Research Article
Volume 12:6, 2021

Journal of AIDS & Clinical Research

ISSN: 2155-6113 **Open Access**

Prevalence of Opportunistic and other Intestinal Parasites Infections and its Associated Factors among HIV/AIDS Patients attending at Dessie Comprehensive Specialized Hospital, Northeast Ethiopia

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Abstract

Introduction: Human Immuno Deficiency Virus (HIV) deplete CD4+ T cell in human and weaken the immune system, this makes HIV positive patients more susceptible to parasitic and other opportunistic infection. Intestinal parasitic infection plays vital role in the prognosis of people living with HIV/AIDS. This study was aimed to determine the magnitude of intestinal parasitic infection and its determinant among people living HIV/AIDS.

Method: A cross-sectional study was conducted from February 2020 to April 2020. A total of 223 study participants were recruited using simple random sampling. A Pre-tested questionnaire was used to collect socio-demographic and other risk factor data. A stool sample was collected to detect parasitic infection using wet mount, formol-ether concentration and Modified ziehl-neelsen technique. The whole blood sample was collected to determine CD4+ T cell count using BD FACSCount™ System. Data was entered into Epi Data version 3.1 and analyzed using SPSS version 20.

Results: Out of 223 participants 166 (74.4%) were males. The mean age of the study participants was 37.9 years old with the majority being found in the age group 26-49 years (64.1%). The overall prevalence of intestinal parasitic infection was found to be 38.1%. The prevalence was significantly higher in males (23.7%) than in females (p≤0.002). The most predominant parasite detected was *G. lamblia* (40%) followed by *E. histolytica* (32.9%). The prevalence of opportunistic infection was 2.24%. The detected opportunistic parasites were *S. stercoloaris, Cryptosporidium spps* and *I. beli*. Sex, residence and low CD4+ T cell counts were significantly associated with the prevalence intestinal parasitic infection among HIV/AIDS patients.

Conclusion: The finding showed intestinal parasitic infections being a major health problem in HIV patients. Low-level CD4 T cell is a risk factor for the high prevalence of parasitic infection. The high prevalence of intestinal parasitic infection indicates the need of routine investigation of the infection that will aid for rapid therapeutic management.

Keywords: Intestinal parasitosis • Opportunistic parasitic infection • Dessie • Ethiopia

Abbreviations: AIDS: Acquired Immunodeficiency Syndrome • HIV: Human Immunodeficiency Virus • CD: Cluster of Differentiation

Introduction

Human Immuno Deficiency Virus (HIV) is a pandemic RNA virus that weakens the immune system by infecting and depleting the CD4+ T cell molecule in human, which later leads to immunodeficiency [1]. The disease is a major public health problem throughout the world with a steady increase in its estimated annual cases. In 2015 the number of people living with HIV/AIDS reached 38.8 million (95% UI 37·6–40·4 million). Since 2005, the mean annual incidence continued to be 2·6 million per year, but the number of HIV/AIDS mortality has been decreased from a peak of 1·8 million deaths in 2005, to 1·2 million deaths in 2015 [2]. Sub-Sharan African countries accounted about 71% of the 35.0 million global cases and 74% of the 1.5 million AIDS-related deaths in 2013. Ten Sub-Saharan Africa countries South Africa (25%), Nigeria (13%), Mozambique (6%), Uganda (6%), Tanzania (6%), Zambia (4%), Zimbabwe (6%), Kenya (6%), Malawi (4%) and Ethiopia (3%) accounted 80% of HIV cases in the globe [3].

Intestinal parasitic infection caused by both helminths and protozoans are the major cause of morbidity and mortality throughout the world mainly in resource-constrained are of the tropical and subtropical regions of the world [4]. It affects about 3.5 billion people and causes morbidity and mortality among 450 million in the world [5]. Intestinal helminthic infection plays a vital role in the pathogenesis of HIV and its progression to AIDS due to its immunomodulation activity [6]. Opportunistic protozoan infection case severe and life threatening diarrhea in HIV/ AIDS patients [7].

Ethiopia is among the top ten countries that accounted 80% of all people living with HIV in the globe. In Ethiopia, a total of 670906 peoples are estimated to live with HIV in 2016 [8]. Ethiopia had the highest burden of intestinal parasitic infection in Sub-Saharan Africa and stands second, third and fourth to have the highest burden of Ascariasis, Hookworm infection and

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Received 05 May 2021; **Accepted** 14 June 2021; **Published** 21 June 2021

Tirichuriasis in SSA respectively. An estimated 26, 21, and 11 million people are at risk of Ascariasis, Hookworm infection and Tirichuriasis respectively [9]. A High prevalence of intestinal parasitic infection among HIV patients had been reported in different parts of Ethiopia. In the country the pooled prevalence of IP among HIV seropositive patients is reported to be 39.15% (95%CI: 32.34, 45.95) [10]. In developing countries like Ethiopia parasitic infection imposed great concern in the management and care of people living with the virus. In those countries, most of the patients enrolled in HIV diagnosis and treatment lately after progression of the disease to advanced stage and when the CD+ T cell count become depleted due to lake of awareness, fear of social stigma, and low coverage of health service to the community. All those will lead the patients to poor prognosis, rapid disease progression and death with opportunistic infections. In the present study, we determine the prevalence of intestinal parasitic infection and associated factors among HIV-infected patients.

Materials and Methods

Study area and period

This study was conducted from February 2020 to April 2020 at the ART clinic of Dessie Comprehensive Specialized Hospital. The Hospital located in Dessie town. Dessie town is the capital city of South Wollo zone, located at 401km to North East of Addis Ababa the capital city of Ethiopia. The town was found at latitude of 11° 8'N, the longitude of 39° 38'E and altitude of 2,470 to 2,550 meters above sea level. The town has 8 health centers, one referral and one general governmental hospital and three private general hospitals, three higher private clinics, one family guidance association of Ethiopia and one Marie stops international Ethiopia reproductive health service provider clinics. Dessie town has an estimated 2,908,529 population. Based on gender 1,480,369 are males and 1,428,160 are females.

Study design and subject

Hospital-based cross-sectional study was conducted. All HIV seropositive patients registered at the ART clinic were the source population. The study population was all individuals who come to the ART clinic during the study period. Study participants who are taking an anti-parasitic drug for the past three weeks were excluded.

Sample size and sampling method

The sample size of this study was calculated using single population proportion formula by considering a 17.72% prevalence of opportunistic parasitic infection reported from Arba Minch Hospital [11] and a 5% margin of error with a 95% confidence level. Then the total sample size was found to be 223. A Simple random sampling technique was used to recruit the required study participants.

Data collection and sample processing

Data regarding socio-demographic and other risk factor variables were collected using pre-tested structure questionnaires. Blood and stool specimens were collected from each study participant. The stool samples were used for the diagnosis of parasitic infections while the blood sample was used to determine the CD4 T-cell count of the study participants. The CD4 T-cell count was determined by using the BD FACSCount™ System (BD Biosciences, USA) machine following a standard operating procedure as described elsewhere [12].

The fecal sample was collected using a clean wide-mouthed leak proof container from each study participant. Direct wet mount and formol-ether concentration technique were performed to diagnose actively motile protozoan parasites together with other helminthes. A small portion of the fresh specimen was used for direct saline wet mount and the preparation was examined by light microscope at low (10X) and high power (40X) objective lenses as described elsewhere [13]. In addition, formol ether concentration was performed by placing about 1 gm of the fresh stool into a clean conical tube of 15 ml size, then 12ml and 3 ml filtered formalin and diethyl ether respectively were added into the tube and centrifuged at 1300 rpm for 5 minutes. Then the supernatant was discarded while the sediment was used for direct smear preparation and examination using a light microscope. Intestinal coccidian parasites were diagnosed using Modified ziehl-neelsen stain as described elsewhere [14,15].

Quality control

The questionnaires were translated to local language and back-translated to English. All material and reagents were checked for clarity and expiration date. The collected data were checked for clarity and completeness. Standard operating procedures were followed to minimize errors during the analytical phase. Microscopic examination was performed by experienced medical laboratory scientists.

Data entry and analysis

Data was entered into Epi Data version 3, exported to and analyzed using SPSS version 20. Socio-demographic characteristics of the study participants were determined using descriptive statistics. Binary logistic regression was used to assess the presence and strength of association between the outcome and predictor variables. Variables with p≤ 0.25 in the bivariable analysis were entered into multivariable analysis. Variables with p≤ 0.05 at 95% confidence level were considered as statistically significant.

Ethical considerations

Ethical clearance was obtained from the ethical review committee of Wollo University College of medicine and health science. After briefly explaining the purpose and objective of the study, written informed consent was taken from each study participant. For participants < 18 years old, written signed assent was obtained from their guardians. Additionally, participant's confidentiality was kept by avoiding personal identifiers and using codes. Finally, participants who are infected with intestinal parasite/s were treated accordingly.

Results

Socio-demographic characteristics of the respondents

A total of 223 HIV seropositive participants were recruited. A higher percentage of the participants were male (74.4%). The majority of the participants were in the age range of 26-29 years old (64.1%) with median age of 37.98 years (range 11-75 years). The majority of the respondents were from urban areas (79.4%). Most of the respondents were married. College and above was the highest level of education attained by the majority of participants (Table 1).

Prevalence of intestinal parasites among HIV seropositive patients

The overall prevalence of intestinal parasites was 38.1% and from these, the prevalence of protozoan, helminths was 35.87% and 2.24%5, respectively. The prevalence of opportunistic infection was 2.24%. The detected opportunistic parasites were *S. stercoloaris, Cryptosporidium spps* and *I. beli*. About 17.65% of the study participants were co-infected by *E. histolytica* and *G. lamblia*. The overall prevalence of intestinal parasite infection was significantly higher among males (23.7%) (p≤0.002) and in the age group 26-49 years old (24.2%) (p≤0.583). Urban residents were more affected than the rural residents (27.35% vs 10.76%) (p≤0.031). Regarding the educational status, study participants who attend college and above (11.65%) were infected in a higher proportion than the others. In addition, the prevalence of an intestinal parasitic infection among HIV-infected patients with a CD4 T cell count <200 cells/μl and 200-499 cells/μl was 19.73% and 10.76%, respectively (P≤0.001).

Distribution of parasitic infection among HIV seropositive patients

Seven different species of parasites were identified. The most predominant intestinal parasite detected was *G. lamblia* (40%) followed by *E. histolytica* (32.9%), mixed (17.65%) *A. lumbricoides* (2.35%), *Cryptosporidium spps* (2.35%), and *S. stercoloaris* (2.35%) (Table 2).

Univariables and multivariable logistic regression

Binary logistic regression was done to assess the presence and strength

Table 1. Socio-demographic characteristics of the study participants.

Variables	Frequency n (%)
Age range	
<12 years	5 (2.2%)
12-25 years	36 (16.1%)
26-49 years	143 (64.1%)
>50 years	39 (17.5%)
Sex	
Male	166 (74.4%)
Female	57 (25.6%)
Marital status	
Single	60 (26.9%)
Married	9944.4
Divorced	3515.7
Widowed	2913
Residence	
Urban	17779.4
Rural	4620.6
Educational status	
Illiterate	22 (9.9%)
Read and write only	44 (19.7%)
Primary	43 (19.3%)
Secondary	49 (22%)
College and above	65 (29.1%)
Occupational status	
Governmental	48 (21.5%)
Merchant	48 (21.5%)
Farmer	13 (5.8%)
House wife	48 (21.5%)
Daily labor	30 (13.5%)
Student	36 (16.1%)

Table 2. Distribution of parasites among the study participants.

Species of parasite	Frequency n (%)
A. lumbricoides	02 (2.35%)
G. lamblia	34 (40%)
S. stercoloaris	02 (2.35%)
Tneaia Spps.	01 (1.2%)
I. beli	01 (1.2%)
E. histolytica	28 (32.9%)
Mixed (*E. histolytica* + *G. lamblia)*	15 (17.65%)
Cryptosporidium spps	2 (2.35%)

of association between dependent and predictor variables. Variable with a p value of ≤0.25 in the univariable analysis was entered into the multivariable analysis. Sex, residence and low CD4 T cell counts were found to be an independent predictor of intestinal parasitic infection in HIV/AIDS patients (Table 3).

Discussion

Intestinal parasites are the major cause of morbidity and mortality in HIV/AIDS patients [7]. In low and middle-income countries intestinal parasites are the major cause of diarrhea in AIDS patients [10]. Our study was aimed at indicating the magnitude of opportunistic and other intestinal parasitic infections among HIV/ADIS in Dessie; Comprehensive Specialized Hospital and evaluating risk factors associated with the infection. In this study, 36.1% of the study participants were infected with one or more intestinal parasites. This finding is almost similar to findings from Sothern, Ethiopia (35.8%) [16]. The finding of this study was higher than that of reported from Hiwot Fana Specialized Hospital Eastern, Ethiopia (33.7%) [17], Tigray Ethiopia (26.4%) [18], Arba Minch Hospital Southern, Ethiopia (28.18%) [11], Benin City, Nigeria (15.3%) [19] and Centre Region of Cameroon (27.9%) [20]. This difference might be due to sample size variability, the difference in immune status, environmental hygiene and participant's personal hygiene. The prevalence reported in this study was lower than the finding of previous studies reported in North West, Ethiopia (45.3%), South West, Ethiopia (45%), Baringo, Kenya (50.9%), Ilorin, Nigeria (68.5%), the island of Bioko, Equatorial Guinea (81.5%) and Ouagadougou, Burkina Faso (73.3%) [21-26]. The low prevalence in this study might be due to difference in environmental condition, HAART treatment (all the study participants of this study were taking HAART) and since most of the study participants in this study were literate and urban residents' good sanitary practice might be a reason for low prevalence.

In this study, the higher prevalence was non-opportunistic parasitic infection (35.87%) with little opportunistic infection (2.24%). The most predominant parasite reported in this study was *G. lamblia* followed by *E. histolytica/dispar* this agreed with reports from Hiwot Fana Specialized University Hospital, Eastern Ethiopia and in St. Mary Aksum general hospital, Tigray, Ethiopia that reported *E. histolytica/dispar* and *G. lamblia* as the predominantly identified

Table 3. Prevalence of intestinal parasitic infections and its association with socio-demographic and other risk factors.

Characteristics		Positive n (%)	COR (95% CI), p value	AOR (95% CI), p-value
Age group	<12 years	3 (1.35)	3.409 (0.498-23.361), 0.212	3.309 (0.398-22.361), 0.323
	12-25 years	11 (4.93)	2.472 (0.400-15.271), 0.330	2.172 (0.200-13.271), 0.430
	26-49 years	53 (23.77)	1.941 (0.291-12.950), 0.493	1.641 (0.291-12.950), 0.583
	>50 years	18 (8.07)	Reference	
Sex	Male	53 (23.77)	2.729 (1.473-5.056), 0.001	2.714 (1.422-5.180), 0.002
	Female	32 (14.35)	Reference	
Residence	Urban	61 (27.35)	2.07 (1.08-3.99), 0.029	2.17 (1.07-4.39), 0.031
	Rural	24 (10.76)	Reference	
Wearing shoe	Yes	80 (35.87)	Reference	
	No	5	4.145 (1.01-22.417), 0.048	2.14 (0.968-6.417), 0.062
Hand washing material	With soap	80 (35.87)	Reference	
	Without soap	5	0.514 (0.179-1.474), 0.216	0.39 (0.159-1.48), 0.41
Trimming finger nail	Yes	78	Reference	
	No	7	1.582 (0.480-5.213), 0.251	1.82 (0.50-5.01), 0.36
CD4 count	<200 cells/μl	44	6.79 (2.94-16.01], 0.000	3.46 (1.27-5.35), 0.001
	200 – 499 cells/μl	28	2.62 (1.86, 4.01), 0.000	2.64 (1.84, 4.85), 0.001
	≥ 500 cells/μl	13	Reference	
Habit of eating raw fruit and vegetable	Yes		1.87 (1.21, 3.62), 0.040	2.12 (1.13, 4.31), .002
	No		Reference	

parasites. The proportion of mixed infection was 17.65% and the mixed parasites identified were *E. histolytica/dispar* and *G. lamblia*.

The prevalence of opportunistic intestinal parasites was 2.24%. The identified opportunistic parasites were *Cryptosporidium* species, *Isospora beli* and *Strongyloides stercoralis*. The low prevalence of opportunistic parasites might be associated with using of antiretroviral drug because the patients begin the drug as soon as they are confirmed as HIV positive and good sanitation practice among the study participants. The prevalence of *Cryptosporidium* species was 2.35%, this finding was lower than reports from Arba Minch Hospital Southern, Ethiopia (8.63%) [11]. *Isospora beli* was 1.2% prevalent in the study participants this finding is consistent with reports from Arba Minch Hospital Southern, Ethiopia [11] and lower than reports from. The other opportunistic parasite was *Strongyloides stercoralis* which is 2.35% prevalent in this study, this finding is lower than reports from and higher than reports from Arba Minch Hospital Southern, Ethiopia (1.81%) [11] and De Maio Health Centre in Maputo, Mozambique (1.3%) [27]. The difference in environmental condition, sample size, sanitation practice and immunity of the participants might attribute to the difference in the prevalence.

The overall prevalence was significantly higher among males (*p≤0.002*), this finding is consistent with a report from Benin city Nigeria [19]. The highest prevalence in males might be due to higher number of male patients participated, in most cases, males are more likely to be exposed to IP due to occupational nature and good sanitation practice among females. Regarding the residence of the study participants, the prevalence was found to be significantly higher in the urban than in the rural residents (p≤0.031). The high prevalence might be due to environmental conditions, the habit of raw fruit and vegetable consumption in the urban residents and the high proportion of participants who are from urban; since the study was conducted in Dessie comprehensive specialized hospital, most of the participants were from the town.

The habit of row fruit and vegetable consumption significantly affects the prevalence of intestinal parasitic infection in the study participants (p≤0.002). Study participants who eat raw/undercooked fruit and vegetable are two times more likely to be infected with intestinal parasites than those who did not consume row/undercooked fruit and vegetable.

Low CD4 T cell count was strongly associated with a high prevalence of intestinal parasites (p=0.001) this agrees with a report from Benin City Nigeria [19]. participants with CD4 T cell count <200 cells/μl and 200 – 499 cells/μl are 3.6 times 2.64 times more likely to be infected with IP than participants with CD4 T cell count ≥500 cells/μl. The CD4 T cell of our immune system plays a critical role in defending and limiting intestinal parasitic infection in the human body. Therefore, depletion of these cells by the HIV virus will increase the risk of intestinal parasitic infection and reactivation and establishment of opportunistic parasites in the body.

Conclusion and Recommendations

Based on the finding of this study intestinal parasitic infection is still found to a common problem among HIV patients. Non-opportunistic parasites are more prevalent in the study participants. The prevalence of opportunistic intestinal parasites was low in the study area. Based on our finding low CD4 T cell count, sex, residence and habit of raw fruit and vegetable consumption are independent predictors for the prevalence of intestinal parasitic among HIV seropositive patients. Therefore, health education regarding the source of infection, mode of transmission about intestinal parasitic as well as regular screening, treatment and follow-up is important to limit the effect of intestinal parasitic among HIV seropositive patients and its disease progression.

Author's Contributions

HB and MD design the project and performed the statistical analysis. TM and MK collect the sample, performed the laboratory tests and help in drafting the manuscript. MB and LS collect data performed the statistical analysis and coordinate the study. HB and MD draft the manuscript. TM, MK MB and LS review the manuscript. All authors read and approve the final manuscript.

Acknowledgment

The authors would like to acknowledge Wollo University and Dessie comprehensive specialized hospital for material support and laboratory adjustment. The authors also would like to thank Medical laboratory scientists in Dessie comprehensive specialized hospital and the study participants.

Availability of Data and Materials

All the material needed for this research is available within the manuscript.

Funding

There is no specific funding for this research.

Disclosure

The authors confirm that there is no competing interest.

Consent for Publication

Not applicable.

References

1. Naif, Hassan M. "Pathogenesis of HIV infection." *Infect Dis Rep* 5 (2013): 6.
2. Kyu, Hmwe H, Grant Nguyen, Timothy Wolock, and Austin Robert Carter, et al. "Estimates of global, regional, and national incidence, prevalence, and mortality of HIV, 1980–2015: the Global Burden of Disease Study 2015." *Lancet* 3 (2016):e361-e387.
3. Kharsany, Ayesha BM, and Quarraisha A. Karim. "HIV Infection and AIDS in Sub-Saharan Africa: Current Status, Challenges and Opportunities." *Open AIDS J* 10 (2016): 34-48.
4. Bangert, Mathieu, David H. Molyneux, Steve W. Lindsay, and Christopher Fitzpatrick. "The cross-cutting contribution of the end of neglected tropical diseases to the sustainable development goals." *Infect Dis Poverty* 6 (2017): 73.
5. Weltgesundheitsorganisation. "Prevention and control of schistosomiasis and soil-transmitted helminthiasis: report of a WHO expert committee; [the WHO Expert Committee on the Prevention and Control of Schistosomiasis and Soil-Transmitted Helminthiasis met in Geneva from 8 to 14 October 2001]." *Geneva: World Health Organization* (2002): 57.
6. Borkow, Gadi, Carrie Teicher, and Zvi Bentwich. "Helminth–HIV Coinfection: Should We Deworm?" *PLoS Negl Trop Dis* 1 (2007): e160.
7. Nissapatorn, Veeranoot, and Nongyao Sawangjaroen. "Parasitic infections in HIV infected individuals: Diagnostic & therapeutic challenges." *Indian J Med Res* 134 (2011): 878.
8. Deribew, Amare, Sibhatu Biadgilign, Kebede Deribe, and Tariku Dejene, et al. "The Burden of HIV/AIDS in Ethiopia from 1990 to 2016: Evidence from the Global Burden of Diseases 2016 Study." *Ethiop J Health Sci* 29 (2018): 859-868.
9. Hotez, Peter J, and Aruna Kamath. "Neglected Tropical Diseases in Sub-Saharan Africa: Review of Their Prevalence, Distribution, and Disease Burden." *PLOS Negl Trop Dis* 3 (2009): e412.
10. Wondmieneh, Adam, Getnet Gedefaw, Birhan Alemnew, and Addisu Getie, et, al. "Intestinal parasitic infections and associated factors among people living with HIV/AIDS in Ethiopia: A systematic review and meta-analysis." *PLOS One* 15 (2020): e0244887.
11. Alemu, Getaneh, Dagninet Alelign, and Ashenafi Abossie. "Prevalence of opportunistic intestinal parasites and associated factors among HIV patients while receiving ART at Arba Minch Hospital in southern Ethiopia: a cross-sectional study." *Ethiop J Health Sci* 28 (2018): 147.
12. Nsagha, Dickson S, Anna Longdoh Njunda, Nguedia Jules Clement Assob, and Charlotte Wenze Ayima, et al. "Intestinal parasitic infections in relation to CD4+ T cell counts and diarrhea in HIV/AIDS patients with or without antiretroviral therapy in Cameroon." *BMC Infect Dis* 16 (2015): 9.
13. Taye, Biruhalem, Kassu Desta, Selamawit Ejigu, and Geme Urge Dori. "The magnitude and risk factors of intestinal parasitic infection in relation to Human Immunodeficiency Virus infection and immune status, at ALERT Hospital, Addis Ababa, Ethiopia." Parasitol Int 63 (2014): 550-556.
14. Biderouni, Tahvildar F, and Nima Salehi. "Detection of Cryptosporidium infection by modified ziehl-neelsen and PCR methods in children with diarrheal samples in pediatric hospitals in Tehran." *Gastroenterol Hepatol Bed Bench* 7 (2014): 125-130.
15. Alemu, Abebe, Yitayal Shiferaw, Gebeyaw Getnet, and Aregaw Yalew, et, al. "Opportunistic and other intestinal parasites among HIV/AIDS patients attending Gambi higher clinic in Bahir Dar city, North West Ethiopia." *Asian Pac J Trop Med* 4 (2011): 661-665.
16. Shimelis, Techalew, Yayehyirad Tassachew, and Tariku Lambiyo. "Cryptosporidium and other intestinal parasitic infections among HIV patients in southern Ethiopia: significance of improved HIV-related care." *Parasit Vectors* 9 (2016): 270.
17. Teklemariam, Zelalem, Degu Abate Habtamu Mitiku, and Yadeta Dessie. "Prevalence of Intestinal Parasitic Infection among HIV Positive Persons Who Are Naive and on Antiretroviral Treatment in Hiwot Fana Specialized University Hospital, Eastern Ethiopia." *ISRN AIDS* (2013): 1–6.
18. Gebrewahid, Tuom, Gebretsadkan Gebrekirstos, Mebrahtu Teweldemedhin, and Hailay Gebreyesus, et, al. "Intestinal parasitosis in relation to CD4 count and anemia among ART initiated patients in St. Mary Aksum general hospital, Tigray, Ethiopia." *BMC Infect Dis* 19 (2019).
19. Akinbo, Frederick O, ChristopherE. Okaka, and Richard Omoregie. "Prevalence of intestinal parasitic infections among HIV patients in Benin City, Nigeria." *Libyan J Med* 5 (2010): 5506.
20. Mbiandou, Stephanie J, Samuel Fosso, Edimo Bille, and Armand Beleck Matoh, et al. "Prevalence of Intestinal Parasitic Infections in Relation to the HIV Status of Patients Attending the Care Units in Three Divisions in the Centre Region of Cameroon." *Int J Infect* 6 (2019).
21. Gebrecherkos, Teklay, Haftom Kebede, and Abebaw Addis Gelagay. "Intestinal parasites among HIV/AIDS patients attending University of Gondar Hospital, northwest Ethiopia." *Ethiop J Health Dev* 33 (2019).
22. Kindie Y, Bekele S. "Prevalence and Risk Factors for Intestinal Parasite Infections in HIV/AIDS Patients with Anti-Retroviral Treatment in South West Ethiopia." *J Trop Dis* 4 (2016).
23. Kipyegen, Cornelius K, Robert Shavulimo Shivairo, and Rose Ogwang Odhiambo. "Prevalence of intestinal parasites among HIV patients in Baringo, Kenya." *Pan Afr Med* J 13 (2012).
24. Obateru, Olusegun, Bojuwoye BJ, Olokoba AB, and Abayomi Fadeyi, et, al. "Prevalence of intestinal parasites in newly diagnosed HIV/AIDS patients in Ilorin, Nigeria." *Alexandria J Med* 53 (2017): 111-116.
25. Roka, Margarita, Pilar Goñi, Encarnación Rubio, and Antonio Clavel. "Prevalence of intestinal parasites in HIV-positive patients on the island of Bioko, Equatorial Guinea: Its relation to sanitary conditions and socioeconomic factors." *Sci Total Environ* 432 (2012): 404-411.
26. Zida, Adama, Abdourahamane Yacouba, Marcel P Sawadogo, and Smael Diallo, et al. "Opportunistic and other intestinal parasites infections among HIV positive patients in the era of combination antiretroviral therapy and preventive treatment in Ouagadougou, Burkina Faso." *J HIV Clin Sci Res* 4 (2017): 8-14.
27. Cerveja, Borges Z, Rafael Manuel Tucuzo, Ana Carina Madureira, and Noémia Nhacupe, et al. "Prevalence of Intestinal Parasites Among HIV Infected and HIV Uninfected Patients Treated at the De Maio Health Centre in Maputo, Mozambique." *EC Microbiology* 9 (2017): 231-240.

How to cite this article: Bisetegn, Habtye, Melaku Dires, Tigist Muluneh, and Mihret Kassa, et al. "Prevalence of Opportunistic and other Intestinal Parasites Infections and its Associated Factors among HIV/AIDS Patients attending at Dessie Comprehensive Specialized Hospital Northeast Ethiopia." J AIDS Clin Res 12 (2021): 845.