

Stunting and its Associated Factors among Human Immunodeficiency Virus Positive Children Who Receiving Anti-retroviral Therapy in Northwest Ethiopia: Multicenter Study

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Abstract

Introduction: Human immunodeficiency virus positive children are highly vulnerable for stunting and stunting is the most serious public health problems in human immunodeficiency virus-positive children who received antiretroviral therapy in the developing world particularly low and middle-income countries. Therefore, the aim of the study was to assess the magnitude of stunting and its associated factors among human immunodeficiency positive children in public Hospitals Northwest, Ethiopia.

Methods: Multicenter cross-sectional study was conducted among 372 HIV infected children. Data were collected systematically from selected participants by using interviewer administered structured and pre-tested questionnaires. We used Epi-data version 4.1 for data entry, and STATA Version 14.1 for data analysis. a p-value of <0.05 was considered to declare statistical significance with the corresponding 95% confidence interval. The goodness of fit (GOF) of the model was checked using Hosmer-Lemeshow GOF test. The p-value of the Hosmer-Lemeshow GOF test of this model is p-value greater than 0.05 which confirms that the model is correctly specified.

Results: The magnitude of stunting was found to be 45.2%, 95% CI (40.4-50.0). Being males (AOR:1.942, 95% CI:1.188, 3.175), age of the child 2-5 years old, opportunistic infections (AOR: 2.40,95%,CI: 1.61, 7.60), and fair/poor dietary diversity (AOR:1.832,95% CI:1.1280, 2.95) were found statically significant associated factors.

Conclusion: More than one-third of children was stunted among human immunodeficiency virus-positive children received antiretroviral therapy. Therefore, early detection and treatment of opportunistic infections, control progression of HIV, educating and counseling the use of a diversified diet, and monitoring this situation was highly recommended.

Keywords: Stunting • HIV • ART

Abbreviations: ART: Antiretroviral Therapy • HIV: Human Immunodeficiency Virus • WHO: World Health Organization • AIDS: Acquired Immune Deficiency Syndrome

Introduction

Stunting is inadequate energy, protein, and micronutrients to meet the basic requirements for body maintenance, growth, and development of children [1]. Globally, nearly 2.84 million children were living with human immunodeficiency virus (PLWHIV), of which more than 90% were in sub-Saharan Africa in 2019 [2]. Stunting is also the most serious public health problem in the world particularly low and middle-income countries [2,3]. Both stunting and human immunodeficiency virus (HIV) are highly prevalent in the world, particularly in sub-Saharan Africa which was to be 32% [4,5]. A few studies which is conducted in Tanzania, Nigeria, and Burkina Faso also showed that stunting was more prevalent among HIV infected children than non-HIV infected children [6-8].

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The prevalence of stunting was higher among HIV-infected children than non-HIV-infected children [9]. Stunting also increased the frequency and severity of the opportunistic infection, delayed recovery from disease, recurring of sickness, faltering growth, and diminished learning ability in HIV infected person [8,10], and affecting the overall clinical outcomes of HIV chronic care in ART clinics [11]. Human immunodeficiency virus that induced immune impairment and enhanced contributing of infection that affect negatively the nutritional status of children which leads to undernourished through decrement of food intake, increased utilization and excretion of nutrients, mal-absorption syndrome and that increase the progression of diseases at a patient, whereas HIV infection also induced stunting by weakening of the immune system and distorted of nutrient intake, absorption and body's use of food [12].

Stunting is a significant factor affecting human immune deficiency virus care and treatment outcome particularly developing countries [13]. This problem occurred due to, stunting underlying poor nutritional status with food insecurity, poverty, and co-infections that pose a serious threat to efforts to combat HIV/AIDS by denying access of a nutrition-rich diet, hindering the chance of good health outcomes [14]. The study which is conducted in southern India showed that the magnitude of stunting among HIV-infected children receiving antiretroviral therapy ranges from 58%-69.9% [10]. A few studies which is conducted in Ethiopia also showed that the magnitude of stunting among HIV positive children received antiretroviral therapy in Ethiopia was between 13.4% to 65% [15-17]. The commonest factors for stunting and statically significant

includes:- residence, presence of opportunistic infection, frequency of meal, age of the child, income, absence of dietary counseling, late diagnosis of HIV, duration of follow-up at ART clinics, being anemic and the presence of diarrhea were statically significant associated factors with stunting [15-17].

The government of Ethiopia also were adapted different types of strategies and implemented for decreament of the impact of HIV/AIDS on the nutrition status of children including by preparing consolidated comphersive national ART guidelines for ART care and treatment, and sustainable development goal (SDG) #2 to end hunger, achieve food security and improved nutrition and promote sustainable agriculture yielding marked success in reduction of HIV and stunting patient morbidity and mortality respectively [18,19]. There is also a livelihood support and food assistance, strengthened community-based nutrition care and support activities of PLWHIV [18,20]. The magnitude of stunting is a serious common public health problem of 51.63% HIV positive children received ART in Ethiopia and the impact of stunting on immune cell level on clinical follow up remains largely unknown [21]. Therefore the aim of this study was to assess stunting as common dependent variable and associated factors of socio-demographic variables, clinical related factors with them further variables.

Methods and Materials

Study area

The study was conducted at Amhara public hospitals of Debre Markos Comperensive Specialized Hospital, Shegaw Motta General Hospital, and Finot Selam General Hospital Northwest Ethiopia [22-24].

Study design

An institutional –based cross-sectional study.

Study populations

All children HIV-infected patients who received ART and available during the data collection period..

Eligibility criteria

We included children patients who were age greater than 2 years old and complete file.

Sample size determination and sampling procedure

We checked the adequacy of sample size based on the objectives. The sample size was calculated using a difference between two population proportions formula, by considering the following conditions with 5% level of significance (α), at 95% level of confidence for the two-tail test, r is the ratio of the size of sample 2 to sample 1=1 and a Power of (1B)=80%. The required sample size is 372 [25].-

- Proportion of HIV infected wasted children of male 12.9% and of female 34.9%
- Proportion of HIV infected underweight children of male 24.7% and of female 16.4%
- Proportion of HIV infected stunted children of male 34.3% and of female 26.2%.
- With 5%level of significance (α), at 95% level of confidence for two tail test, r is the ratio of the size of sample 2 to sample 1=1 and a Power of (1-B)=80% (Table 1).

let $r = \frac{n_2}{n_1}$ and $P = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2} = \frac{p_1 + r p_2}{1 + r}$ is the common population proportion

$$n_1 = \frac{\left[Z_{\alpha/2} \sqrt{\left(1 + \frac{1}{r}\right) p(1-p)} + Z_{\beta} \sqrt{p_1(1-p_1) + \left(\frac{p_2(1-p_2)}{r}\right)} \right]^2}{(p_1 - p_2)^2}$$

So the required sample size by taking the largest sample was 372, then we used systematic sampling technique.

Variables

Dependent variable: Stunting (yes/no)

Independent variables: Data were socio-demographic characteristics including age, sex, educational attainment of a mother, orphan hood, Family size, nutritional support and counseling, meal frequency. Dietary and food security-related factors information also included food group of grain, pulse, fruit and vegetables, vitamins, egg, meat, fat and oils, and milk and milk products and clinical related factors included- diahrea diseases in the two last weeks, HAART treatment, prophylactic treatment status, Adherence status of ART, Ols, Presence of comorbidity, HIV diagnosis, CD4 count, and stage of WHO.

Operational definitions

- **Stunting:** Children having height-for-age (HAZ) below -2 SDs of Z-score [5].
- **Dietary diversity:** The number of reported different foods and food groups consumed in an individual's over 24-hour. This includes food groups consumed by outside home and less than 4 and greater or equal to 4 food group are fair/poor and good dietary diversity respectively [26].
- **Adherence to ART:** The recent adherence status of the adult to the ART which is recorded as poor when an adult takes less than 85% of the dose, fair when he/she takes 85-94% of the dose, and good when he/she takes 95% and above of the dose [18].
- **Comorbid disease:** A chronic disease with a confirmed diagnosis of the disease other than HIV infection [18].
- **Opportunistic infections/diseases:** The list of opportunistic diseases indicated on national comprehensive HIV prevention, care, and treatment [18].

Data collection and quality control

Data were extracted from comphersive and consolidated ART care and treatment checklist [18], the Food and Agriculture Organization (FAO) standardized verbal questionnaires [27] and prepared from the previous work of literatures [26,28,29]. We used an interviewer-administered and a structured questionnaire to collect the data. The height measurement of children were taken by using the standardized measuring scale. Children ' take off their shoes, stand erect, and look straight in the horizontal plane. The occipital, shoulder, buttocks, and heels touched the measuring board, and height was recorded to the nearest 0.1cm on a standing position. The presence or absence of bilateral pitting pedal edema also was assessed. Anthropometric measurements were converted to physical growth indicator of (HAZ) and used both WHO anthro and WHO anthroplus software. Three nurses currently working in the ART clinics were recruited involved as data collectors. To maintain data quality, the questionnaire was first developed in English then translated to Amharic and

Table 1. Sample size calculations to assess the magnitude of stunting and associated factors among HIV positive children patients Amhara Regional Public Hospitals, Northwest Ethiopia, 2018.

Undernutrition	r	P1 (Male)	P2 (female)	P (pooled)	Z $\alpha/2$	Z β	n1	n2	Ni	FPC N	Nf
Wasting	1	0.129	0.086	0.349	1.96	0.84	514	514	1028	581	372
Underweight	1	0.247	0.164	0.5779	1.96	0.84	234	234	468	581	168
Stunting	1	0.343	0.262	0.7533	1.96	0.84	318	318	636	581	304

back to English. The tool was pre-tested on 10% of the total sample size at Bichena Health Center. To assure data quality, daily supervision was done by the principal investigator. Two-day training was given for both data collectors and supervisor concerning the data collection tool and the data collection process. Moreover, all collected data were checked for completeness and consistency during the data management, storage, and analysis phase by the research team members.

Statically analysis

Data were entered through EPI DATA version 4.1, and analysis was made using STATA version 14.1 statistical packages. Descriptive statistics of categorical variables were visualized using tables and graphs whereas results of continuous variables were described using measure of central tendency (mean and media), and dispersion (standard deviation and range). Bi-variable association between each individual explanatory variable and under nutrition was evaluated using odds ratio (OR) with the corresponding 95% confidence interval (CI) as a parameter estimate. In the next step, we purposely included additional explanatory variables which were statistically significant a p-value of <0.25 to build an empirical model. In our analysis, a potential problem of multicollinearity was checked using variance inflation factor (VIF) at cut off point of 10. Interaction was also checked and we found no significant interaction terms. Finally, in the multivariable binary logistic model, a p-value of <0.05 was considered to declare statistical significance with the corresponding 95% confidence interval. The goodness of fit (GOF) of our model was checked using Hosmer-Lemeshow GOF test. The p-value of the Hosmer-Lemeshow GOF test of this model is p-value greater than 0.05 which confirms that the model is correctly specified.

Results

Socio-economics characteristics of the study participants

A response rate of 100% with most 96(51.6%) children were males and majority 290 (78) of were being urban areas. The mean (± SD) age of children included in the study was 8.8 (± 3.2) years ranging from 2year to 14 years. More than 133 (35.8%) parent were married, and Majority 300 (80.6) of children had mother (Table 2).

Dietary diversity-related factors of participants

More than half of 200 (52.3%) children were ate fair/poor food variety per 24 hours. Majority 330(80.64) 335(90%), 312(83.87%), and 295 (79.30%) of children ate food groups of grain, pulse, egg, and meat and meat products respectively (Figure 1).

Clinical related characteristics of HIV infected children

Two-third 251(67.5%) of children were have taken HAART regimen of (ABC + 3TC + LPV/r) and one-tenth 41(11%) of where have taken 2e (AZT + 3TC + LPV/r). Most 369(99%) of children were diagnosed a virus in the blood greater than 12 months and more than two-third 284 (78.3%) of children had no diarrhea in the last 2 weeks. Most 343(92.2%) of were received ART greater than 12 months and 301(89.9%) and 340 (91.4%) were an early stage of WHO (I&II). Majority 84.6% and 79.2% of children had CD4 ≥ 500cell/mm³ in the current and in the last 6 months respectively. Majority 299(80.4%) of children did not develop comorbidity diseases (Table 3).

Magnitude of stunting among HIV positive children

The magnitude of stunting was found to be 45.2%, 95% CI (40.4-50.0).

Associated factors of stunting among HIV positive children

Variables with (P-value <0.25) of residence, age of a child, educational status of mother, marital status, family size, dietary diversity, CD4 cell count, duration of ART, co-morbidity disease, OI, and diarrhea were associated factors with stunting in binary bivariable logistic regression analysis. Only three variables were identified as statically significant associated factors of stunting.

Accordingly being male children were male 1.94 (AOR=1.942, 95% CI: 1.188, 3.175) times more likely developed stunting as compared to females. Children who were age group b/n 2-5 years old were 58% times more likely to develop stunting as compared to the age group 10-15 years old (AOR:0.434,95% CI: 0.253,0.746). Participants who had opportunistic infections 2.41 (AOR: 2.41, 95%, CI: 1.61, 7.60) times more likely to develop stunting as compared to the counterpart. Moreover, children who had fair/poor individual dietary diversity were 1.83(AOR=1.832, 95% CI (1.128,2.95) times more likely to develop stunting as compared to children who had good dietary diversity (Table 4).

Discussion

In this study, 45.2% (95% CI: 40.4-50.0) children were stunted which is aligns with studies, which is conducted at East Africa 48.21% -51.63% [21]. However, this finding lower than the report of some studies which is conducted in Ethiopia 65% [15], and India 69.8% [30]. Conversely, this study finding is much higher than the study reported in Adama, Ethiopia stunting about 13.4%

Table 2. Socio-demographic characteristics of HIV positive children who were attending in Northwest, Ethiopia, 2018.

Variables	Frequency (N)	Percent (%)
Age		
2-5 years	54	14.5
5-10 years	149	40.1
10-15 years	169	45.4
Maternal Marital Status		
Married	133	35.8
Divorced	74	19.8
Windowed	75	20.2
Others*	15	4
Maternal Educational Status		
Can not read and write	99	26.6
can be read and write	53	14.2
1-8 grade	58	15.6
9-12 grade	44	11.8
College/university	43	11.6
Family size		
01-Mar	189	50.8
04-Jun	162	43.5
>6	21	5.6
Meal Pattern Per 24 Hours		
Three and above	227	61
Below three	105	28
Do not know	41	11.2
Nutritional Support and Counseling		
Yes	80	21.5
No	292	78.5

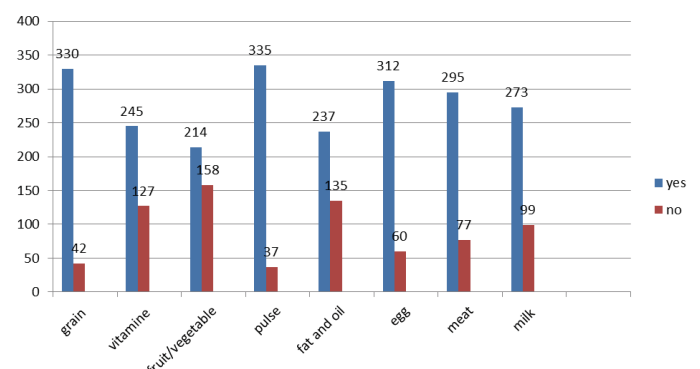


Figure 1. Individual dietary diversity of characteristics of the study participants at Amhara Regional Public Hospitals, Northwest, Ethiopia, 2018.

Table 3. Clinical related characteristics of HIV positive children received antiretroviral therapy attending who were attending in Northwest, Ethiopia, 2018.

Variables	Frequency (N)	Percent (%)
Virus occurred in the blood		
≤12 months	3	0.8
>12 months	369	99.2
OI		
Yes	177	47.6
No	195	52.4
Stage of WHO		
Ealy stage(I&II)	301	80.9
Advanced stage (III&IV)	71	19.1
Prophylactic therapy		
Yes	292	78.5
No	80	21.5
ART duration		
≤12 months	29	7.8
>12 months	343	92.2
Comorbidity diseases		
Yes	73	19.6
No	299	80.4
ART adherence		
Good	310	83.3
Fair/poor	62	16.7
HAART regimens		
AZT + 3TC + LPV/r	41	11
ABC + 3TC + LPV/r	251	67.5
ABC + 3TC + EFV	71	19.1
TDF+3TC+EFV	9	2.4

Table 4. The bi-variable and multivariable logistic regression analysis of associated factors of stunting at northwest, Ethiopia, 2018.

Variables	Stunting		COR95%CI	AOR95%CI	p-value
	Yes	No			
Sex of the Child					
Male	96(51.6)	90(48.2)	1.689(1.119,2.550)	1.942(1.188, 3.175)	0.002
Female	72(38.7%)	114(61.3)	1	1	
Age of Child					
2-5 year	33(61.1%)	21(38.9%)	1	1	
5-10 year	47(31.5%)	102(68.5%)	1.446(0.77,2.702)	0.223(0.161,3.206)	0.143
10-15 year	88(52.1%)	81(47.9%)	0.424(0.268,0.671)	0.434(0.253,0.746)	0.04
OI					
Yes	109(61.6%)	68(58.4%)	1.12(1.34,1.98)	2.41 (1.61, 7.60)	0.018
No	115(59%)	80(41%)	1	1	
Dietary Diversity					
Good	80(45.5%)	96(54.5%)	1	1	
Fair/poor	108(55.1%)	88(44.9%)	1.023(0.679, 1.539)	1.832(1.128, 2.95)	0.001

[16], 30% in eastern Ethiopia [17], and 27% in Nigeria [31]. The above variation could be explained by the difference of sample size, study setting, feeding habits, culture, economic status, a sample size of care providers/parents, ART duration, and socio-demographic characteristics of study participants.

This study depicts that being male, age group of 2-5 years, presence of OI, and fair/poor dietary diversity were significant factors with stunting. In this study being male was a statically significant factor with stunting. This finding is consistent with studies which are reported in Ethiopia [16], and Tanzania [31]. This finding contradicts also findings from a study reported from India [32], and Gonder, Ethiopia [15]. The variation could be explained due to difference of cultural feeding practice and sample size. The association between gender and malnutrition remain unclear and need further investigation [33], but in this study, the variation was due to most of male child-mother occupation were daily workers and lack of awareness of the use of diversified diet.

This study also revealed that being age group of 2-5 years old was a statically significant factor with stunting. Children who were being the age group of 2-5 years old were more likely developed stunted as compared to the age group of 10-15 years. This find aligns with the studies which are conducted in Ethiopia [15]. The possible explanations for these findings were age group of 2-5 years/ younger children were weaning from the breast, inadequate supplementary feeding, loss of passive immunity, and more leading to recurrent infections and a poorly nourished child at this age. Additionally, opportunistic infections were statistically significant associated factors with stunting. These findings are consistent with the studies which are conducted in Adama, Ethiopia [16], and Nepal [34]. The possible explanation might be an opportunistic infection that affects the nutritional status of the child which leads to undernourished through distortion of food intake, abosbation, and increased utilization and excretion of nutrients and fasten the progression of the disease [12].

Finally, this study found that children who had fair/poor, dietary diversity were statically significant associated factors with stunting. This finding is consistent with studies conducted in Hawassa, Ethiopia [25]. The possible reason might be that a patient did not get variety of food that have enhanced for different types of infection and compromised the immunity of the patient that developed stunting [35].

Conclusion

In the present study, more than two-fifth of the study children was developed stunting among HIV-positive children. Age of children 2-5 years, being male, presence of opportunistic infections and fair/poor individual dietary diversity increased the risk of stunting among children living with HIV. Therefore policymakers and clinicians should be a focus, early detection of opportunistic infections, control progression of HIV, educating and counseling the use of the diversified diet, monitoring this situation is highly recommended.

Limitations of the study

The study has several limitations. It cannot show a cause-effect relationship between the variables since the study design was hospital cross-sectional. There may be measurement bias and recall bias for individual dietary diversity and it might also undermine the generalization of the study result to the general population.

Declarations

Ethics approval and consent to participants

The study was given ethical clearance [Protocol Identification Number: MS-Et/M.3-P 4.4/2015-2016] by the Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana. Permission was obtained from the clinician-in-charge of the HIV clinic at the KBTH and informed consent was sought and obtained from each study participant. Patients' data were de-identified during data capture, entry, analysis and storage by ensuring only the study codes were used consistently throughout the project cycle.

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Authors' Contributions

YS: Conception of a research protocol, literature review, study design, data analysis, interpretation, and drafting of the manuscript. YS, NAM, AEG, BTZ, and MG: Data analysis, interpretation, and manuscript review. All authors have read and approved the manuscript.

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References

- Derso, Terefe, Amare Tariku, Gashaw Andargie Bikis, and Molla Mesele Wassie. "Stunting, wasting and associated factors among children aged 6–24 months in Dabat health and demographic surveillance system site: A community based cross-sectional study in Ethiopia." *BMC Pediatr* 17 (2017): 96.
- UNICEF. Monitoring the situation of children and women, Accessed 7 July 2020.
- Yeung, S, Wilkinson D, Escott S, and Gilks C. "Paediatric HIV infection in a rural South African district hospital." *J Trop Pediatr* 46 (2000): 107-110.
- Gedle D, Gelaw B, Muluje D, and Mesele M. "Prevalence of malnutrition and its associated factors among adult people living with HIV/AIDS receiving anti-retroviral therapy at Butajira Hospital, Southern Ethiopia." *BMC Nutr* (2015): 5.
- UNICEF. Joint child malnutrition estimates - Levels and trends. (2018).
- Sunguya, Bruno F, Krishna C Poudel, Keiko Otsuka, and Junko Yasuoka, et al. "Undernutrition among HIV-positive children in Dar es Salaam, Tanzania: antiretroviral therapy alone is not enough." *BMC Pub Health* 11 (2011): 869.
- Anyabolu, HC, Adejuyigbe EA, and Adeodu OO. "Undernutrition and anaemia among Haart-Naive HIV Infected Children in Ile-Ife, Nigeria: A case-controlled, Hospital Based Study." *Pan Afr Med J* 18: (2014) 77.
- Poda Ghislain G, Chien-Yeh Hsu, and Jane C-J Chao. "Malnutrition is associated with HIV infection in children less than 5 years in Bobo-Dioulasso City, Burkina Faso: A case-control study." *Medicine* 96 (2017): e7019.
- Rose, AM, Hall CS, and Martinez-Alier N. "Aetiology and management of malnutrition in HIV-positive children." *Arch Dis Child* 99 (2014): 546-551.
- Swetha, Krishna, Hemalatha R, Vasudev Murali, and Damayanti K, et al. "Health & nutritional status of HIV infected children in Hyderabad, India." *Indian J Med Res* 141 (2015): 46-54.
- Oguntibeju, O, and Van Den Heever W. "The interrelationship between nutrition and the Immune system in HIV infection: A review." *Pak J Bio Sci* 10 (2007): 4327-4338.
- Press. The African food system and its interaction with human health and nutrition. CU (2010).
- Semba, RD, Darnton-Hill I, and de Pee S. "Addressing tuberculosis in the context of malnutrition and HIV coinfection." *Food Nutr Bull* 31 (2010): S345-S364.
- Kalofonos, Ippolytos A. "All I eat is ARVs: the paradox of AIDS treatment interventions in central Mozambique." *Med Anthropol Q* 24 (2010): 363-380.
- Megabiaw, Berihun B., and Rogers NL. "Malnutrition among HIV-Positive Children at two Referral Hospitals in Northwest Ethiopia." *J Res Health Sci* (2011).
- Asiya, Jeylan, and Girma A. "Magnitude of Stunting, Thinness and Associated Factors among HIV Positive Children Attending Chronic HIV Care and Support in Adama Hospital Medical College, Adama, Oromia Regional State, Ethiopia." *Int J Health Sci Res* 8 (2018): 11.
- Dawit, Gezahegn, Gudina Egata, Tesfaye Gobena, and Abebaw B. "Predictors of stunting among pediatric children living with HIV/AIDS, Eastern Ethiopia." *Int J Pub Health Sci* 9 (2020): 82-89.
- Federa I Ministry of Health. "National Comprehensive HIV Prevention, Care and Treatment Training for Health care providers." Participant Manual (2018):1-123.
- WHO. "Health in the sustainable development goals, good health and well-being, World Health Organization, Regional Office for South-East Asia." (2016): 1-83.
- FDRE. National Nutrition Program 2016-2020.
- Abate, Biruk B., Teshome Gebremeskel Aragie, and Getachew Tesfaw. "Magnitude of underweight, wasting and stunting among HIV positive children in East Africa: A systematic review and meta-analysis." *PLoS one* 15 (2020): e0238403-e0238403.
- Shegaw Motta General Hospital annual report (2017).
- Debremarkos Comprehensive Hospital annual report (2017).
- Finot Selam General Hospital annual report (2017).
- Wude, Beyene, and Wondimu A. "Nutritional Status and Associated Factors in Human Immunodeficiency Virus Infected Children in Hawassa University Referral Hospital Hawassa City, SNNPR, Ethiopia." *EPHI* (2014).
- WHO. "Country progress in creating enabling policy environments for promoting healthy diets and nutrition." *Globalnutrition* (2015-2017).
- FAO. "Guidelines for Measuring Household and Individual dietary diversity, FAO Nutrition and consumer Protection Division, with Support from the EC/FAO Food Security Information for Action Programme and the Food and Nutrition Technical Assistance (FANTA) Project." (2007).
- FMOH. "Guidelines on Clinical and Programmatic Management of Major Non Communicable Diseases, Ethiopia." (2016).

29. Weldegebreal, Fitsum, Tesfaye Digaffe, Frehiwot Mesfin, and Habtamu Mitiku. "Dietary diversity and associated factors among HIV positive adults attending antiretroviral therapy clinics at Hiwot Fana and Dilchora Hospitals, eastern Ethiopia." *HIV AIDS* 10 (2018): 63-72.
30. Rakholia, Ritu, Meher Bano, and Vineeta Rawat. "Malnutrition among HIV- infected Children by Anthropometric Measures in Poor Outreach Area of a Developing Country and its Relationship with CD4 Counts." *Int J Pediatr* 4 (2016): 1643-1654.
31. Choudhury, KK., Hanifi MA, Rasheed S, and Bhuiya A. "Gender inequality and severe malnutrition among children in a remote rural area of Bangladesh." *J Health Popul Nutr* 18 (2000): 123-130.
32. Gogia, Priya, Ravi Ambey, and Saumya Sahu "Assessment of nutritional status of HIV positive children in ART center: a study from central India." *Int J Pediatr Res Pract* 1 (2015): 7-11.
33. States. "Report on Food and Nutrition for People with HIV/AIDS. president's emergency plan for AIDS relief." (2006).
34. Thapa, Rajshree, Archana Amatya, Durga Prasad Pahari, and Kiran Bam. "Nutritional status and its association with quality of life among people living with HIV attending public anti-retroviral therapy sites of Kathmandu Valley, Nepal." *AIDS Res Ther* 12 (2015): 14.
35. Mangili, A, Murman DH, Zampini AM, and Wanke CA. "Nutrition and HIV infection: review of weight loss and wasting in the era of highly active antiretroviral therapy from the nutrition for healthy living cohort." *Clin Infect Dis* 42 (2006): 836-842.

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