Under-nutrition and Associated Factors Among Children on ART in Southern Ethiopia: a Multicenter Facility Based Cross-sectional Study

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Abstract

Background: Malnutrition is very common in HIV infected individual due to decreased food intake, altering digestion, absorption and altering metabolism and by increasing energy need. Even though data from different settings are necessary to tackle it, evidences are limited especially in case of nutritional status of HIV-infected children. Hence, this study aims to assess the nutritional status and associated factors among children on antiretroviral therapy.

Methods: An institutional-based cross-sectional study was conducted among 383 HIV-positive children in Southern Ethiopia. Data were collected using interviewer administered questionnaire and anthropometry measurement. Data were coded and entered into Epi-Data Version 3.1, and analyzed using SPSS Version 25. Bivariable and multivariable binary logistic regression models were used to identify factors associated with nutritional status and variables with p-values 0.05 in multivariable logistic regression were considered as statistically significant factors.

Results: The prevalence of wasting among HIV positive children in Southern Ethiopia selected Hospitals was 36.3% (95% CI: 31.6, 41.0), while stunting on the same study population was 5.5% (95% CI: 3.4, 7.8). Rural residence (AOR = 4.1, CI: 2.0, 8.4), lack of maternal education (AOR =9.3, CI: 5.0, 17.3), low CD4 counts (<500) (AOR =4.9, CI: 2.3, 10.4), using unprotected water source (AOR = 3.2, CI: 1.8, 5.8), having non-biological mother (AOR =4.2, CI: 1.9, 9.2) and recurrent oral lesion (AOR =2.2, CI:1.2, 4.2) were significantly associated with wasting. Furthermore, history of hospital admission (AOR =4.9, CI: 1.6, 15.0), recurrent oral lesion (AOR =3.9, CI: 1.1, 14.1), low CD4 counts (< 500) (AOR =3.5, CI: 1.0-12.0), advanced WHO clinical stage III (AOR =4.0, CI: 1.1, 14.2) were statically associated with stunting.

Conclusion: This study found that the prevalence of under-nutrition among HIV-positive children in Ethiopia was significantly high. Rural residence, lack of maternal education, low CD4 count, recurrent oral lesion, having none-biological caretakers and unprotected source of water were significantly associated with childhood wasting. On the other hand, history of hospital admission, recurrent oral lesion, advanced WHO clinical stage and low CD4 counts were significantly associated with stunting of HIV positive children. Therefore, timely identification and monitoring of nutritional problems should be necessary to enhance the effectiveness of ART treatment and to prevent further related complications.

Background

The pandemic of human immunodeficiency virus (HIV) is one of the major public health problems and associated with a range of long and short-term consequences (1). At the end of 2019, approximately 38.0 million people were living with HIV globally, of which 1.8 million were children (age 0–14 years) (2). Ethiopia is one of the Sub-Saharan Africa (SSA) countries which suffer from the global burden of HIV- infection. By the end of 2018, an estimated 56,514 children under age of 15 were living with HIV. Of which, around 2,994 were newly infected with HIV (3).

Malnutrition is one of the major causes of death for HIV positive children (4). Human Immune deficiency Virus (HIV) infection and malnutrition often coexist, which increases the risk of morbidity and mortality (5). Malnourished children have lowered resistance to infection and are more likely to die from common childhood

illness. Children living with human immunodeficiency virus (CLHIV) are physically stunted and underweight compared to non-infected children (6).

Maintaining good nutritional status remains very challenging issue for HIV-positive children. The problem is related with inadequate dietary intake, the effect of anti- retro Virus therapy (ART), and the HIV-infection itself (5). People with HIV/AIDS often do not eat enough as the illness and the drugs taken for it alter the food taste, decrease appetite, and inhibit the body rate of food absorption.

In Ethiopia, few studies have been conducted to assess nutritional status of CLHIV (5–9). However, to the best of our knowledge, there was no study conducted to explore the nutritional status and associated factors among HIV positive children (< 15 years of age) in the study area. Current and up-to-date evidence regarding nutritional status in HIV-positive children is essential for policy makers and clinicians to take appropriate actions. Therefore, the findings of this study will highlight the magnitude and associated factors of malnutrition among HIV-positive children with implications to improve health workers' interventions, to ensure treatment effectiveness, and to accelerate the reduction of HIV related morbidity and mortality of children.

Methods

Study area, design, and period

An institutional-based cross-sectional study was conducted from February to March 2021 among HIV-infected children on ART in Southern Ethiopia. The study was carried out in three selected governmental hospitals (i.e.,Otona Teaching and Referral Hospital, Halaba District Hospital, and Duramie General Hospital). These hospitals provide service for more than six million people in the Region. All the three hospitals provide chronic HIV care and follow up services for HIV infected clients. Now a days, there are approximately 579 children (<15 years of age) receiving ART follow up service in these hospitals.

Study participants, sample size, and sampling technique

All confirmed HIV-positive children (aged <15years) taking ART in Southern Regional State governmental hospitals were the target population. All HIV-infected children who had ART follow up at the selected hospitals were the study population. However, children with incomplete baseline medical information were excluded. Furthermore, a child who does not have care taker or parents to undertaken the consent, care takers diagnosed to have mental problem or children who have physical malformation and seriously ill were excluded for the study.

The minimum required sample size was determined using a single population proportion formula. To calculate our sample size, the following statistical assumptions were considered: 60.2% proportion (p) of malnutrition from a study done in East and West Gojjam Zones, Amhara, Northwest, Ethiopia (8); 5% margin of error; 10% non-response rate; and 95% confidence intervals (CI).

$$n = \frac{(Za/2)^2 p(1-p)}{(d)^2} = \frac{(1.96)^2\ 0.6(1-0.6)}{(0.05)^2} = 368.64 \sim 369$$

Where, n= the required sample size, Zα/2= Standard normal variation for type 1 error, p=prevalence (0.5) & d= Margin of sampling error tolerated (0.05).

The calculated sample size was 369. After considering a 10 % non-response rate, the final sample size of our study was 406.

This study was conducted in three randomly selected governmental hospitals. From the beginning, a sampling frame was prepared using the patient's medical registration number from each hospital's ART registration logbook. Then the total sample sizes were proportionally allocated for each hospital. Finally, study participants were taken from each of the three selected hospitals using computer generated simple random sampling technique.

Data collection tool and procedure

The data abstraction checklist was developed from the current Ethiopian Federal Ministry of Health ART clinic intake and follow-up forms. Data were collected by trained health professionals through anthropometric measurement, face to face interview, and clinical record review. Training about the objectives of the study, contents of the tool, and data collection procedures was given for data collectors and supervisors for one day. Pretest was carried out at Sodo health center. During data collection time, care givers who had malnourished child were linked to therapeutic feeding center. Besides, weight and height were measured for each study participant, and nutritional advice was given to all caregivers. The assigned supervisors and principal investigator closely monitored and supervised the whole data collection process.

Operational definitions

Under-nutrition: - was defined when the children having either W/H or H/A or W/A z-score <-2 SD of the median value of WHO standard (10, 11).

Stunting: - was defined as children having height-for-age z-score <-2 SD (10, 11).

Wasting: - was defined as children having weight-for-height z-score <-2 SD (10, 11).

Underweight: - was defined as children having weight-for-age z-score <-2 SD (10, 11).

Data management and statistical analysis

The consistency and completeness of the collected data were examined during data management and analysis. Data were entered into Epi Data Version 3.1 and analysis was done using Statistics Package for Social Science (SPSS) Version 25. The anthropometric measurements was converted into Z-scores using WHO Anthro Plus software version 3.2.2. Frequencies and cross tabulations were used to check for missed values of variables and to describe the study population in relation to relevant variables. Moreover, percentages, proportions, and summary statistics (mean, median) were used to summarize the study population characteristics. Binary logistic regression analysis was implemented to assess the association of factors against the outcome variable. Variables with p-values < 0.25 in the bivariable analysis were entered into the final model to control the effects of confounders and identify significant factors. Adequacy of the model to fit the outcome variable with the predictors was checked using Hosemer-Lemeshow test for goodness of fit. In the multivariable analysis, variables with p-values less than 0.05 at 95% CIs were considered as statistically significant factors. Finally, the strength and the direction of association were assessed using odds ratios with their correspondence 95% CIs.

Results

Socio demographic characteristics of study participants

Out of 406 study participants, 383 were included in this study with response rate of 94.3%. Nearly half of the study participants' (50.4%) were boys and 157 (41%) were from rural areas. Children age less than 60 months were 124 (32.4%), while 52 (13.6%) of the study participants was between 60 and 120 months. The majority (73.6%) of caretakers were unmarried, and most (54.6%) of the caretakers were unable to read and write. Among the caretakers 152 (39.7%) were daily laborer and more than half (61.9%) of them have greater than four family in the house they live (Table 1).

Table 1
Socio demographic characteristics of study participants at public hospitals in Southern Ethiopia, 2021 (n = 383).

Variables	category	Frequency (n)	Percentage (%)
Age	< 60 months	124	32.4
	60 to 120 month	52	13.6
	121 to 180 month	207	54.0
Sex	Male	193	50.4
	Female	190	49.6
Religion	Protestant	107	27.9
	Orthodox	76	19.8
	Muslim	76	19.8
	Catholic	58	15.1
	Other	66	17.2
Ethnicity	Nuer	64	16.7
	Agnuak	258	67.4
	Tigre	14	3.7
	Oromo	28	7.3
	Amhara	19	5.0
Residence	Urban	116	30.3
	Rural	157	41.0
	Refugee	110	28.7
Marital status of care takers	Unmarried	282	73.6
	Married	101	26.4
Care taker relation with the child	Biological mother	92	24.0
	other	291	76.0
Educational status of Care giver	unable to read and write	209	54.6
	able to read and write	174	45.4
Occupational status mother	Government employed	45	11.7
	NGO employed	41	10.7
	Merchant	126	32.9
	Daily Laborer	152	39.7

Variables	category	Frequency (n)	Percentage (%)
	Other	19	5.0
Monthly family income (in Ethiopian Birr)	< 1500	77	20.1
	1500 to 3000	126	32.9
	> 3000	180	47.0
Family size	>=4	146	38.1
	< 4	237	61.9

Environmental related characteristics

In this study, about 52.7% of study participants used unprotected drinking water source. The majority (40.5%) of the respondents used open field waste disposal system and 54.8% of them have not any nutritional support (Table 2).

Table 2
Environmental related characteristics of HIV positive children on ART at public hospitals in Southern Ethiopia, 2021 (n = 383).

Variables	Category	Frequency (n)	Percentage (%)
Source of water	Protected	181	47.3
	Unprotected	202	52.7
Waste disposal system	Open field	155	40.5
	Burned	130	33.9
	Other (specify)	98	25.6
Availability of nutritional support	Yes	173	45.2
	No	210	54.8
Toilet utilization	Not using toilet	50	13.1
	Use toilet facility	333	86.9

Table 3
Clinical related characteristics of HIV positive children on ART at public hospitals in Southern Ethiopia, 2021 (n = 383).

Variables	Category	Frequency (n)	Percentage (%)
Birth weight	< 2.5kg (Less than Normal)	129	33.7
	2.5kg and above (Normal)	142	37.1
	I don't know	112	29.2
child had diarrhea	Yes	166	43.3
	No	217	56.7
Diagnosis of any disease during pregnancy of this child	Yes	177	46.2
	No	206	53.8
Recurrent oral lesion	Yes	248	64.8
	No	135	35.2
Hospital of admission History	Yes	194	50.7
	No	189	49.3
WHO clinical stage	Stage 1	121	31.6
	stage 2	38	9.9
	stage 3	98	25.6
	stage 4	126	32.9
ARV drug toxicity	Yes	14	3.7
	No	369	96.3
Co -morbid illness	Yes	138	36.0
	No	245	64.0
Adherence to the drug	poor	122	31.9
	Faire	120	31.3
	Good	141	36.8
Current CD4 count	>=500	162	42.3
	350–499	85	22.2
	200–349	136	35.5

Clinical related characteristics

One hundred twenty -nine (33.7%) of study participants had less than normal birth weight. Almost one third of participants (32.9%) were categorized to WHO clinical stage III and 35.5% of them had CD4 count less than 350 cells/mm^3. Slightly more than one-third, 138 (36%) of children were experienced opportunistic infection and the commonest, 248 (64.8%) was oral lesion. Half, 192 (50.1%) of study participant had history of admission. Nearly one-third (31.9%) of study participants had poor adherence level during their last follow up time.

Prevalence of under-nutrition

The overall prevalence of wasting was 36.3% (95% CI: 31.6, 41.0) (Fig. 1). Moreover, the prevalence of stunting on the same study population was 5.5% (95% CI: 3.4, 7.8) (Fig. 2).

Factors associated with wasting

Bivariable and multivariable logistic regression analysis were conducted to determine factors associated with under-nutrition. In the multivariable logistic regression analysis, residency, maternal education, current CD4 count, having recurrent oral lesion, marital status of mother, caretaker's relation with child and source of water were significantly associated factors with wasting of HIV positive children. Subsequently, the likely hood for the presence of wasting was 4.1 times more likely among HIV positive children who lives in rural area (AOR 4.08; 95% CI: 1.98, 8.40) compared to who lives in urban. Regarding maternal education, wasting was 9.3 times (AOR = 9.33; 95% CI: 5.02,17.35) more likely to occur in those HIV positive children who have mother who was unable to read and write as compared to those who was able to read and write. Moreover, HIV positive children who had current CD4 count less than 500 cell/mm^3 were 4.9 times more likely to have wasting (AOR = 4.91; 95% CI: 2.33,10.37) as compared to their counterparts. The odds of wasting was 3.2 times more likely among the HIV positive children who uses unprotected water source (AOR = 3.23; 95% CI: 1.79, 5.79) compared to who uses protected water source. Additionally, HIV positive children those who have non-biological mother were 4.2 times more likely (AOR = 4.17; 95% CI: 1.89, 9.19) to have wasting than those whose caretakers was biological mothers. Lastly, HIV positive children who have recurrent oral lesion were 2.2 times more likely (AOR = 2.22; 95% CI: 1.17, 4.23) to have wasting than those who did not complain oral lesion (Table 4).

Table 4

Bivariable and multivariable logistic regression analysis of factors associated with wasting among HIV positive children on ART at public hospitals in Southern Ethiopia, 2021(n=383).

Factors	Wasting n (%)				
	Yes	No	COR(95%CI)	AOR(95% CI)	
Residency					
Rural	79(56.8)	80(32)	2.25(1.362-3.720)	**4.083(1.985-8.400)**	**0.000***
Refuge	24(17.3)	86(35.2)	0.62(0.341-1.129)	1.265(0.582-2.749)	0.553
Urban	36(25.9%)	78(32.8)	1		
Age in month					
<60	51(36.7)	73(29.9)	1.428(0.901-2.263)	0.944(0.478-1.865)	0.868
60-120	20(14.4)	32(13.1)	1.278(0.681-2.398)	0.553(0.232-1.319)	0.182
121-180	68(48.9)	139(57.0)	1		
Mother education					
unable to read and write	104(74.8)	70(28.7)	7.386(4.603-11.852)	**9.329(5.017-17.348)****	**0.000***
Able to read and write	35(25.2)	174(71.3)	1		
WHO Clinical stage					
Stage IV	50(36.0)	67(27.5)	2.359(1.368-4.070)	1.370(0.672-2.795)*	0 .386
Stage III	43(30.9)	61(25.0)	2.228(1.271-3.908)	0.703(0.320-1.544)*	0.380
Stage II	15(10.8)	18(7.4)	2.634(1.189-5.836)	1.075(0.331-3.489)*	0.905
Stage I	31(22.3)	98(40.2)	1		
Having diarrhea					
Yes	98(70.5)	119(48.8)	2.511(1.613-3.909)	1.779(0.977-3.239)**	0.060
No	41(29.5)	125(51.2)	1		
Marital status					
Unmarried	59(42.4)	42(17.2)	3.547(2.211-5.692)	1.855(0.970-3.549)**	0.062
Married	80(57.6)	202(82.8)	1		
Current CD4 count					
>500	36(25.9)	126(51.6)	1		

350-499	48(34.5)	37(15.2)	4.541(2.577-8.002)	**4.911(2.325-10.369)****	**0.000***
200-359	55(39.6)	81(33.2)	2.377(1.435-3.936)	1.771(0.909-3.451)**	0.093
Oral lesion					
Yes	109(78.4)	139(57.0)	2.745(1.703-4.422)	**2.221(1.169-4.219)****	**0.015****
No	30(21.6)	105(43.0)	1		
Source of water					
Unprotected	104(74.8)	98(40.2)	4.427(2.793-7.017)	**3.216(1.787-5.788)****	**0.000***
Protected	35(25.2)	146(59.8)	1		
Care takers relation					
Biological mother	13(9.4)	79(32.4)	1		
Other than mother	126(90.6)	165(67.6)	4.641(2.470-8.720)	**4.172(1.894-9.190)****	**0.000***
Notes: *p-value ≤ 0.01; **p-value ≤0.001.					

Factor associated with stunting

In the multivariable analysis, history of hospital admission, recurrent oral lesion, WHO clinical stage and current CD4 count were significantly associated factors with stunting of HIV positive children. Thus, the odds of stunting among HIV positive children who had history of hospital admission was 4.9 times more likely (AOR = 4.94; 95% CI: 1.63, 14.97) compared to those who did not had history of hospital admission. Besides, the odds of stunting among HIV positive children who had current CD4 count < 500 cell/mm^3 were 3.5 times more likely (AOR = 3.49; 95% CI:1.02–11.98) compared to their counterparts who had CD4 count > 500 cell/mm^3. Moreover, the odds of stunting among HIV positive children who had recurrent oral lesion were 3.9 times more likely (AOR = 3.93; 95% CI: 1.09, 14.13) compared to those who did not complain oral lesion. Similarly, the odds of stunting among study participants classified as WHO clinical stage III was 4 times more likely (AOR = 3.98; 95% CI:1.11,14.25) compared to WHO clinical stage IV counter parts (Table 5).

Table 5
Bivariable and multivariable logistic regression analysis of factors associated with stunting among HIV positive children on ART at public hospitals in Southern Ethiopia, 2021 (n = 383).

Factors	Stunting n (%)		COR(95%CI)	AOR(95% CI)
	Yes	No		
Sex of thee child				
Male	149(66.7)	179(49.4)	1	
Female	7(33.3)	183(50.6)	2.045(0.806–5.184)	1.489(0.535–4.145)
History of admission				
Yes	16(76.2)	178(49.2)	3.308(1.187–9.220)	**4.938(1.629–14.966)****
No	5(23.8)	184(50.8)	1	
WHO Clinical				
Stage IV	4(19.0)	122(33.7)	0.959(0.234–3.924)	0.928(0.217–3.956)
Stage III	3(14.3)	88(24.3)	3.324(1.009–10.948)	**3.982(1.113–14.251)****
Stage II	10(47.6)	35(9.7)	2.507(0.535–11.740)	3.168(0.630-15.946)
Stage I	4(19.0)	117(32.3)	1	
Can read and write				
Yes	8(38.1)	201(55.5)	2.029(0.821–5.014)	1.443(0.536–3.885)
No	13(61.9)	161(44.5)	1	
Marital status				
Unmarried	8(38.1)	93(25.7)	1.780(0.715–4.430)	1.239(0.442–3.472)
Married	13(61.9)	269(74.3)	1	
Current CD4 count				
>=500	5(23.8)	157(43.4)		
350–499	8(38.1)	77(21.3)	3.262(1.033–10.305)	**3.490(1.016–11.985)****
200–359	8(38.1)	128(35.4)	1.962(0.627–6.145)	2.589(0.774–8.663)
Having recurrent oral lesion				
No	3(14.3)	143(39.5)	1	
Yes	18(85.7)	219(60.5)	3.918(1.133–13.542)	**3.932(1.094–14.126)****

Notes: **p-value ≤0.05.

Discussion

In the current study, the prevalence of Wasting among children living with HIV/AIDS was 36.3 % (95% CI: 31.6, 41). This is in line with a study done in Nigeria which was 33.5% (12).

However, this finding is higher than the study conducted in Eastern Ethiopia (28.2%) (5), Oromia (21.8%) (7), Cameron (18.4%) (13), Nigeria (9%) (14), and Tanzania (9.4%) (15). This study also revealed that, the prevalence of stunting among children living with HIV/AIDS was 5.5 % (95% CI: 3.4, 7.8). This finding is lower than the study done in Oromia (13.4%) (7), Eastern Ethiopia (24.7%) (5), and Cameron (63.6%) (13). The possible source of variation for both of the above prevalence could be due to the difference in study approach (population and hospital based), study population (age group), and sampling technique.

In this study, we also explored factors associated with under-nutrition among HIV positive children on ART in Southern Ethiopia. The results indicated that different factors were significantly associated with wasting and/or stunting. Accordingly, children who had recurrent oral lesion were more likely to develop wasting. This is in line with previous studies conducted in Ethiopia (Gojam, North Wollo) and Cameron (8, 13, 16). This is because children with oral lesion have difficulty of swallowing which reduces the amount of food intake that leads to nutritional imbalance less than body requirement.

This study revealed that children in the advanced WHO clinical stages were more likely to be wasted. This is in line with previous studies conducted in Ethiopia (5, 16). This can be explained by the fact that HIV positive children who have advanced WHO clinical stage of disease are more vulnerable to opportunistic infections, making them susceptible to under nutrition by decreasing intake, altering digestion, absorption and metabolism as well as by increasing energy need (17). Additionally, children who lived in rural area were four times more likely to be wasted. This is in line with a study conducted in eastern Ethiopia (5). This is due to the fact that there is difference between rural and urban residents in access to health facilities for early management of malnutrition, in the level of awareness towards balanced diet, and infrastructure to access the health facilities.

This study revealed that wasting is associated with educational status of mother. This can be explained, because mothers who are unable to read and write are more prone to have knowledge deficit secondary to unable to read literatures and magazines, which talks about nutritional requirements for children living with HIV/AIDS. These mothers may also have lack of awareness on early management of malnutrition.

Finding from this study also revealed that, HIV-positive children who uses unprotected water source was more prone to wasting. The possible explanation for this, those HIV positive children who use unprotected water sources are more vulnerable to develop water borne disease like worms because of their immunocompromised status, which predisposes them to have malnutrition (18, 19). Moreover, the occurrence of wasting was more likely in those HIV positive children who had none biological care takers. This might be due to the fact that, children whose caretakers are none-biological mothers are less likely to get breast feeding and they are also more prone to have poor drug adherence and good nutritional supplementation.

This study also found that children with history of hospital admission were associated with stunting. The reason for hospital admission among HIV positive children is most of the time due to opportunistic infection, which decreases food intake. Besides, HIV positive children classified as WHO clinical stage III are more likely to have stunting. This is supported by the study conducted in eastern Ethiopia (5). This can be explained by the fact that HIV positive children classified as advanced clinical stage of disease are more vulnerable to opportunistic

infections, making them susceptible to under nutrition by decreasing food intake, absorption, altering digestion, and metabolism as well as by increasing energy need (20).

Additionally, CD4 count from 350 to 499 cell/mm3 was significantly associated with stunting. This could be explained by those whose CD4 count between 350 and 499 cell/mm3 may have low attention of care by health workers compared to those who have CD4 count less than 350 cell/mm3 (20). Furthermore, children who had recurrent oral lesion were more likely to be wasting. This is because children with oral lesion have difficulty of swallowing which leads nutritional imbalance less than body requirement.

Limitations

Before interpreting the findings, this study has its own limitation that must be considered. Since the study was done based on cross-sectional study design, it did not establish the possible cause and effect relationship between independent and dependent variables. There might be potential recall bias among respondents answering questions relating to events happening in the previous time. As the survey was conducted during a dry season, it was difficult to entertain the seasonal variations.

Conclusion

The finding of this study demonstrated that, the prevalence of wasting and stunting among HIV positive children was relatively high. Living in rural area, unable to read and write of caretakers, low CD4 count, recurrent oral lesion, none-biological caretakers and unprotected source of water were found to be significantly associated with wasting. On the other hand, history of hospital admission, recurrent oral lesion, advanced WHO clinical stage and low CD4 count were factors significantly associated with the occurrence stunting among HIV positive children.

Abbreviations

AIDS: Acquired Immune Deficiency Syndrome; **AOR**: Adjusted odd ratio; **ART**: Antiretroviral Therapy; **CI**: Confidence Interval; **COR**: Crud odd ratio; **HAZ**: Height-for-Age Z-score; **HIV**: Human immunodeficiency Virus; **MUAC**: Mid Upper Arm Circumference; **IRB**: Institutional Review Board; **OI**: Opportunistic Infection; **SPSS**: Statistical Package for Social science; **WAZ**: Weight-for-Age Z-score; **WHO**: World Health Organization; **WHZ**: Weight –for- Height Z-score.

Declarations

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Authors' contributions

All authors have made substantial contributions in this study. The corresponding author conceived and designs the study, did the literature search, coordinated the write-up, participated in data analysis, editing and submission

of the article. All coauthors participated in literature search, analysis and interpretation of data, drafting the article and revising it for important intellectual content, and approve the final version of the manuscript.

Availability of data and materials

The data sets used and/or analyzed during the current study are available from the Corresponding author upon reasonable request.

Consent for publication

Not applicable

Ethics approval and consent to participate

The study was conducted after obtaining ethical clearance from Wolaita Sodo University, College of health sciences, and medicine through ethical letter with protocol number 0437/2020, written on November 23, 2020. The study was also done as per the declaration of Helsinki. An informed written consent was obtained from the care taker or parents of study participants after the purpose and procedures of study was fully informed. To maintain confidentiality participants name and unique ART number were not included in the data collection tool. Moreover, confidentiality of data was kept at all levels of the study and not used for any other purposes than the stated study objectives.

Competing interests

The authors declared that they have no competing interests.

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Figures

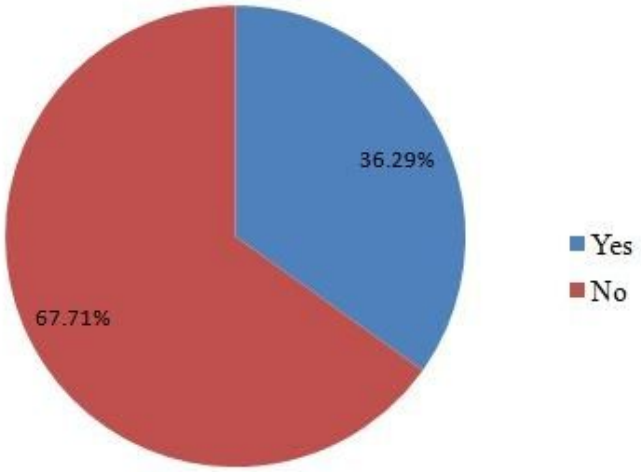

Figure 1

prevalence of wasting among HIV positive children under 15 years of age attending ART at public health institutions in southern Ethiopia

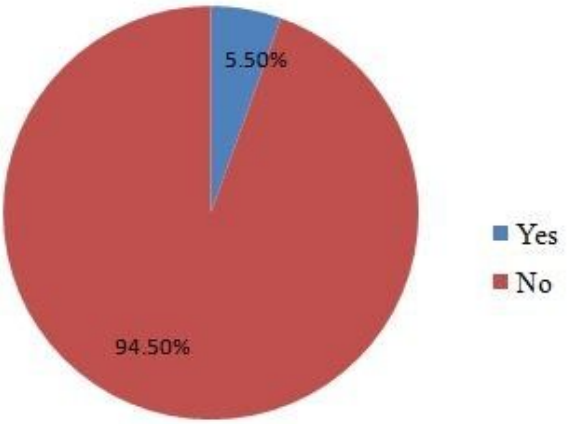

Figure 2

prevalence of wasting among HIV positive children under 15 years of age attending ART care at public health institutions in Southern Ethiopia, 2021