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Developmental delay and associated factors among HIV-infected under-five children in public health facilities, Southern Ethiopia

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Delays in development that occur during early childhood can have long-lasting consequences, potentially leading to poor academic achievement. Research has shown that the human immunodeficiency virus can have neurotropic effects, which may impact the development of the brain in infected children. However, there is a scarcity of evidence regarding developmental delays among children with human immunodeficiency virus in the study area. This study aimed to determine the prevalence of developmental delay and associated factors among children with the human immunodeficiency virus in southern Ethiopia. A cross-sectional study was undertaken among 422 children aged below five during October 30 to December 30, 2021, who acquired the human immunodeficiency virus at public hospitals. A pretested tool anthropometric measurements were utilized. To examine developmental delay, the age and stage questionnaires (version 3) were used. Descriptive statistics were performed. Bivariable and multivariable binary logistic regression models were fitted to identify potential factors associated with delays in child development. The analysis was performed using STATA version 14.2. Adjusted odds ratios with 95% confidence intervals and variables with p-values less than 0.05 were considered to be significantly associated with global developmental delay. A total of 413 under-five children with human immune virus participated, with a 97.9% response rate. Of all children, 222 (53.75%) were male, and the mean age of children was 3.5 ± 1 (± SD) years. Overall global developmental delay was 41.89% [95% CI 37–47%]. Maternal age 35 and older [AOR 2.2; 95% CI (1.11–4.3)], maternal educational status [AOR 0.47; 95% CI (0.23–0.96)], higher birth order [AOR 3; 95% CI (1.5–4)], and stunting [AOR 2.2; 95% CI (1.4–3.42)] were significant factors associated with global developmental delay. Half of the children examined demonstrated delayed development across domains. The global developmental delay constitutes a significant public health concern, underscoring the necessity for early detection initiatives including developmental screening, diagnostic evaluations, and therapeutic interventions. We found significant associations between the developmental status of the children and the maternal age, educational level of mothers, higher birth order, and stunting of under-five children. Policies should aim to enhance mother and child health services, expand access to early intervention programs, and incorporate developmental surveillance into routine pediatric care. Additional research may be necessary to elucidate the underlying causes of the high prevalence of Global developmental delay, evaluate the efficacy of current interventions, and investigate innovative approaches to mitigate developmental delays.

Keywords Developmental delay, Guji Zones, Ethiopia, Under-five children

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ASG	Age and Stage Questionnaire
CART	Combined anti-retroviral therapy
CNS	Central nerve system
DD	Developmental delay
EBF	Exclusive breast feeding
ECD	Education and child development
EDHS	Ethiopian Demographic and Health Survey
FMOH	Federal Ministry of Health
GDI	Global developmental impairment
IYCF	Infant and young child feeding
HIV	Human immunodeficiency virus
HUU	Human immunodeficiency virus unexposed uninfected
LMICs	Low and middle income countries
SDGs	Sustainable developmental goals
WHO	World Health Organization

Childhood development refers to the numerous, dynamic changes that occur primarily throughout childhood and continue into early adulthood in a child's physical development, social, emotional, intellectual, and communication skills[1,2]. Developmental delay is a condition in which children do poorly in developmental domains for their age[3]. The human immunodeficiency virus has been linked to a number of developmental obstacles, including cognitive decline, neurological symptoms, learning disabilities, and speech and language difficulties. The human immunodeficiency virus attacks and invades the growing brains of children, causing substantial neurological abnormalities[4].

It is estimated that more than 25% of children worldwide have developmental delays[5] While more than 250 million children in low- and middle-income countries (LMICs) have some sort of developmental delay, the burden is highest in Sub-Saharan Africa, which includes Ethiopia[6]. According to one study, 19.0% of Ethiopian children have developmental delays. One-third (34.1%) of the participants in the study were stunted, with rates of underweight and wasting of 6.9% and 11.9%, respectively[7]. A recent estimate also showed 81.0 million children aged 3–4 years in middle-income countries (LMICs), with the highest burden (29.5 million) in Sub-Saharan Africa, had low cognitive and/or socioemotional development[8]. Extreme poverty and food insecurity in Ethiopia prevent children from reaching their full developmental potential. It is estimated that 59% of Ethiopian children are at risk of developmental delays[9,10].

Research on children with the human immunodeficiency virus in Yunnan found that 39% of them had global developmental delays, while South Africa reported 55.88% of global developmental delays[11,12]. Early developmental delays may persist into childhood and result in low educational achievement and decreased lifetime earnings[13]. Global developmental delay was reported to have affected 39% of children with human immunodeficiency virus in another study done in Yunnan, but it was reported that it affected 55.88% of children in South Africa[14].

The human immunodeficiency virus may hinder ideal social, emotional, physical, and academic functioning and results, producing impairments, restrictions, and limitations that last throughout childhood and beyond related to the infections that occur as a result of immunosuppression[15,16].

Antiretroviral therapy started early and improved neurocognitive outcomes. Even though antiretroviral therapy (ART) is effective in reducing mortality in children with human immunodeficiency virus, children who start antiretroviral therapy later in life face a neurodevelopmental risk. Despite suppressive ART, neurodevelopmental deficits in childhood persist into adolescence[16,17].

In addition to the human immunodeficiency virus, research showed that maternal education, maternal age, malnutrition, and infant birth order were other factors associated with global child developmental delay[7,18,19]. While Sustainable Development Goal (SDG) is to ensure that everyone has the opportunity to live as fully and equally as they are capable of[20] developmental delay have been affecting quality of life among children in Sub Saharan Africa.

The dearth of scientific data on the prevalence of developmental delays and the correlation between developmental status and associated factors in human immunodeficiency virus-positive children under the age of five in African countries, particularly in Ethiopia, is noteworthy. To the researchers' knowledge, no prior attempts have been made to evaluate the extent of developmental delays and related factors among children with human immunodeficiency virus in Ethiopia. The study's findings will provide a good picture of HIV-infected children's developmental status, as well as related factors, allowing early identification of developmental disability and intervention at the earliest possible time to improve children's developmental potential. Consequently, this study aimed to assess the prevalence of developmental delays and associated factors among human immunodeficiency virus-positive children at public health facilities in Oromia, Southern Ethiopia.

Materials and methods

Study design and setting

An institution-based cross-sectional study design was conducted among 422 randomly selected under-five children with human immunodeficiency virus on follow-up at the three public hospitals in the Guji and Borena zones, Southern Ethiopia, from October 30 to December 30, 2021. The selected hospitals were Adola, Bule Hora, and Yabello General Hospitals. Adola General Hospital is located 494 km south of the country's capital, Adis Ababa. This hospital offers an ART service clinic with 160 under-five children with human immunodeficiency

virus. Bule Hora Hospital and Yabello General Hospital also provide ART service clinics for 300 and 240 children under the age of five with human immunodeficiency virus, respectively.

Study population

The present study encompassed all children under the age of five who were infected with human immunodeficiency virus and receiving antiretroviral therapy at randomly selected public health facilities. However, children with physical defects caused by trauma that prevented proper measurements were excluded from the study.

Sampling size determination

A single population proportion formula was used to calculate the sample size by considering the following statistical assumptions;

P = proportion of global developmental delay among HIV-infected children is 50% which yields maximum sample size since there are no similar studies in Ethiopia on these objectives.

$(\mathrm{Za}/2 = \text{the corresponding Z score of } 95\% \text{ CI})$

$\mathrm{d} = \text{Margin of error } (5\%)$

$$\mathrm{n} = \frac{(\mathrm{Z}_{\mathrm{a}/2})^2 * \mathrm{P}\ (1-\mathrm{P})}{\mathrm{d}^2}$$

$$= (1.96)^2 \frac{0.5\,(1-0.5)}{(0.05)^2}$$

$$= 385$$

By adding a 10% non-response rate, the final total sample size was 422.

Sampling techniques and procedure

Three general hospitals that provide ART clinics were selected. Simple random sampling was used to select the predetermined sample size. The sampling unit was selected from each hospital by allocating the total sample proportionately. Then sampling frame was developed from the record by assigning ID numbers for all MRNs and a computer-generated random number was used to recruit the 422 study participants (Fig. 1).

Data collection tools

The required data were collected using body dimension measurements and a pretested structured questionnaire. The questionnaire was initially prepared in English and then translated into Afan Oromo by a language expert, and again it was translated back into English to check its consistency. There were three supervisors, all of whom had a master's degree in public health and a health background. The weights of children under the age of five were measured to the nearest 0.1 kg using a UNICEF-recommended weighing scale, without shoes or clothing. We employed a UNICEF-recommended digital weighing scale designed solely for children. The nutritional status

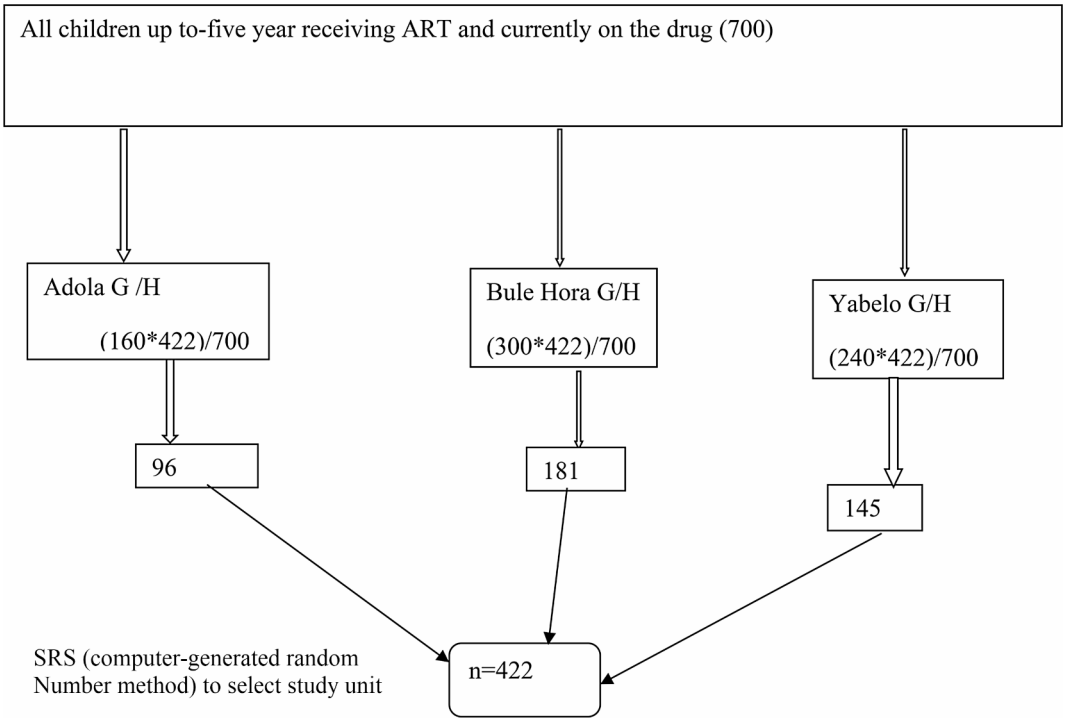

Fig. 1. Schematic diagram of sampling procedure of HIV-infected children attending ART follow-up at public hospitals Guji and Borena Zones.

indices height-for-age (HFA), weight-for-height (WFH), and weight-for-age (WFA) were stated as z-scores using the World Health Organization Child Growth Standards[21]. A child's developmental status was assessed with the use of the age and stage questionnaire, third edition (ASQ-3) as a screening tool[22]. The ASQ-3 is quick and simple to use, taking caregivers about 10–15 min to complete and experts about 2–3 min to score. The ASQ-3 effectively screens five key developmental areas: communication, gross motor, fine motor, problem solving, and personal-social; each domain contains six questions that can be answered with a yes (10 points), sometimes (5 points), or not yet response (0 points). The scores in each domain are compared to cut-off scores of one and two standard deviations, which are used to identify children who are at risk of developmental delay. Empirical research is used to generate cutoff scores.

Study variables

Dependent variable
Developmental delay.

Independent variables
Socio-demographic factors (maternal age, maternal educational status, religion, marital status, size of household, and residence), child-related factors (sex of child, birth order, place of birth, mode of delivery), and nutritional factors (breast feeding status, time breast feeding initiated, wasting, stunting, and underweight).

Operational definitions

Developmental delay
Delay in specific or global functioning of children involving domains communication, fine and gross motor, problem-solving, and personal-social areas, where a child's performance on developmental tasks lies at 2 or below the standard deviation point from the mean of the age-appropriate standardized norm-referenced[22].

Global developmental delay
Delayed developmental domains (includes communication, fine and gross motor, problem-solving, and personal-social) in two or more areas of children where performance on the developmental task of children (i.e., in which each component is assessed by six items of question, a composite of 60) lies at 2 or below the standard deviation from the mean[22].

Wasting
Weight-for-height (WHZ), Children were classified as waste, if they score< -2 standard deviation (SD)[23].

Underweight
Weight-for-age (WAZ), Children were classified as, underweight, if they score< -2 standard deviation (SD)[23].

Stunting
Length-for-age (LAZ), Children were classified as stunted if they score< -2 standard deviation (SD)[23].

Data quality control

To maintain the quality of the data, two days of training on the content of the questionnaire and the objective of the study were given to data collectors and supervisors. Pretesting of the questionnaire was done by taking a 5% sample of volunteer participants in nearby Bore Hospital. Cronbach's alpha was checked for child background and developmental status with a value of 0.72 and 0.92, respectively. The collected data was checked for inconsistency and completeness of entry. Finally, double data entry was performed by two data clerks and cross-validated.

Data processing and analysis

Collected data were entered using Epi-data 3.1 and then transported to Stata 14.2 for analysis. Descriptive statistics (frequencies, percentages, and means) were computed to describe the study population concerning relevant variables. Bivariable analysis was done, and explanatory variables with a p-value less than 0.25 were entered into multivariate analysis. The Hosmer–Lemeshow goodness-of-fit test was used to test for model fitness, and the multi-collinearity test was carried out using the Variance Inflation Factor (VIF). Finally, variables with a p-value < 0.05 in the multivariable logistic regression were considered significantly associated factors.

Results

Socio-demographic characteristics of study participants

Of 422 children with mothers or caregivers invited to take part in the study, 413 (97.9%) participants gave a complete response. Concerning maternal age, the largest number of 199 (48.2%) mothers of children were in the age range of 35 and above, and about 142 (34.40%) mothers of children have no formal education. The average family size was 5 with two standard deviations, and the minimum and maximum family sizes were 2 and 15, respectively (Table 1).

Children-related characteristics and nutritional status

Of all children, 222(53.75%) were male and the mean age of children was 3.5 ± 1 ($\pm$SD) years. Nearly one-third of children were born second, and about 99 (23.97%) were above the fourth birth order. About 211 (51.09%) of children were born at health facilities, and a large proportion (377 (91.28%) were born through spontaneous vaginal delivery. More than half of the 268 children (64.89%) were breastfed, and 162 (39.23%) initiated

Variable	Category	Frequency	Percentage
Maternal age	19–24	58	14.04%
	25–29	76	18.40%
	30–34	80	19.37%
	> 35	199	48.20%
Maternal education	No formal education	142	34.40%
	Primary school	118	28.60%
	High school	81	19.60%
	College and above	72	17.40%
Religion	Apostolic	6	1.45%
	Catholic	49	11.86%
	Muslim	130	31.48%
	Orthodox	101	24.46%
	Protestant	104	25.18%
	Other	23	5.57%
Marital status	Single	14	3.39%
	Married	270	65.37%
	Divorced	98	23.73%
	Widowed	31	7.51%
Size of household	≤ 3	137	33.17%
	≥ 4	276	66.83%
Residence	Rural	169	40.92%
	Urban	244	59.08%

Table 1. Socio-demographic characteristics of mothers/caregivers of HIV-infected under five children on ART follow-up at public health facilities in Guji and Borena Zones, Oromia, Southern Ethiopia, 20,222.

breastfeeding in less than one hour. More than one-third of the 160 children (39.02%) were stunted, and nearly one-third of the children (145, or 35.10%) were not breastfed. (Table 2).

The prevalence of developmental delays

The overall and developmental scores of children were calculated at each milestone using the age-specific ASQ-3 tool. The total mean ASQ-3 score was 196.71 (with a standard deviation of 55.1). The mean ASQ-3 score for each domain ranged from 36.95 to 43.2 (SD ± 8.9 to 11.95) on a scale of zero to 60. As a result, 191 (46.25%) children showed developmental delay in the gross motor skills domain, followed by 121 (29.28%) children in the personal-social skills domain and 106 (25.7%) children in the communication skills domain (Table 3).

The prevalence of global developmental delay

In addition to considering developmental delays in specific domains for all age categories involved in this study, an attempt was made to determine the number of children who exhibited delayed development in two or more domains (global developmental delay) of development. Taking the numbers, it gives 173. These 173 children manifested delayed development in two or more areas, which gives a prevalence of 41.9% (95% CI (37–47%)).

Factors associated with global developmental delays

In this study, maternal age, educational status, birth order, breastfeeding status, time breastfeeding was initiated, the primary caregiver of the child, mode of delivery, wasting and stunting were variables that showed a p-value < 0.25 in bivariable analysis and became candidates for multivariable analysis. In multivariable analysis, by taking other variables constant, children who are their maternal age 35 and above were 2.2 times more likely to have a global developmental delay as compared to mothers with age 19–24 [AOR = 2.2; 95% CI (1.112-4.3)]. Similarly, the odds of having global developmental delay were 2.2 times higher among children stunted as compared with normal [AOR = 2.2; 95%CI (1.404–3.416)]. Children whose mothers had a college diploma and above had a 53% reduced risk of global developmental delay as compared to mothers who had high school [AOR = 0.47; 95% CI (0.227–0.962)]. Children who were in their birth order fourth and above were three times more likely to have global developmental delay as compared to the first birth order [AOR = 3; 95% CI (1.5–4)]. All variables' VIFs were examined, and the maximum VIF was 1.3. There was no multi-collinearity between variables as a result. (Table 4)

Discussion

Identifying the prevalence of developmental delay in children is critical for monitoring their developmental status and preventing subsequent issues such as intellectual disability. This study aims to examine the prevalence of developmental delay and associated variables among children with HIV who attended ART follow-up in Guji and Borena Zone public health facilities. The study's findings revealed that approximately 41.89% (95% CI

Variable	Category	Frequency	Percentage
Sex	Female	191	46.25%
	Male	222	53.75%
Birth order	First	102	24.70%
	Second	140	33.90%
	Third	72	17.43%
	Fourth and above	99	23.97%
Term at birth	Yes	392	94.92%
	No	21	5.08%
	Other	23	5.57%
Place of birth	Health facility	211	51.09%
	Home	166	40.19%
	On the way to health facility	36	8.72%
Mode of delivery	Instrumental	36	8.72%%
	SVD	377	91.28%
Breast feeding status	Yes	268	64.89%
	No	145	35.10%
Time breast feeding initiated	< 1 h	162	39.23%
	1–23 h	76	18.40%
Time child start complementary feeding	At 6 months	225	54.48%
	< 6 month	142	34.38%
	> 6 month	46	11.14%
Wasting	Wasted	167	40.63%
	Normal	244	59.37%
Stunting	Stunted	160	39.02%
	Normal	250	60.69%
Underweight	Underweight	159	38.50%
	Normal	254	61.50%

Table 2. Child characteristics of HIV-infected under five children on ART follows-up at public health facilities in Guji and Borena, Oromia, South Ethiopia, 2022.

37–47%) of children exhibited global developmental delays. The high prevalence of global developmental delay (GDD) indicates a significant public health concern, underscoring the necessity for early screening programs and increased allocation of resources to early childhood health services, including developmental screening, diagnostic assessments, and therapeutic interventions. Timely identification of children at risk may facilitate the implementation of prompt measures to improve outcomes.

This finding is comparable with the investigations carried out in Yunnan (39%), Thailand (44%), and South Africa (40.91%)[12,24,25]. One suggested explanation for this phenomena is that the human immunodeficiency virus has neurotropic capabilities, entering children's brains and producing damage as a result of the infection. Immunosuppression may cause this deficit, which could result in major global developmental delays[4]. It is higher than research results in South Africa (27%), but lower than research results in Zimbabwe (53.57%) and Jonesburg (55.88%)[11,26,27]. This disparity could be attributed to time-initiated ART, heterogeneity of assessment techniques, limited access to health care, and sociodemographic characteristics, all of which may be plausible explanations for variation. The current study indicated that maternal education was associated with global developmental delays. This finding is consistent with previous studies[12,28–31]. Maternal education has been shown to have a significant impact on various aspects of a child's development throughout their lifetime. One possible explanation for this association is that mothers with lower levels of education may lack enough financial resources, which could have an undesirable effect on their children's nutrition and overall well-being. Furthermore, they may be unable to provide a stimulating atmosphere that supports optimum health and development[32].

In this study, stunted children were also linked to global developmental delays. This outcome lines up with research undertaken in southern Ethiopia, Kenya, and Malawi. During this crucial time, nutritional deficits that affect brain growth and cognitive function include inadequate consumption of proteins, vitamins, and minerals (such as iron, zinc, and iodine). Malnutrition, which accompanied by stunting, can have an impact on the way the mind works, including decreased brain capacity, changes in the thickening process, and decreased creativity. These changes can impair intellectual capacity, motor abilities, and growth in language, resulting in global developmental delays[33,34].

The current study also found that having four or more birth order children was associated with global developmental delay. This is similar to research done by Ethiopia and the United States[7,35]. The possible explanation is that parents are often overly anxious about their first child and may be more restrictive with the first child than with later children[36].

Area of development	Mean score/standardized norm-referenced	Standard deviation	Children scored at or below 2 sd	Percent
24 months age children				
Communication	51.23	13.03	21	5.1%
Gross motor	54.73	8.33	53	12.8%
Fine motor	51.70	8.27	49	11.9.%
Problem-solving	49.40	9.81	4	0.97%
Personal-social	51.14	9.80	22	5.3%
Delay into two or more areas			53	12.8%
36 months age children				
Communication	51.88	10.44	34	8.23%
Gross motor	54.68	8.84	57	13.8%
Fine motor	47.07	14.50	2	0.48%
Problem-solving	51.97	10.84	20	4.84%
Personal-social	52.82	8.74	40	9.7%
Delay into two or more areas			48	11.6%
48 months children				
Communication	52.92	11.10	36	8.7%
Gross motor	52.71	9.97	43	10.41%
Fine motor	45.35	14.77	2	0.5%
Problem-solving	52.78	10.74	30	7.3%
Personal-social	50.34	11.87	22	5.32%
Delay into two or more areas			32	7.75%
60 months age children				
Communication	52.42	9.62	15	3.63%
Gross motor	52.17	10.44	38	9.2%
Fine motor	51.57	12.52	20	4.84%
Problem-solving	52.59	11.30	12	2.9%
Personal-social	54.84	7.89	37	8.96%
Delay into two or more areas			40	9.7%

Table 3. Prevalence of developmental delay among HIV-infected under five children on ART follows-up at public health facilities in Guji and Borena zones, Oromia, South Ethiopia, 2022.

In this study, mothers aged 35 and above were associated with children's global developmental delays. This finding is similar to research done in Turkey, Australia, and Brazil[18,37,38]. This could be because pregnant women over the age of 35 are more likely to experience miscarriage, fetal chromosomal abnormalities, gestational diabetes, placenta previa, cesarean birth, and hypertension, all of which can cause developmental delays in children.

Limitation of the study

The cross-sectional design of this study was a limitation because it measured exposure and outcome at the same time. It does not demonstrate a cause-and-effect relationship. It would be preferable if the study was designed as a follow-up study. We measure mental development at one point in time, but this can lead to bias. It would be preferable if it could be measured more than once. Lastly, potentially relevant variables such as maternal depression, WHO clinical stage of HIV/AIDS, month on ART, and dietary diversity score were not considered.

Conclusion

In the current study, nearly half of the children were found to be developmentally delayed. Maternal age, educational status of mothers, higher birth order, and stunting of under-five children were found to be significantly associated with the developmental status of the children under study. Findings from the study suggest that investigations need to focus on the overall developmental aspects of the early childhood development of children. The findings indicate that local health officials and policymakers should prioritize early childhood development. Policies should aim to enhance mother and child health services, expand access to early intervention programs, and incorporate developmental surveillance into routine pediatric care. Additional research may be necessary to elucidate the underlying causes of the high prevalence of GDD, evaluate the efficacy of current interventions, and investigate innovative approaches to mitigate developmental delays.

Variable	Category	Global developmental delay		COR 95% CI	AOR 95% CI
		Yes (n, %)	No (n, %)		
Maternal age	19–24	21(36.21%)	37(63.79%)	1	1
	25–29	27(35.53%)	49(64.47%)	0.6(0.33,1.09)	1.34(0.62,2.90)
	30–34	28(35.00%)	52(65.00%)	0.58(0.34,1.00)	0.92(0.42,2.03)
	> 35	97(48.74%)	102(51.26%)	0.57(0.33,0.97) *	2.20(1.112,4.3) *
Maternal education	No formal education	57(41.14)	85(59.86)	0.63(0.36,1.12)	0.70(0.37,1.30)
	Primary school	50(42.37%)	68 (57.63%)	0.70(0.39,1.25)	0.76(0.40,1.45)
	High school	29(35.80%)	52(64.20%)	0.53(0.28,1.01)	0.47(0.23–0.96)*
	College and above	37(51.39%)	35(48.61%)	1	1
Birth order	First	60(58.82%)	42(41.18%)	1	1
	Second	58(41.43%)	82(58.57%)	2.50(1.42, 4.41)	0.40(0.23,0.71)
	Third	19(26.39%)	53(73.61%)	1.24(1.73,2.10)	0.23(0.11,0.50)
	> 4th	36(36.36%)	63(63.64%)	0.63(0.3,0.92)	3.00(1.50,4.00)***
Place of delivery	Health facility	83(39.34%)	128(60.66%)	1	1
	Home	71(42.77%)	95(57.23%)	0.58(0.29,1.18)	0.65(0.34,1.25)
	On the way	19(52.78%)	17(47.22%)	0.67(0.33,1.38)	0.88(0.54, 2.23)
Mode of delivery	Instrumental	11(30.56%)	25(69.44%)	0.58(0.28,1.22)	1.12(0.22,1.67)
	SVD	162(42.97%)	215(57.03%)	1	1
Time breast feeding initiated	< 1 h	75(46.30%)	87(53.70%)	1	1
	1–23 h	43(56.58%)	33(43.42%)	3.04(0.86,4.24)	2.23(0.89,3.34)
	> 24 h	3(13.64%)	19(86.36%)	2.24(2.25, 4.22)	0.67(0.56,1.56)
	Unknown	50(32.68%)	103(67.32%)	0.25(0.21,2.22)	0.69(0.50,2.56)
Time complementary feeding started	At 6 months	98(43.56%)	127(56.44%)	1	1
	Early	52(36.62%)	90(63.38%)	0.75(0.49, 1.15)	0.98(0.75,2.01)
	Late initiation	23(50.00%)	23(50.00%)	1.29(0.69, 2.45)	0.90(0.88,1.34)
Wasting	Wasted	79(47.31%)	88(52.69%)	1.46(0.98,2.17)	1.22(0.55,2.45)
	Normal	93(38.11%)	151(61.89%)	1	1
Stunting	Stunted	87(54.37%)	73(45.63%)	2.31(1.54,3.47)	2.20(1.40,3.42)***
	Normal	85(34.00%)	165(66.00%)	1	1

Table 4. Multivariable logistic regression model showing factors associated with global developmental delay among HIV-infected under five children on ART follow-up at public health facilities in Guji and Borena zones, Oromia, South Ethiopia, 2022. *SVD* Spontaneous vaginal delivery, *COR* crude odds ratio, *AOR* Adjusted odds ratio, *CI* confidence interval. *p-value < 0.05, **p-value < 0.01, ***p-value < 0.001.

Data availability

All data analyzed during this study are included in the manuscript.

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Author contributions

AA, HSH, AE, RG, JB and TD conceived the idea and designed the study, led the data analysis and interpretation, developed the first draft of the manuscript, and made all revisions. AA and AE critically revised the manuscript for important intellectual content and ensured that the requirements for submission of the manuscript were met. AA, HSH, AE, RG, JB and TD contributed to the analysis and data interpretation and revised and edited the manuscript. AA and AE reviewed the expert opinions and revised the manuscript for important intellectual content. AA, HSH, AE, RG, JB and TD supervised the study design and wrote the manuscript. All the authors have read and agreed to the final version of the manuscript for publication.

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Declarations

Competing interests
The authors declare no competing interests.

Ethical approval and consent to participate
The study protocol was reviewed and approved by the Institutional Health Research Ethics Review Committee (Ref no. IHRERC/175/2021/YYY) of the College of Health and Medical Sciences, Haramaya University, Ethiopia. Before data collection, study participants have explained the rights, potential benefits, and harms of participation in the study. The written informed consent was obtained from the parents or legal guardians upon the agreement. The privacy and confidentiality of the participants were assured. Furthermore, the research procedures were conducted in accordance with the principle expressed in the World Medical Association's Declaration of Helsinki.

Additional information
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