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ORIGINAL ARTICLE

INTESTINAL PARASITES AND RISK AWARENESS OF PEOPLE LIVING WITH HIV/AIDS IN DEBRE BREHAN REFERRAL HOSPITAL, DEBRE BREHAN, ETHIOPIA

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ABSTRACT

Introduction*: Intestinal parasites are a significant cause of morbidity and mortality in most developing countries which affected more than 3.5 billion people throughout the world. The prevalence of intestinal parasites is relatively high in people living with HIV/AIDS. However, data on the prevalence of intestinal parasites among people living with HIV/ AIDS are insufficient in the study area. Hence, this study aimed to determine the prevalence of intestinal parasites and associated risk factors among people living with HIV/AIDS at Debre Brehan Referral Hospital, Central Ethiopia.*

Methods*: A cross-sectional study was conducted among 350 people living with HIV/AIDS from March to August 2019. Stool samples were collected with clean screw cupped containers and processed using direct microscopy, formol-ether concentration and modified acid-fast staining laboratory techniques.*

Results: *The overall prevalence of intestinal parasites among HIV/AIDS patients was 20.3% (71/350). Among these, Entamoeba histolytica/dispar takes the highest rank (13.4%) followed by Gardia lamblia (2.9%). Lack of latrine, high viral load count, and bad health practice of the participants were significantly associated with intestinal parasitosis.*

Conclusion*: The prevalence of intestinal parasites in this study was high. Thus to reduce the disease burden; government officials and stakeholders should work on reducing risk factors and increase awareness how to prevent and control of acquiring the disease.*

Key words*: Intestinal parasites, HIV/AIDS, Prevalence, Debre Brehan, Ethiopia.*

INTRODUCTION

Intestinal parasitosis (IPs) is a gastrointestinal infection caused by helminthes (multicellular) and protozoa (unicellular) (1, 2). Epidemiological studies indicate that both helminthes and protozoa are prevalent in developing countries whereas protozoan parasites are more dominant in developed countries (3, 4). More than 3.5 billion people are affected with intestinal parasites (IP) in the world, among which 450 million are in sub-Saharan Africa, affected by associated morbidities (5-7). Parasitic co-infection with Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) is the major public health crisis of the world, mainly in Sub-Saharan Africa (8).

The most common type of helminthes that are strongly associated with morbidity and mortality of HIV/AIDS patients are: *Ascaris lumbricoides*, *Trichuris trichiuria*, Hookworm and *Strongyloid stercoralis* that occupy the human intestine (9-11), whereas *Entamoeba histolytica/dispar* and *Giardia lambellia* are the dominant species among protozoans (1).

Protozoan parasites are also the foremost prevalent in tropical and subtropical regions of the developing world where water and sanitation facilities are insufficient (12-16). The main transmission mode of IPs is feco-oral route due to poor personal hygiene and environmental contaminations (17). More importantly, improper disposal of human excreta in Sub-Saharan countries like Ethiopia is the major contributing factor for the increased distribution of IPs (18). HIV/AIDS patients with poor knowledge, and bad health practices for IP infection prevention and control are more susceptible to opportunistic and non-opportunistic parasitic infections (19, 20).

There are about 36.9 million people infected with HIV/AIDS globally; among these Sub-Saharan Africa accounts for more than half (22.4 million) (14, 21), and where Ethiopia had a prevalence of 2.4% (8, 22). Moreover, HIV infection results in weakening of the human immune system which leads to the occurrence of opportunistic infections (OIs) (21-25).

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Almost 80% of AIDS patients die from AIDS-related infections like intestinal parasites rather than HIV infection itself (4). Opportunistic parasites, such as, *Cryptosporidia*, *Isospora,* and *Microsporidia* have been strongly linked to cause diarrhea among HIV/AIDS patients (12, 26). These parasites enhance the progression of HIV infections to AIDS unless such co-infections are diagnosed and treated properly (4, 26-28). Diarrhea is the most common clinical symptom of the intestinal parasitic infections. Reports designated that 30-60%, and 90% of AIDS patients can develop diarrhea in developed and developing countries respectively (4, 6, 29-31).

The utilization of anti-retroviral therapy (ART) can reestablish immunity by increasing the number of CD4 cells able to protect against opportunistic infections, and reduced the incidence of diarrhea (32). Most of the previous studies suggest that patients with CD4 counts <200 cells/µl are more vulnerable to opportunistic infections than patients with CD4 counts > 200 cells/µl (33).

Although there's an improvement in the survival of people living with HIV/AIDS (PLWHA) in Ethiopia, there are still a considerable number of deaths related to AIDS across the country (26). Intestinal parasitosis is one among the foremost common causes of morbidity and mortality due to the depletion of host immunity (3). Furthermore, little is known about the prevalence of both pathogenic and opportunistic intestinal parasites, KAP as well as associated risk factors among PLWHA in Debre Brehan, Ethiopia. Hence, this study aimed to work out the prevalence of intestinal parasites, KAP and associated risk factors among PLWHA attending at ART clinic in Debre Brehan Referral Hospital, Ethiopia.

MATERIALS AND METHODS

Study design and setting

A cross-sectional study was conducted from March 01, 2019 to August 30, 2019 among PLWHA at Debre Brehan Referral Hospital, Central Ethiopia. Debre Brehan is 130 Km north of the capital city of the country, Addis Ababa. During the study period, there were 2950 people living with HIV/AIDS registered for ART care and treatment service in the Hospital.

Debre Brehan is situated at an altitude of 2840 meter above sea level with a mean annual rainfall of 964 mm. Few months from March to September had precipitation ranges from 40% to 75% and the mean annual temperature ranges from 10 to 16 °C (34). The town is totally highland and has relatively cold, dry, and windy weather conditions with two distinctive seasons, summer and winter.

All people living with HIV/AIDS attending at the ART clinic in Debre Brehan Referral Hospital during the study period, which fulfills the inclusion criteria, were recruited for the study.

Sample size determination and Sampling method

The required sample size was calculated using single population proportion formula by referring a similar study conducted in Gondar, 29.1% prevalence of intestinal parasites among HIV/AIDS clients in University of Gondar Hospital (26), 5% desired precision and 95% confidence interval (CI) was considered.

$$n = \frac{(Z^2_{\alpha/2})p(1-p)}{d^2}$$

$$n = \frac{(1.96)^2 0.291(1-0.291)}{(0.05)^2}$$

$$n = 317 + (317x\ 10\%\ non-respondents) = 349 \approx 350$$

Where, n = sample size, Z = statistic for a level of confidence, p = expected prevalence or proportion, d = degree of precision.

So based on the standard sample size calculation, 10% non-respondent rate added, and the total of 350 samples were collected during the study period.

The study participants were selected conveniently among HIV/AIDS patients visiting ART department for regular follow up service during the study period. The study participants were evaluated for inclusion criteria and invited for the study.

After a written consent was obtained from the study participants, they were interviewed using questionnaire about their socio-demographic characteristics, and their exposure to risk factors of intestinal parasitosis. In addition, viral load counts were taken from their medical records of the most recent data within six months.

We also assessed KAP towards intestinal parasitosis by using yes or no questions targeting on the cause and transmission of the infection. The questionnaire was prepared in English and translated to the local language (Amharic). The questionnaire was checked for consistencies and completeness on thirty-five study participants in the same study population before the study period.

Inclusion and exclusion criteria

All HIV/AIDS patients registered for ART follow up program and volunteer to participate in the study were included, while those who were on anti-parasitic therapy within the last two weeks, those who registered for ART service with less than six months and didn't have viral load count within the last six (6) months were excluded from the study.

Laboratory Diagnosis Methods for Stool Sample

Stool sample collection

Instruction was given to each study participant not to contaminate the stool with urine, water and soil. In addition, they are also informed to collect forty gram of fresh stool sample or 10 ml of diarrheic sample with clean, wide mouthed, grease free and screw cupped plastic containers. Moreover, emphasis was given to diarrhea stool samples by giving priority due to its less time stability of trophozoites in the diarrheal stool sample. Besides, formed and semi-formed stool samples were preserved by 10% formalin for further examination by microscope and concentration techniques in case of unavoidable delay. Direct wet mount, Formol-ether concentration and smear for modified acid-fast staining techniques were performed as per the standard operating procedures (SOP) of each method soon after collection within 30 minutes (35) (*see supporting information for detail of SOP*).

Direct microscopy

A stool sample was collected in a labeled cup from all study participants and a direct saline wet mount of each sample was done immediately at the laboratory for motile trophozoites, ova, cyst, and larvae stage of intestinal parasites. The wet mounts were examined under a light microscope at 10X eye pieces and 40X objective (36).

Formol- Ether concentration technique

Formol-ether sedimentation technique, in which parasites are concentrated by centrifugal force, was applied to concentrate the parasite. Briefly, one gram of stool sample was placed in a clean 15ml volume capacity conical centrifuge tube containing 7ml 10% formalin and stirred with an applicator stick. The resulting suspension was filtered through a sieve into another conical centrifuge tube. After adding 3ml of diethyl ether to the stool containing formalin suspension, it was centrifuged at 3200 rpm for 3 minutes. The supernatant was poured away and the tube was being placed in its rack. Finally, the smear was prepared on clean grease-free microscope slide from the sediment, covered with cover slide and observed under a microscope with a magnification of 10x eyepieces and 40x objective (12, 35).

Modified Ziehl Nelson method

A small portion of the fresh stool sample was processed for the detection of opportunistic parasites using the modified Ziehl Nielsen method. Briefly, the thin smear was prepared directly from the sediment of concentrated stool and allowed to air dry. Then the slides were fixed with methanol for 5 minutes and it was stained with 1% carbol fuchsine for 30 minutes. After washing the slides with tap water, slides were being decolorized with 1% acid alcohol for 1–3 minutes and stained with 0.5% methylene blue for 1 minute. The slides were then washed with tap water and observed under a light microscope with a total magnification of 1000X (12). Slides were rechecked by senior experts at the Ethiopian public health institute (EPHI).

Data Analysis

The data were entered and analyzed using SPSS version-20 software. Descriptive and logistic regression statistics were used for data analysis. The mean, percentage, and frequency were used to see the distribution. The relative contribution of independent variables for the outcome variables was assessed using logistic regression. A P-value of less than 0.05 was considered as a statistically significant association between the presence of intestinal parasites and each contributing factor. The results of our findings were presented in text, graphs, and tables.

Quality Assurance

The questionnaires were checked for their consistencies and completeness on thirty-five study participants in the same study population before the study period. Internal quality control was also performed for each of laboratory techniques based on the quality control policy of Debre Brehan Referral Hospital Laboratory.

Operational Definition

Good knowledge: Individuals who answered ≥50% of the knowledge questions in the questionnaire.

Poor knowledge: Individuals who answered <50% of the knowledge questions.

Positive attitude: Individuals who answered ≥50% of the attitude questions.

Negative attitude: Individuals who answered <50% of the attitude questions.

Good practice: Individuals who answered ≥50% of the practice questions that supports IP prevention activities.

Bad practice: Individuals who answered <50% of the practice questions.

Intestinal parasitosis: A gastrointestinal infection caused by intestinal parasites

Ethical consideration

Ethical approval was obtained from ethical review committee of the Department of Medical Laboratory Sciences, College of Health Sciences, Addis Ababa University with a reference number MLS/02/2019. Permission letter was obtained from the institutional review board of Debre Brehan Referral Hospital. Written informed consent was taken from each study participants, and for children between 12 and 18 years old, both consent and assent were taken from their parents / guardians and children themselves respectively. The study participants were informed about their right to refuse or participate in the study, and withdraw at any time during the study period without affecting their right to access other health services. All personal information was kept confidential, and those who were positive for intestinal parasite were linked to the attending physician for further clinical management.

RESULTS

Socio-demographic characteristics of the study population

A total of 350 study participants living with HIV/AIDS were enrolled in the study. Of which 46.6% were males and 77.7% were urban residents. The mean ± SD age of study participants' was 37.04 ±12.99 years, ranged from 6-80 years (Table 1).

Prevalence of intestinal parasites

The overall prevalence of IP among people living with HIV/AIDS attending at the ART clinic in Debre Brehan Referral Hospital was 20.3% (71/350). Among these, *E. histolytica/dispar* accounted for the highest rank 47 (13.4%) followed by *G. lamblia* 10 (2.9%). Hookworm, *Ascaris lumburcoids*, *Hymenolepis nana*, *Tanea species* and *Strongyloid stercoralis* accounted the least frequency of infection having proportion of 3 (0.8%), 3 (0.8%), 2 (0.6%), 2 (0.6%) and 1 (0.3%) respectively.

Distribution of helminthes was dominated by protozoan parasites which accounted for protozoa 61 (82.4%) and helminthes 13 (17.6%). Most of the intestinal parasitic infections were single infections 68 (95.8%). On the other hand, multiple infections were seen in 3 (4.2%) of the study participants. Two of the co-infections were *E. histolytica/dispar* with Hookworm and one was *E. histolytica/dispar* with *G. lamblia*. In this study, no opportunistic parasite was identified (Fig. 1).

Table 1: Socio-demographic characteristics of PLWHA at Debre Brehan, Ethiopia, 2019.

Variables		Frequency	Percent
Gender	Male	163	46.6
	Female	187	53.4
Residence	Urban	272	77.7
	Rural	78	22.3
Age group	<= 15	8	2.3
	16-30	123	35.1
	31-45	138	39.4
	46-60	67	19.1
	>= 60	14	4.0
Marital status	Married	220	62.9
	Single	91	26
	Divorced	31	8.9
	Widowed	8	2.3
Educational status	No reading and writing	34	9.7
	Reading and writing	41	11.7
	Grade 1 - 8 complete	110	31.4
	Grade 9 - 12 complete	96	27.4
	College and above complete	69	19.7
Occupation	Agriculture	52	14.9
	Merchant	59	16.9
	Office work	58	16.6
	Daily wage laborer	49	14
	Student	44	12.6
	Driver	29	8.3
	House wife	47	13.4

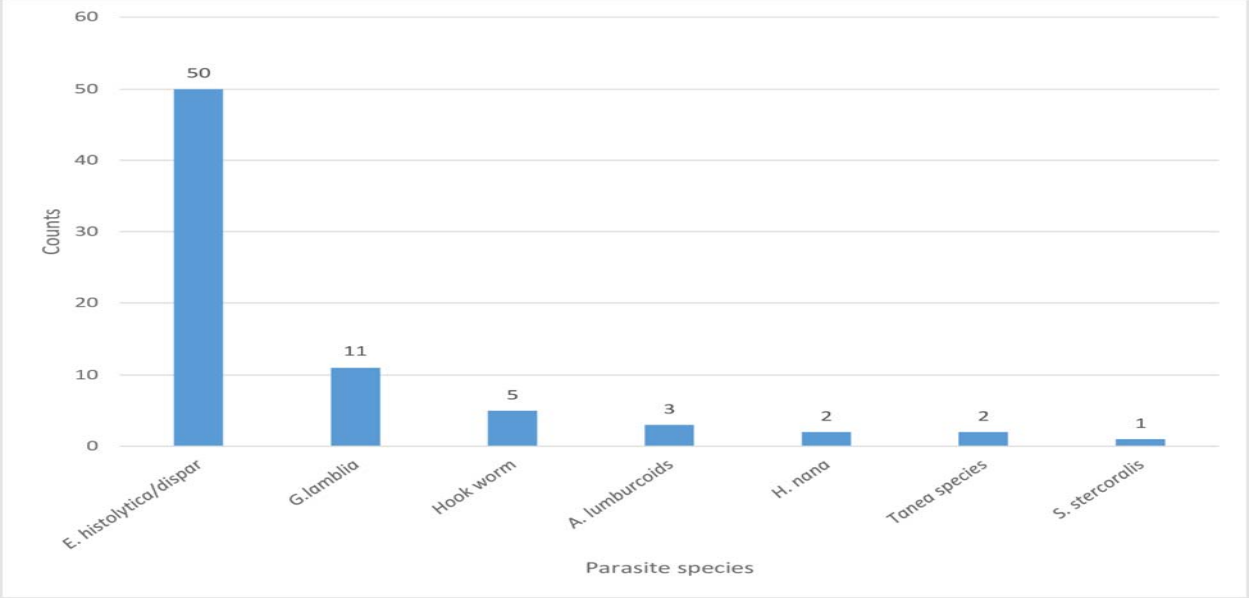

Figure 1. Intestinal parasite species distribution among people living with HIV/AIDS in Debre Brehan Referral Hospital, Ethiopia from March 01 to August 30, 2019.

Association of intestinal parasite infection with socio -demographic and other risk factors

As shown in the socio-demographic characteristics features of our study participants (Table 1) most of the study participants were urban residents (77.7%) and had the occupational status of trade and office work, 16.9% and 16.6% respectively.

From all study participants, 334 (97.7%) had regular hand washing habit with soap before and after the meal, and 323 (94.6%) of them had latrine. Among all participants, 319 (93.4%) had regular water supply and washed their hands after the toilet frequently. Most of the study participants had pure/tape water supply (88.8%), vegetable feeding habits (68.9%), raw meat eating habits (58.3%), and animal contacts in their living settings (60%) (Table 2).

Multivariate analysis was done to know the association of the potential confounding factors such as place of residence, type of occupation, presence of latrine/ toilet, source of water supply, and viral load levels with intestinal parasitosis. As a result, only the viral load level and availability of latrine showed a significant association. People living with HIV/AIDS who had viral load count >1000 cps/ml were almost four times more likely to develop parasitic infection than those who had viral load count results TND (target not detected) (AOR = 4.2, 95% CI: 1.4, 12.4) and those who did not have latrine were four times more likely to acquire intestinal parasite infection than those who had latrine in their home (AOR = 3.97, 95% CI: 1.3, 11.84) (Table 2).

Knowledge, attitude and practice of study participants towards intestinal parasitosis

Among all study participants, those whose age was greater than 15 years were interviewed for their knowledge, attitude, and practice towards intestinal parasitosis, N= 342 (97.7%). In general from these interviewed participants; 182 (53.2) had good knowledge about intestinal parasitosis, its transmission, and prevention mechanisms. Only 66 (19.3%) of the study participant understood the relationship between intestinal parasitosis and HIV/AIDS that all responded as HIV/AIDS increases the morbidity due to intestinal parasitosis (table 3).

Among 342 study participants, 260 (76%) considered IP infection as a communicable disease. The majority of them, 255 (72.9%) agreed on the transmission from person to person. From all respondents, 199 (58.2%) believed that HIV/AIDS increases the risk of acquiring intestinal parasite infection, and 147 (43%) believed that using antiretroviral treatment prevents intestinal parasite infection (table 4).

From study participants who responded for practice questions, 337 (98.5%) had regular hand washing habit with soap before and after the meal. The participants who had latrine were 323 (94.4%). Among all respondents, 303 (88.6%) had pure/tape water supply for drinking and sanitary use. The proportion of vegetable feeding habits of the study participant were about 237 (68.9%); of them, 211 (89%) ate vegetable by cooking (table 5).

Table 2: Prevalence of Intestinal parasitic infections with regards to socio-demographic information and other associated risk factors among PLWHA, Debre Brehan, Ethiopia, 2019.

Characteristics		Intestinal parasite		COR (95% CI)	P-value	AOR (95% CI)	P- value
		Positive (%)	Negative (%)				
Sex	Male	36 (22.1)	127 (77.9)	1			
	Female	35 (18.7)	152 (81.3)	0.81(0.48, 1.37)	0.43		
Age group	≤15	2 (25)	6 (75)	1.24(0.24, 6.53)	0.79		
	16-30	26 (21.1)	97 (78.9)	1			
	31-45	25 (18.1)	113 (81.9)	0.83(0.45, 1.5)	0.54		
	46-60	14 (20.9)	53 (79.1)	0.98(0.47, .05)	0.97		
	≥60	4 (28.6)	10 (71.4)	1.49(0.43, 5.1)	0.53		
Residence	Urban	46 (16.9)	226 (83.1)	1		1	
	Rural	25 (32.1)	53 (67.9)	2.3(1.3, 4.1)	0.004	1.45 (0.55,3.86)	0.45
Educational status	Unable to read and write	8 (23.5)	26 (76.5)	1.21(0.45, 3.24)	0.71		
	Read and write	9 (22)	32 (78)	1.1(0.43, 2.84)	0.83		
	Grade 1-8	22 (20)	88 (80)	0.98(0.46, 2.1)	0.96		
	Grade 9-12	18 (18.8)	78 (81.2)	0.9(0.42, 1.97)	0.8		
	College and above	14 (20.3)	55 (79.7)	1			
Occupational status	Farmer	19 (36.5)	33 (63.5)	3.13(1.3, 7.8)	0.014	1.5(0.45, 5.1)	0.5
	Merchant	13 (22)	46 (78)	1.54(0.6, 3.94)	0.37	1.33(0.5, 3.6)	0.57
	Daily worker	5 (10.2)	44 (89.8)	0.62(0.19, 1.99)	0.42	0.5(0.15, 1.6)	0.25
	Student	10 (22.7)	34 (77.3)	1.6(0.59, 4.36)	0.357	1.37(0.48, 4.0)	0.56
	Driver	6 (20.7)	23 (79.3)	1.42(0.45, 4.47)	0.55	1.5(0.48, 4.99)	0.47
	House wife	9 (19.1)	38 (80.9)	1.29(0.47, 3.56)	0.62	0.85(0.28, 2.58)	0.78
	Office work	9 (15.5)	49 (84.5)	1		1	
Availability of latrine	Yes	58 (18)	265 (82)	1		1	
	No	11 (57.9)	8 (42.1)	6.21(2.4, 16.1)	<0.001	3.97(1.33, 11.84)	0.013*
Source of water supply	Pipe	55(18.3)	248(81.7)	1		1	
	Pond	11(35.5)	20(64.5)	2.45(1.11,5.4)	0.026	1.1(0.4, 3.24)	0.83
	Spring	3(37.5)	5(62.5)	2.67 (0.62,11.5)	0.19	1.1(0.18, 6.1)	0.95
Viral load	TND	44(17.7)	205(82.3)	1		1	
	<20 cps/ml	10(19.2)	42(80.8)	1.1(0.52, 2.4)	0.79	1.0(0.45, 2.27)	0.99
	20-1000 cps/ml	9(30)	21(70)	1.99(0.86, 4.65)	0.11	2.4(0.94, 6.1)	0.07
	>1000 cps/ml	8(42.1)	11(57.9)	3.4(1.3, 8.9)	0.013	4.2(1.4, 12.4)	0.009*

TND: Target not detected, **cps/ml**: copies/milliliter, **COR**: Crude odd ratio, **AOR**: Adjusted odd ratio, **CI**: confidence interval, ***** statistically significant

Table 3: Knowledge of PLWHA about transmission and prevention of intestinal parasitosis, Debre Brehan, Ethiopia, 2019.

Knowledge variables (Total no N)	**Yes number (%)**	**No number (%)**
Knowledge about intestinal parasitosis (342)	200 (58)	142 (42)
Knowledge about the relationship between intestinal parasitosis and HIV/ AIDS (342)	66 (19.3)	276 (80.7)
Knowledge about the transmission ways of intestinal parasitosis (342)	189 (55.3)	153 (44.7)
Source of information about intestinal parasitosis (200):		
Parent	20 (10)	
Friends	44 (22)	
Reading books and journals	95 (47.5)	
Mass media	41 (20.5)	
Response for the most common transmission ways of IP (189):		
By eating contaminated food	172 (91)	
By drinking contaminated water	16 (8.5)	
By lack of personal hygiene	1 (0.5)	
Knowledge about the best treatment for intestinal parasitosis (342):		
Medicine prescribed by Doctors	326 (95.3)	
Traditional medicine	13 (3.8)	
No treatment required	3 (0.9)	
Overall knowledge level		
Good knowledge(N=342)	182 (53.2)	
Poor knowledge (N=342)	160 (46.8)	

Table 4: Attitude of PLWHA about transmission and prevention ways of IP infection, Debre Brehan, Ethiopia, 2019.

Attitude variables (N=342)	**Agree (No (%))**	**Disagree (No (%))**	**No idea (No (%))**
IP infection is communicable disease.	260 (76)	9 (2.6)	73 (21.3)
IP infection can be transmitted from person to person	255 (72.9)	8 (2.3)	79 (22.6)
HIV/AIDS increases the risk of IP infection	199 (58.2)	15 (4.4)	128 (37.4)
IPI can cause severe complications and death if not treated	264 (77.2)	25 (7.3)	53 (15.5)
Use of antiretroviral treatment prevents IP infection	147 (43)	36 (10.5)	159 (46.5)
Use of toilet and good personal hygiene practice protects from IP infection	317 (92.7)	4 (1.2)	21 (6.1)
If not protected well, water can be a potential source of IPI	312 (91.2)	7 (2)	23 (6.8)
Raw meat should not be eaten, since it can transmit IPI	226 (66.1)	54 (15.8)	62 (18.1)
Without cooking, washing vegetables is enough to prevent IPI	63 (18.4)	240 (70.2)	39 (11.4)
IP infection can be acquired from animal and animal products	266 (77.8)	4 (1.2)	72 (21)
Overall attitude level			
Positive attitude (N=342)	289 (84.5)		
Negative attitude (N=342)	53 (15.5)		

Table 5: Practices of PLWHA related to prevention and control of IP infections, Debre Brehan, Ethiopia, 2019.

Practice variables (342)	Yes (no(%)	No (no(%)
Hand washing before and after meal (342)	337 (98.5)	5 (1.5)
Availability of latrine (342)	323 (94.4)	19 (5.6)
Type of latrine (323)		
Private	282 (87.3)	
Public	41 (12.7)	
Source of water supply (342)		
Pipe water	303 (88.6)	
Pond	31 (9.0)	
Spring	8 (2.4)	
Vegetable eating habit (342)	237 (69.3)	105 (30.7)
Vegetable feeding methods (237)		
Raw vegetable without washing.	3 (1.3)	
By washing	23 (9.7)	
By cooking	211 (89)	
Raw meat eating habit (342)	145 (42.4)	197 (57.6)
Animals living with humans (342)	206 (60.2)	136 39.8)
Overall practice level		
Good practice (N=342)	314 (91.8)	
Bad practice (N=342)	28 (8.2)	

This study showed that 182 (53.2%) of the study participants had good knowledge and 160 (46.8%) of the participants had poor knowledge, 289 (84.5%) had a positive attitude while 53 (15.5%) had a negative attitude and study participants also had good practice 314 (89.7%) and poor practice 28 (10.3%) about transmission, prevention and control of intestinal parasites. Although the knowledge and attitude of study participants didn't show an association, the overall performance of health practices was significantly associated with intestinal parasitosis. Persons who had poor health practices towards intestinal parasitosis were almost three times more likely to develop intestinal parasitosis than persons with good health practices related to transmission and prevention of IPI (AOR = 2.88, 95% CI: 1.2, 6.88).

DISCUSSION

This study determined the prevalence of intestinal parasites, assessed potential associated risk factors and awareness of the study participants about the transmission, prevention, and control of the disease in Debre Brehan, Central Ethiopia. In the present study, the overall prevalence of IP among PLWHA following ART treatment and care programs in the study area was 20.3% (71/350). This was relatively consistent with studies performed in Dessie Hospital on ART patients, Ethiopia (17.6%) (12), in Abuja, Nigeria (24.7%) (14), and Hospital of Kathmandu, Nepal (19.17%) (4). On the other hand, our finding was much lower compared to studies conducted in different parts of Ethiopia; Arbaminch Hospital, (45.4%), East Gojjam, (36.8%), Butajira, (35.9%) and Gondar Hospital, (28%) (3, 18, 26, 37).

Our findings were higher when it also compared with previous studies among non-HIV persons, revealed as IP infection in Kobo Health Center, 10%, 2014 (38), Debre Brehan Referral Hospital, 17.4%, 2014 (34) and Debre Brehan, 9.8%, 2016 (39) in Ethiopia. This variation in the magnitude of parasitic infection might be due to the difference in the geographical location of the study site, endemicity of parasite, HIV status of the study participants, methodology, time gaps of the studies, and climatic conditions at different study sites. Also, the lower IP prevalence in our findings might be due to increment in awareness of PLWHA and improvements in the clinical management system.

The parasite distribution of single infections was observed in which *E. histolytica/dispar (*69.1%*)* showed higher proportion when compared to other studies in Dessie, Ethiopia (45.5%), East Gojjam, Ethiopia (24%), and Arbaminch, Ethiopia (7.4%) (3, 12, 18). However, the other parasite's frequency in our study *G. lamblia* (14.7%), *A.lumburcoids* (4.4%), and *S. stercoralis* (1.5%) were lower than a study conducted in Dessie, East Gojjam, and Arbaminch(3, 12, 18). There was no opportunistic parasite in this study similar with the study conducted in Dessie (12), but studies in Arbaminch, East Gojjam, and Butajira revealed the highest number of opportunistic parasitic infections observed as 20%, 4.9%, and 8.7% respectively (3, 12, 18).

The difference in frequency of individual parasites might be due to the difference in geographical location, altitude, the climatic condition of study areas, and hygiene and sanitation practice of study population. Furthermore, the decrement of opportunistic infections especially *Cryptosporidium species* and *I. belli* suggested an increase in the health-seeking behavior of the community.

Intern resulted in good adherence of HIV/AIDS clients to ART treatment and care programs. An improvement in the immunologic conditions of the patients and better response to infections also might be the reason. Opportunistic parasites were known to be resolved spontaneously with immune restoration among HIV/AIDS patients on ART (1).

Study participants who had a viral load count >1000 cps/ml had higher IP infections when compared to patients with <1000 cps/ml viral load counts. In this study, study participants who had viral load count of > 1000 cps/ml were about four times more likely to be infected with intestinal parasites than those who had a viral load counts Target not detected (AOR = 4.2, 95% CI: 1.4, 12.4). This showed that increased viral load counts of the study participants contributed to the acquisition of intestinal parasite infections.

The other association was with the availability of latrine, where our study indicated that 323 (94.6%) of the study participants had latrine in their home. This study revealed that participants who did not have latrine were four times more likely to be infected with intestinal parasite than those having latrine (AOR = 3.97, 95% CI: 1.33, 11.84). This result was in line with a study in Gondar, Ethiopia that study participants didn't have latrine were six times more likely infected with IP than those having latrine (AOR = 6.2, 95% CI: 1.75, 22.06) and also supported by a similar study in Dessie, Ethiopia that patients who did not have latrine had IP infections almost 8 times more likely than those having latrine (AOR = 7.56, 95% CI: 1.3, 44.2) (12). These relative comparable results suggested the similarities in accessibility and using habit of the toilet in those study sites.

In this study, knowledge, attitude, and practice of the individual participants towards intestinal parasitosis were assessed using a structured questionnaire. As a result, 53.2% of study participants had good knowledge about transmission, distribution, and prevention of intestinal parasitosis and its association with HIV/AIDS whereas the remaining 46.8% had poor knowledge. About 189 (55.3%) of study participants knew the transmission ways of intestinal parasitosis. Of which, 172 (91%) understood that it was through eating contaminated foods.

This result was slightly higher than the study conducted in Addis Ababa, Ethiopia in which 49.4% understood the transmission ways and 63.5% of them believed transmission was through contaminated foods (40). This variation might be due to the socio-demographic difference of study participants and the time gap of studies. About 92.7% of study participants agreed that the use of toilets contributes to protecting individuals from intestinal parasitic infections or failure to use toilet exposes for the infection. This result was higher compared to the study in Asmara, Eritrea provided that 60.3% of study participants agreed that defecating in the open air or fail to use toilet contributes to intestinal parasitic infections (20). The difference might be due to the difference in the pathological outcome of the endemic intestinal parasite species in the study sites.

The current study revealed that 98.5% (337/342) of study participants had practiced hand washing before a meal and 94.4% (323/342) of study participants had a latrine. Of latrine users, 87.3% (282/323) had private latrine while 12.7% (41/323) had a public latrine. This result was higher compared to another study among street dwellers conducted in Addis Ababa, Ethiopia shown that 15.6% of the study participants practiced regular hand washing before a meal and 95% had a latrine. Of these latrine users, 56.5% had private latrine and 38.5% had public latrine (40). The difference might be due to variation in the economic and educational level of the study participants.

Health practices of the study participants were significantly associated with intestinal parasitosis. Persons who had poor health practices towards intestinal parasitosis were almost three times more likely to develop intestinal parasitosis than persons with good health practices related to transmission and prevention of IPI (AOR = 2.88, 95% CI: 1.2, 6.88).

Limitation of the study

- According to the current national treatment protocol every person tested for HIV and results become positive needs to start treatments immediately. Due to this reason, it was difficult to get any ART naïve PLWHA during the study period and unable to analyze the outcomes comparatively for both groups of ART status.
- There was no CD4 count data available during the study period instead only viral load count had been used and analyzed.
- Advanced molecular diagnostic methods were not implemented that would increase the detection of opportunistic parasites.
- Non-probability sampling method has been used in this study that limits the chance of getting equal opportunity of the participants to involve in the study.

Conclusion

This study updated the prevalence of intestinal parasites and associated risk factors among people living with HIV/AIDS following ART treatment in the study area. In the study *E. histolytica/dispar* and *G. lamblia* showed greater proportion of parasite distribution. The absence of latrine and increased viral load count for PLWHA were identified as the potential risk factors for the acquisition of intestinal parasitic infections. The study showed that most of the study participants had positive attitude, good practices and poor knowledge related to the transmission and prevention activities of intestinal parasitosis. Health practices of the study participants related to transmission and prevention showed significant association with intestinal parasitosis. Thus to reduce the disease burden, the community health workers, other government officials, and related stakeholder give attention on increase awareness of latrine use, importance of strict follow up of clinician advice which help to reduce viral load count, and avoid bad health practice, as well as encourage frequent diagnosis of patients to decrease the burden of intestinal parasites among PLWHA.

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Supplementary Materials

All supplementary materials used during the study are archived with this manuscript. These are: information sheet that enables the study participants to be introduced about the study, questionnaires that used to gather information from study participants, informed consent/assents that guarantees the permission of the participants to use their information/ sample for the study and SOPs are the short descriptions of the procedures and principles of the laboratory methods.

Conflict of interest:

The authors has no conflict of interest to declare.

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