, including age, parity, menopausal status, presence of medical illness, BMI, preoperative transfusions, NACT, final diagnosis, length of preoperative hospital stay, and ASA grade, with p-values less than 0.25. Multivariate analysis showed that the likelihood of complications was 2.7 times greater in malignant cases compared to benign, and that underweight patients had a threefold increased risk, while overweight patients faced a 1.7-fold increased risk of postoperative complications compared to those with normal BMI across all groups (both benign and malignant). Each additional day a patient stay in the ward before surgery increases the likelihood of postoperative complications by 4.4%. (table 4).

Table 4: Predictors of postoperative complication of Patients in the Study on 30-Day Postoperative Complications Following Gynecologic Surgery at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia from January 2021 – December 2023 G.C.

Variable		P value	COR 95% CI	P value	AOR 95% CI
Age (per 1 year increase)		0.076	1.01(0.99-1.03)	0.652	0.99(0.96-1.02)
Parity:					
	Nulliparous	-	1		1
	Primi-parous	0.05	2.04(1.01-4.13)	0.08	2.01(0.93-4.38)
	Multiparous	0.42	1.26(0.72-2.19)	0.95	0.98(0.5201.84)
Menopausal status: ref: postmenopausal		0.03	0.59(0.37-0.93)	0.50	0.82(0.45-1.48)
Known medical illness: ref: Yes		0.12	1.457(0.90-2.35)	0.92	1.03(0.60-1.77)
BMI					
	Normal	-	1	-	1
	Underweight	0.06	2.47(0.95-6.40)	0.03	3.16(1.12-8.99)*
	Overweight	0.06	1.64(0.98-2.73)	0.04	1.73(1.02-2.95)*
	Obese	0.35	2.06(0.45-9.49)	0.29	2.37(0.48-11.6)
ECOG performance status		0.57	-	-	
Preoperative blood transfusion given: ref: Yes		0.21	0.45(0.13-1.58)	0.28	0.47(0.12-1.85)
NACT given: ref: yes		0.03	0.39(0.17- 0.92)	0.25	0.575(0.23-1.46)
Final diagnosis: ref: Benign		< 0.01	2.57(1.57-4.20	< 0.01	2.70(1.59-4.53)*
Preoperative length of hospital stays in days: continuous		0.08	1.06(1.01-1.10)	0.05	1.04(1.01-1.09)*
ASA grade					
	ASA 1		1	-	1
	ASA 2	1.04	0.56(0.28-1.13)	0.22	0.63(0.30-1.32)
	ASA 3	0.01	0.31(0.13-0.75)	0.29	0.59(0.22-1.56)
Intraoperative transfusion: ref: yes		0.99	- -	-	

Discussion

In this study, the overall postoperative complication rate was 31%, with 41.2% of patients with malignancies experiencing complications. Intraoperative or postoperative blood transfusion was the most common complication, followed by surgical site infections (SSI). The 30-day postoperative mortality rate was 1.6%. Comparable to this study, a study conducted in Ethiopia assessing the postoperative complication rate following hysterectomy found a rate of 32.6%[24]. While no studies directly compare complications between benign and malignant gynecologic cases, a study by Sumer K. Wallace et al. reported complication rates of 19.4% for malignant cases and 7.9% for benign cases after hysterectomy[8]. This finding aligns with a study by Ikram et al. in Yemen, where 30.6% of patients developed postoperative complications[2]. Similarly, in Bangladesh (2014), 30.0% of gynecologic surgeries led to postoperative complications. Additionally, a study by Lambrou N. et al. in Baltimore, Maryland (USA, 2000), found that 33% of patients developed postoperative complications following gynecologic surgeries[25,26].

The majority of these complications occurred in patients who underwent surgery for ovarian cancer (40%). A study conducted in Sweden evaluating postoperative complications after cytoreductive surgery for ovarian cancer reported a complication rate of 65%, while a similar study by Kati et al. in 2022 reported a 76% postoperative complication rate following extensive debulking surgery[27,28]. The lower complication rate observed in this study may be attributed to the retrospective study design, where incomplete data recording may have led to an underestimation of the true prevalence of the primary outcome.

In this study, the risk of developing postoperative complications was nearly three times greater in underweight patients and two times greater in overweight patients compared to those with a normal BMI. Wound infection was one of the most frequent postoperative complications observed. This result is consistent with existing literature, which shows that the risk of wound infection increases with higher BMI compared to normal BMI after abdominal surgery[29,30].

The risk of postoperative complications was found to be more than 2.7 times higher for malignant cases compared to benign cases. Most benign patients underwent myomectomy and simple hysterectomy, while more complex procedures were performed for malignant conditions. These findings suggest a correlation between the extensive procedures carried out in malignancy cases and the increased rates of associated complications.

In our study, 16.3% of patients received intraoperative blood transfusions, and 23.5% of postoperative malignant patients were transfused, with a median (IQR) of 2 (1–3) units transfused. In contrast, a study conducted in India reported a blood transfusion rate of 3.69%, which is lower than the rate observed in our study. One possible explanation for this is that the majority of the Indian study population consisted of benign gynecologic cases[9]. Another study conducted in the USA reported an overall transfusion rate for gynecologic oncologic cases after laparotomy of 22.4%[24], which is more consistent with the findings of this study. Similarly, studies by Jaron M. et al. and Sumer K. Wallace et al. reported transfusion rates of 5.9% and 18%, respectively, both lower than the rate observed in our study[32,33].

The postoperative readmission rates in this study were 2.4% for benign patients and 6.4% for malignant patients. Readmissions were more frequent among patients undergoing surgery for malignancy compared to those treated for benign conditions. Surgical site infection was the most common cause of readmission.

In comparison, Lorry C. et al. reported readmission rates of 3% for benign cases and 8.2% for oncologic cases[12]. A similar study conducted in Saudi Arabia found unplanned readmission rates of 9.4% for benign conditions and 7.7% for malignant conditions[34]. Additionally, Lori A. et al. reported readmission rates of 1.75% for benign cases and 5% for oncologic cases, while Morell A. et al.

found an overall readmission rate for gynecologic oncologic cases of 3.5% (13,35). Other studies have reported readmission rates ranging from 4.3% to 20.9%[14,15,16].

This study was conducted at a single center, limiting the generalizability of the findings. However, the inclusion of all patients in the analysis helps to mitigate this limitation. Additionally, the retrospective nature of data collection meant that incomplete patient files led to missing values, which may have affected the assessment of risk factors and their association with outcomes. The most commonly missing data were BMI values, absent in 6.8% of patient charts. Furthermore, patients who presented with postoperative complications to other centers may not have been captured by our data collection method.

Conclusion and Recommendation

Postoperative complication rates following gynecologic surgeries are similar to those reported in other global studies. This suggests that complications—particularly among patients with malignancies—are not uncommon, with a reported mortality rate of 1.6%. Key risk factors such as BMI and the nature of the diagnosis should be considered during preoperative evaluations to identify high-risk patients. This study provides valuable insights by focusing on postoperative complications in gynecologic surgeries. It underscores the need for improved surgical techniques and postoperative care, which could inform clinical practice and guide future research to enhance quality of care. Recommendations for improving outcomes include comprehensive preoperative assessments, structured postoperative monitoring, and further research on risk prediction. These measures may improve patient care and surgical outcomes in gynecologic surgery.

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Availability of Data and Materials

The datasets used and analyzed during this study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare no conflicts of interest.

Authors' Contributions

The principal investigators and authors were entirely responsible for the study design, conduct, and data analysis.

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LABIAL ADHESIONS IN REPRODUCTIVE-AGE WOMEN: CLINICAL CASE SERIES

Getu Dinku Heyi[1], Sintayew Debas Endalew[1], Awoke Yibeltal Belay[1], Tadie Siraw Mulu[1]

BACKGROUND

Labial adhesion—also known as labial fusion, labial agglutination, or synechia vulvae—is a rare condition in women of reproductive age. We report two cases of reproductive-aged women with labial adhesion who were successfully managed surgically.

CASE PRESENTATION: The first case involves a 29-year-old para one who presented with difficulty engaging in penetrative sexual intercourse following childbirth at a health centre two years earlier. Physical examination of the genitalia revealed fusion of the labia, with the exception of a small distal opening.

The second case concerns a 20-year-old nulligravid woman who was sexually inactive and presented with a three-year history of painful menstrual flow. Examination revealed fusion of the labia with a small proximal opening.

CONCLUSION: Labial adhesion is rare in the reproductive age group. It should be considered in the differential diagnosis of women presenting with menstrual irregularities or sexual dysfunction.

KEYWORDS: Labial adhesion, agglutination, reproductive-age women, surgical adhesiolysis

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INTRODUCTION

Labial adhesion is a rare condition defined as the complete or partial fusion of the labia minora or majora[1]. The membrane typically seals the vaginal opening, leaving only a small anterior gap through which urine is passed[2]. Labial adhesion is most commonly seen in prepubertal girls and postmenopausal women and is extremely rare in women of reproductive age, with only a few reported cases in the literature[1,3]. It is hypothesized that the relative hypoestrogenic states in prepubertal and postmenopausal periods predispose these populations to labial adhesions[4]. In the prepubertal group, the condition often resolves spontaneously[5]. In contrast, labial adhesion in reproductive-aged women is considered extremely rare due to the typically high estrogen levels. In this age group, the etiology remains unclear[5]. Known secondary causes include female circumcision, lichen sclerosus, herpes simplex virus infection, diabetes mellitus, pemphigoid, and caustic vaginitis[6]. Cases without evidence of hypoestrogenism or chronic skin conditions are particularly uncommon. Postpartum labial adhesions are rarely described in the literature[4]. Vaginal lacerations following childbirth, along with the transient hypoestrogenic state of the postpartum period, are proposed risk factors[4,5].

The standard treatment for adult labial adhesion is surgical adhesiolysis. In contrast, pediatric cases often respond well to topical estrogen therapy and improved hygiene[5]. In adults, however, topical estrogen is generally less effective, and surgery is frequently required[1,2,3,6]. Current literature does not support topical estrogen as a first-line treatment. Instead, surgical dissection under local or regional anesthesia is recommended, especially in postpartum cases[4].

We report two cases of labial adhesions in reproductive-aged women managed surgically. Although rare in this age group, such cases can significantly impair quality of life and often require surgical intervention, unlike similar conditions in younger or older women.

Case 1

A 29-year-old para one was referred from a private health facility to our hospital with complaints of difficulty engaging in sexual intercourse. She had delivered vaginally at a health centre two years earlier, during which she sustained genital trauma that was sutured. She had been using depot medroxyprogesterone acetate injectable contraception. Her menstrual cycle was regular, with a three-day flow, and she had no urinary complaints.

On physical examination, the labia minora were fused except anteriorly, where there was a small opening measuring 0.5 cm in diameter. The labia majora appeared normal, with no visible skin lesions or scarring. Pelvic ultrasound, urinalysis, and complete blood count results were all within normal limits.

Following informed written consent, surgical adhesiolysis was performed under spinal anesthesia. The labial edges were sutured using Vicryl 3-0, and the patient was advised to apply petroleum jelly to the area for three weeks. At follow-up, her vagina, cervix, and clitoris appeared normal, and the labia had healed completely without recurrence of adhesion.

Figure 1. Labial adhesions before surgery. (thin arrow indicating the opening of the labial adhesion, big arrow indicating vaginal mucosa but there was no communication at the site with the vaginal canal)

Figure 2. After surgical correction of labial adhesions

Case 2

A 20-year-old nulligravida was referred from a local health center to our hospital with a complaint of painful menstruation lasting for three years. Her menses occurred monthly but flowed for two weeks. She reported no difficulty with urination, had no history of genital trauma, and was not sexually active.

On physical examination, the labia majora and clitoris appeared normal. However, there was fusion of the labia minora except anteriorly, where a small opening was noted. There were no visible skin lesions.

After counseling and obtaining written informed consent, surgical adhesiolysis was performed under spinal anesthesia, with caution taken to preserve her virginity. The edges of the wound were sutured using Vicryl 3-0. She was advised to apply petroleum jelly to the affected area for three weeks. At her follow-up visit two months later, the wound was found to be completely healed.

Figure 3. Labial adhesion before surgical correction

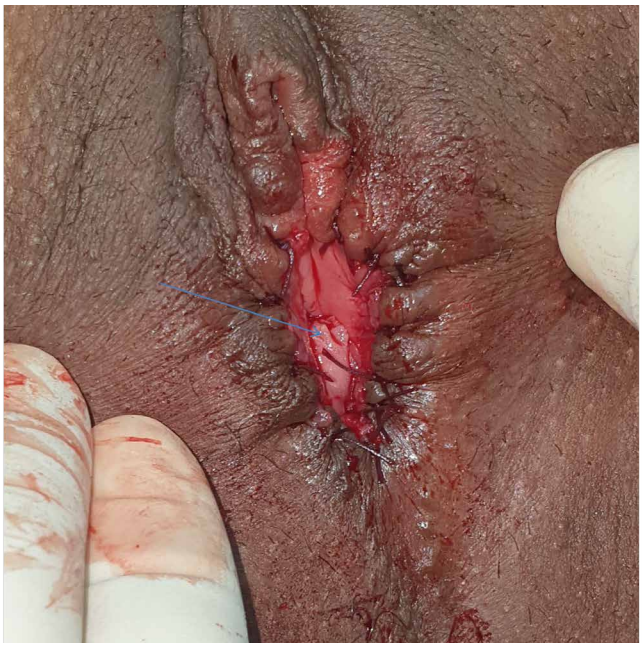

Figure 4. After surgical correction of labial adhesions (thin arrow indicating intact hymen)

Discussion

Labial fusion, while common in children, is a rare clinical entity in adults and even more so in reproductive-age women. The exact etiology of labial adhesions in this age group remains unclear. In prepubertal girls, a relatively hypoestrogenic environment and sexual abuse or genital trauma are considered major predisposing factors. In adults, labial fusion has been associated with recurrent urinary tract infections, vulvovaginitis, genital trauma, hypoestrogenism, and lack of sexual activity. In some cases, a diagnosis of lichen sclerosis was made following a punch biopsy.

Although reproductive-aged women typically have normal levels of sex hormones, which are thought to be protective against this condition, labial adhesions can still occur. In the second case presented, a history of perineal tear and ongoing breastfeeding may have contributed to the development of labial adhesion. No clear risk factor was identified in the first case, and the patient was unaware of when the condition began.

Current postpartum perineal care guidelines often recommend separating the labia during urination and cleansing the perineum regularly with a peri bottle or sitz bath. These practices may help prevent the formation of tissue bridges, particularly in women with unrepaired labial lacerations.

Although a hypoestrogenic state in the immediate postpartum period has been hypothesized to contribute to labial adhesion formation, the failure of topical estrogen therapy in such cases challenges this theory. Moreover, postpartum adhesions typically present as tissue bridges or bands rather than thin membranes.

Labial adhesion recurrence rates range from 11% to 14%. Recurrent adhesions, especially those that occur post-surgically, tend to be denser and less likely to respond to conservative treatment. In our cases, both patients were in an estrogenic state, as evidenced by regular menstruation, and presented with dense adhesions. Thus, topical estrogen and steroid creams were not attempted, and surgical adhesiolysis was performed. Postoperatively, both patients were advised to apply petroleum jelly to the affected area to aid healing and reduce recurrence risk.

Conclusion

Although labial adhesions are rare in reproductive-age women, they should be considered in the differential diagnosis of women presenting with prolonged menstrual periods or difficulty with penetrative sexual intercourse. Timely diagnosis and prompt management are essential for achieving favorable clinical outcomes.

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