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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

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Abstract

Human Immunodeficiency Virus (HIV) and intestinal parasitic infections are among the main health problems in developing countries like Ethiopia. Particularly, co-infections of these diseases would worsen the progression of HIV to Acquired Immunodeficiency Syndrome (AIDS). The purpose of this study was to determine the magnitude and risk factors for intestinal parasites in relation to HIV infection and immune status. The study was conducted in (1) HIV positive on antiretroviral therapy (ART) and (2) ART naïve HIV positive patients, and (3) HIV-negative individuals, at All African Leprosy and Tuberculosis (TB) Eradication and Rehabilitation Training Center (ALERT) hospital in Addis Ababa, Ethiopia. Study participants were interviewed using structured questionnaires to obtain socio-demographic characteristics and assess risk factors associated with intestinal parasitic infection. Intestinal parasites were identified from fecal samples by direct wet mount, formol ether concentration, and modified Ziehl–Neelsen staining techniques. The immune status was assessed by measuring whole blood CD4 T-cell count. The overall magnitude of intestinal parasite was 35.08%. This proportion was different among study groups with 39.2% (69/176), 38.83 % (40/103) and 27.14 % (38/140) in ART naïve HIV positives patients, in HIV negatives, and in HIV positive on ART patients respectively. HIV positive patients on ART had significantly lower magnitude of intestinal parasitic infection compared to HIV negative individuals. Intestinal helminths were significantly lower in HIV positive on ART and ART naïve patients than HIV negatives. Low monthly income, and being married, divorced or widowed were among the socio-demographic characteristics associated with intestinal parasitic infection. No association was observed between the magnitude of intestinal parasites and CD4 T-cell count. However, *Cryptosporidium parvum,* and *Isospora belli* were exclusively identified in individuals with CD4 T-cell count of $\leq$ 350 cells/mm^3. Regular provision of mass preventive

chemotherapy and extended health education will curb the burden of intestinal parasitic infection in the community. Emphasis should also be given to laboratory diagnosis and identification of opportunistic intestinal parasites in patients with lower CD4-Tcell count.

Keywords

Intestinal parasites, HIV status, Immune status, Risk factors, CD4 T-cell count, Ethiopia

1. Introduction

Human Immunodeficiency Virus (HIV) is a major cause of morbidity and mortality in Ethiopia. It has been estimated that in the year 2010, more than one million individuals were living with HIV. The national prevalence of HIV was 1.5 % and varied between geographical regions of Ethiopia being higher in Gambela region (6.5 %) and Addis Ababa (5.2 %) [1]. Overall, the prevalence of HIV in Ethiopia has been declining steadily with a few exceptions in small towns and markets. The incidence rate has also remained stable from 2001 to 2010. The rate was 0.99 % and 0.12 % in urban and rural areas, respectively [2].

On the other hand, intestinal parasitic infection caused by helminths and protozoan parasites are among the most frequent worldwide infection in humans, being highly widespread in developing countries [3, 4]. Intestinal parasitic infection is one of the main problems for HIV infected patients, as their immune response to intestinal helminths would shift the T-helper 1 (Th1)/Th2 balance to Th2, thus accelerating the progress from HIV infection to AIDS [5]. In addition, intestinal protozoan parasites like *Entamoeba histolytica, Giardia lamblia, Cryptosporidium parvum,* and *Isospora belli* would cause severe and threatening diarrhea in HIV/AIDS patients [6, 7].

The magnitude of intestinal parasitic infection in HIV/AIDS patients remained controversial. Some studies indicate that the magnitude of intestinal parasites was significantly higher in HIV infected patients than HIV negative controls [8-10]. In contrast, others showed there would be no significant difference in magnitude of intestinal parasites between the HIV positive and negative groups [11-13]. However, the patterns of individual protozoan and helminths was found to differ among HIV positive and HIV negative patients in which intestinal protozoans were found to be

significantly higher in HIV infected than HIV negatives, while helminths were significantly lower in HIV infected patients [14-18].

Given the variability of intestinal parasitic infection and their risk factors according to geographic locations and environmental situations [19], there is limited information on the magnitude of intestinal parasites and their risk factors in relation to HIV infection and immune status in Addis Ababa, Ethiopia.

Here, we reported the magnitude , risk factors and distribution of intestinal parasites in three groups of HIV status (HIV positive patients with and without treatment and HIV negatives) and the distribution of individual intestinal parasites in relation to immune status (CD4 T-cell count < 350 cells /mm^3, 351-500 cells /mm^3, and > 500 cells /mm^3).

2. Materials and Methods

2.1. Study design, site and participants

A comparative cross-sectional study was conducted among patients attending the clinical laboratory of All African Leprosy and Tuberculosis (TB) Eradication and Rehabilitation Training Center (ALERT) hospital, Addis Ababa, Ethiopia. The patients were referred from three distinct hospital's clinics namely: the Antiretroviral Therapy (ART) clinic, the Voluntary Counseling and Testing (VCT) center, and Provider Initiative Counseling and Testing (PICT) center from May 9th to August 31st, 2007. The hospital is found in the Kolfe Keranio sub-city of Addis Ababa which has a population size of 546, 219 in 61.25 km^2 area [20]. In the sub-city, the ALERT hospital is the main referral center for the surrounding health centers and clinics for ART service. Patients attending the clinical laboratory of the hospital for CD4 T-cell count and HIV testing were involved in the study. The study participants were selected systematically, i.e. every third HIV

positive patient (either HIV positive on ART or ART naïve HIV positive) who visited the laboratory for CD4 T-cell count and every 2nd HIV negative individual at VCT center were included in the study. HIV patients on ART were HIV positive patients with at least 6 months of continuous therapy that had been subjected to various laboratory investigations including CD4 T-cell count. ART naïve HIV positive patients were those who had never started HIV therapy and were referred to the ART clinic either from VCT / PICT or from surrounding health centers or clinics and sent to the hospital laboratory for pre-ART laboratory investigations including CD4 T-cell count. In addition, HIV positive patients who had never started ART, but had undergone regular checkups for their CD4 T-cell count level were also assigned under this group. HIV negatives were individuals who knew their HIV status from the VCT/PICT clinic after attending the laboratory for HIV screening tests.

2.2. Data collection for socio-demographic and risk factors

Data on socio-demographic characteristics (age, sex, marital status, religion, ethnicity, educational background, occupation and monthly income) and potential risk factors for intestinal parasitic infection (sources of water and personal hygiene) were collected by interview using structured questionnaires. The interviews were administered by the principal investigator during sample collection at ALERT hospital laboratory.

2.3. Fecal sample collection and processing

A single fresh fecal sample was collected in a clean wide mouth container and intestinal parasites were identified using direct wet mount, formol ether concentration and modified Ziehl–Neelsen staining as described elsewhere [10, 13]. Briefly, direct wet mount microscopy was performed by smearing a well-mixed and small amount of fecal sample (~2 mg) on a glass slide with normal saline solution and cover slide. Then the slide was examined with light microscope (Olympus BH-

2) using 10X and 40X objectives. Actively motile protozoan parasites together with other helminths were identified based on motility and morphological structure. Differentiation of *Entamoeba histolytica* and *Entamoeba dispar* was made by identification of engulfed red blood cells and by staining the nuclei. The remaining fecal sample was subjected to the formol ether concentration technique. Briefly, a portion of fecal sample was mixed with 10% formalin solution and sieved through double layered gauze. The filtrate was transferred to a 15ml volume plastic test tube and formalin was added to reach the volume of 12ml and 3ml of diethyl ether was added. Then the tube was shook vigorously and centrifuged for 5 minutes at 3000 rpm. The sediments were observed under light microscope (Olympus BH-2) using 10X and 40X objectives. A portion of the pellet was smeared on a glass slide and stained with Ziehl–Neelsen staining methods to look for *Cryptosporidum species* and *Isospora belli*. The stained slides were examined under microscope using 100X oil immersion [10, 13].

2.4. CD4 T-cell count

The immune status of the participants were evaluated by measuring the CD4 T-cell count and classified into three groups ($\leq$ 350 cells /mm^3, 351 to 500 cells /mm^3 and > 500 cells /mm^3) according to the new WHO guideline [21]. Results of CD4 T-cell count were obtained from the laboratory registration book corresponding to each HIV positive study participant. For HIV negative individuals, upon knowing their status at VCT clinic, every 2nd HIV negative individual was asked to participate in the study. Voluntary participants gave signed consent so their HIV tested blood samples could be used for CD4 T-cell count. HIV screening results were ready within 30 minutes and CD4 T-cell counts were performed within 2 hours of sample collection. All blood and fecal samples were collected in the morning and the results were ready in the early afternoon of the same day.

2.5. Quality assurance

The questionnaires were pre-tested, allowing appropriate amendments before the actual data was collected. Known positive fecal samples of *Cryptosporidium parvum, Cyclospora cayetanensis* and *Isospora belli* were used as positive control to ensure proper parasite identification in our specimens. In addition, some of our positive and negative samples were verified by experienced senior laboratory technologist and experts from the parasitology laboratory in the Ethiopian Health and Nutrition Research Institute (EHNRI). The accuracy of CD4 T-cell count was cross checked at EHNRI and St. Peter specialized hospital.

2.6. Data analysis

Questionnaires and laboratory data were sorted, entered into Microsoft Access and exported to the statistical software, STATA version 11 for analysis. Descriptive statistics, Pearson Chi-square test, Fisher's exact test, Bivariate and Multivariate logistic regression were used to describe and measure the associations between variables where appropriate. Crude and adjusted odds ratios were also used to measure the level of association. Level of significance was determined at 95% confidence interval or at p-value < 0.05.

2.7. Ethical Consideration

This study was conducted after ethical clearance was obtained from the departmental research and Ethics review committee of department of Medical Laboratory Science, College of health sciences, Addis Ababa University. Official permission was obtained from the ALERT hospital administration and the ART clinic. All patients came for personal clinical health care and were then referred to the laboratory for further investigation. The laboratory then called for volunteers to participate in this study by obtaining a written consent from each participating patients. Those who

were found to be infected with intestinal parasites were sent to the ART and VCT / PICT clinics to be treated with standard dose of anti-helminths and anti-protozoan drugs.

3. Results

3.1. Socio-demographic data

Of the 422 study participants enrolled, 419 participated in the study yielding a response rate of 94.8 %. Their age ranged from 2 to 65 years with mean and median ages of 32 (+/-11) and 30, respectively. Sixty-two percent (260/419) of the participants were females. Among the 419 study participants, 75.4 % (316) were HIV positive, while 24.6 % (103) were HIV negative. In the HIV positive group, 55.7 % (176) were ART naïve and 44.3 % (140) were on ART. The majority of the study participants were residents of Addis Ababa, about 92.4 % (387/419) Christian by religion, about 72.3 % of the study subjects were literate. On the other hand half, 51 % (212/419) of the study participants were not engaged in any kind of work or occupation. Open field was also used as latrine by 5.7 % (24/419) of the study participants (Table 3.1).

3.2. Magnitude and risk factors of intestinal parasitic infection

The overall magnitude of intestinal parasites was 35.08 % (147/419). Of the 147 infected patients 80.95 % (119/147), 17.69 % (26/147), and 1.36 % (2/147) had single, double and triple infections respectively. The overall magnitude of diarrhea was 18.6 % (78/419) and parasitic infection among patients with diarrhea was higher 42.31 % (33/78) than patients without diarrhea 33.43 % (114/341) (p=0.051).

The magnitude of intestinal parasitic infection was 33.86 % (107/316) in all HIV positive patients and 38.83 % (40/103) in HIV negative individuals (AOR=0.544, 95 % CI (0.305, 0.970), p=0.039). This showed significantly lower magnitude of intestinal parasites in HIV positive patients than HIV negative controls. When we looked in to the three groups of HIV status, the

magnitude of intestinal parasites was 39.20% (69) in ART naïve HIV positive patients, 38.83 % (40/103) in HIV negatives, and 27.14 % (38/140) in HIV positive on ART patients. The magnitude of intestinal parasitic infection was slightly higher in ART naïve HIV positive individuals than HIV positive on ART and HIV negatives.

Compared to HIV negative individuals, HIV positive patients on ART showed a significantly lower magnitude rate of intestinal parasitic infection (AOR=0.429, p=0.013) (Table 3.1). When compared to HIV positives on ART, the odds of being infected by intestinal parasites is 2.3 times (p=0.013) higher in HIV negatives. On the other hand, no significant difference was observed in magnitude of intestinal parasites between HIV negative and HIV positive ART naïve patients (AOR=0.682, p= 0.209). Similar trend was observed between HIV positives on ART and HIV positive ART naïve patients (AOR=1.486, p=0.153). Detailed description of the magnitude of intestinal parasitic infection and its association with socio-demographic characteristics and other possible risk factors is shown in Table 3.1.

After adjusting for all socio-demographic characteristics and potential confounding variables; monthly income and marital status were significantly associated with intestinal parasitic infection. Low monthly income was highly associated with intestinal parasitic infection, in which those who had monthly income above 600 Ethiopian Birr (equivalent to $75 USD at the time of study) per month had significantly lower magnitude of intestinal parasitic infection (AOR=0. 120, p=0.002) compared to those who earned less than 150 Ethiopian Birr ($18.75 USD) per month (Table 3.1). In addition, participants who were married, divorced, or widowed had significantly higher magnitude intestinal parasitic infection than singles (Table 3.1).

3.3. Distribution of individual intestinal parasites in relation to HIV status

The present study identified a total of 11 pathogenic intestinal parasites shown in detail in Table 3.2. The distribution of individual intestinal parasites varied with HIV status of study participants. Any helminths (p=0.02), *Ascaris lumbricoides* (p=0.005) and Hookworms (p=0.021) were lower in HIV positive patients than HIV negative controls, while *Giardia lamblia* was significantly higher in HIV positives (p=0.001). Similarly, the distribution of helminthic and protozoan parasites was found to be different in three groups of HIV status. Protozoan parasites were more common in HIV positive ART naïve patients (p=0.05) while helminthic infections were higher in HIV negative individuals than the other groups (p=0.02) (Table 3.2). However, after adjusting for all other variables and intestinal parasites, infections with *Ascaris lumbricoides* and any helminths were found to be associated with HIV status (Table 3.3). Compared to HIV negative individuals, HIV positive on ART and ART naïve HIV positive patients have low magnitude of helminthic infection.

3.4. Distribution of individual intestinal parasites in relation to CD4 T-cell count

Out of 419 study participants with CD4 T-cell count, 216, 62, and 141 subjects had CD4 T-cell count $\leq$ 350 cells/mm^3, 351-500 cells/ mm^3, and > 500 cells/ mm^3, respectively (Table 3.4). As expected, 91.26 % (94/103) of HIV negative individuals had CD4 T-cell count > 500 cells/ mm^3. On the other hand, the majority of HIV positive patients had CD4 T-cell count $\leq$ 350 cells/mm^3 ($p<0.001$).

Overall, no association was observed between the magnitude of intestinal parasites and CD4 T-cell count (p=0.362). Adjusting for socio-demographic characteristics, risk factors and HIV status did not change the association. In addition, the distribution of individual intestinal parasites did not

show significant difference with CD4 T-cell count category (Table 3.4). Furthermore, intestinal parasitic co-infections (single, double and triple infections) were not associated with CD4 T-cell count category. However, opportunistic parasites like *Cryptosporidium parvum* and *Isospora belli* were identified exclusively in patients with CD4 T-cell count $\leq$ 350 cells/mm^3.We have also seen whether intestinal parasitic co-infection (double or triple infections) were associated with HIV or immune status. Patients with double or triple parasitic infection were neither associated with HIV status (p=0.26) nor with immune status (p=0.42) of the study participants.

4. Discussion

Intestinal parasitic infection is highly prevalent in Ethiopia and it has been one of the major health problems in HIV infected individuals [13, 14]. Investigation of the magnitude of intestinal parasites and identification of their potential risk factors in relation to HIV and host immune status is critically important for the management and control of both HIV and intestinal parasitic diseases. The present study therefore documented the magnitude and risk factors of intestinal parasites in HIV positive patients on ART, ART naïve HIV positive patients and HIV negative individuals. In addition, it would also shed light on the patterns of individual parasites in relation to immune status or CD4 T- cell count.

In our study, the overall magnitude of intestinal parasites was high in the study area. This result is comparable with studies conducted in Jimma hospital, southwest Ethiopia [13]. On the other hand, our result was higher than studies from Cameroon (14.64%) [22], and Nigeria (22.7%) [11]. The higher proportion of intestinal parasites in our case may be due to the difference in geographical and environmental conditions. In addition, the lower access to water supply and sanitation in Ethiopia may contribute to the high magnitude of intestinal parasites. In contrast, our finding was

lower than studies conducted in Bahir Dar (69%) [14] and another study in Jimma (62.5%), Ethiopia [15]. The increased magnitude in Bahir Dar and Jimma studies could be due to the involvement of a higher proportion of rural participants who would have had high exposure to intestinal parasitic infection due to poor sanitation, untreated water supply and close contact to animals compared to our urban study participants [23].

Lower proportion of intestinal parasites in the current study to HIV positive patients than HIV negative controls was in contrast with other studies in Bahir Dar [14], Jimma [13, 15], Hawassa [8], and Cameron [22]. On the other hand, the lower magnitude in HIV positive on ART patients was in agreement with studies conducted by Missaye et al [23] and Bachur et al [24]. Significantly reduced magnitude of intestinal parasites in HIV positive patients on ART than HIV negatives could be due to provision of anti-helmenthic drugs and prophylactic agents like cotrimoxazole for patients on ART or the direct effect of ART on intestinal parasites [24, 25]. Furthermore, the frequent advice given to HIV positive patients on ART on how to care for their overall health by healthcare providers during their frequent visit could contribute for lower magnitude of intestinal parasites.

Similar to our findings, no difference in magnitude of intestinal parasitic infection between HIV positive ART naïve and HIV negative controls has been reported in Jimma, Ethiopia [13, 15], Nigeria [11], Mazandaran province, Iran [12]. However, this may still have significant clinical impact for HIV patients as infections with intestinal parasites would accelerate the progression from HIV to AIDS [5-7, 26].

The association of intestinal parasitic infection with monthly income and marital status in the present study was comparable with studies conducted by Mehraj *et al.,* in Pakistan and Ngui *et al.,*

in Malesia [27, 28] which showed poverty and low socioeconomic conditions to be important risk factors for intestinal parasitic infection. The significantly lower magnitude of intestinal parasitic infection observed among participants earning relatively higher monthly income was not a surprise since higher income is one of the indicators for better health care, good personal hygiene and living conditions [29-31]. On the other hand, low household income was usually associated with poor health [32] and high intestinal parasitic infection [27, 28].

Decreased helminthic infections in HIV positive patients in our investigation was similar to studies in Tanzania [33] and Malawi [34]. This may be due to reduced egg excretion of helminths in HIV infected patients like Schistosomes. The reduced egg excretion may cause low detection rate of these parasites in fecal sample resulting in lower magnitude [35, 36]. Nevertheless, studies involving egg count of helminths need to be carried out to verify the magnitude of egg excretion reduction in individuals living with HIV/AIDS. On top of these, ART naïve HIV patients who were on regular checkup for CD4 T-cell counts may take cotrimoxazole prophylaxis that would contribute to the low magnitude of helminthiases [25].

The higher magnitude of protozoan parasites including *Giardia lamblia* in HIV positive ART naïve patients in the present study was also in agreement with studies conducted in China [16], Brazil [37], and Indonesia [38], even though this was not consistent after adjusting for other variables.

The magnitude of opportunistic intestinal parasites like *Cryptosporidium parvum* in our study was similar with studies conducted in Brazil [39] and Iran [40]. Additionally, the proportion of *Strongyloides stercoralis* and *Isospora belli* were in line with studies conducted in Jimma, Ethiopia [13], India [41] and Democratic Republic of the Congo [42]. However, it was lower than

reports from Bahir Dar [14], Hawassa [8], Iran [43] and Malaysia [44]. This might be due to the difference in populations, sanitary condition, and geographic areas.

Like our results, Abuye *et al.,* also reported that as there is no significant association between intestinal parasites and CD4 T-cell count [45]. Even though it is not statistically significant in our investigation, identification of opportunistic parasites like *Cryptosporidium parvum,* and *Isospora belli* had been common in immunocompromised HIV patients [8, 23, 46, 47].

In conclusion, our findings showed that the overall magnitude of intestinal parasites is high in the study area. The magnitude of intestinal parasites was significantly lower in HIV positive patients on ART than HIV negative individuals. On top of these, intestinal helminths were significantly lower in HIV positive on ART and ART naïve patients than HIV negative controls. The distribution of individual parasites in different groups of immune status also revealed none of the intestinal parasites were significantly associated with CD4 T-cell count. However, *Cryptosporidium parvum,* and *Isospora belli* were exclusively found in immunocompromised patients with CD4 T-cell count $\leq$ 350 cells/mm^3. Since regular provision of mass preventive chemotherapy would reduce helminthiases in both HIV positives and negatives, deworming needs to be reinforced in the country. Moreover, routine examination and treatment of protozoan parasites shouldn't be neglected in HIV positive patients. There is also a need to extend the organized health education on intestinal parasites currently offered to individuals living with HIV/AIDS to HIV negatives to curb the burden of intestinal parasitic infection in the community. Emphasis should also be given to laboratory diagnosis and identification of opportunistic intestinal parasites in patients with lower CD4-Tcell count.

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Table 3.1

The prevalence of intestinal parasitic infections and its association with socio-demographic and other risk factors of 419 study participants in ALERT hospital, Addis Ababa Ethiopia in 2007.

Characteristics	No of study participants	No of Intestinal parasites infection (%)	[a] COR (95% [b] CI), p-value	[c] AOR (95%CI), p-value
HIV status				
HIV negative	103	40 (38.83)	-	-
HIV positive ART naïve	176	69 (39.20)	1.015 (0.616, 1.672), 0.951	0. 638 (0. 345, 1.180), 0.153
HIV positive on ART	140	38 (27.14)	0. 586 (0.340, 1.010), **0.055**	0. 429 (0. 220, 0. 838), **0.013**
Address				
Kolfe Keranio	284	93 (32.75)	-	-
Lafto	100	40 (40)	1.369 (0 . 855, 2.192), 0.191	1.354 (0.796, 2.305), 0.263
Others	35	14 (40)	1.369 (0 . 666, 2.813), 0.393	1.044 (0.443, 2.461), 0.921
Age				
<15 years	22	8 (36.36)	-	-
15-30 years	191	72 (37.50)	1.05 (0. 419, 2.625), 0.917	0.723 (0. 244, 2.138), 0.558
31-45 years	164	58 (35.37)	0.957 (0. 379, 2.416), 0.927	0.712 (0. 226, 2.243), 0.562
46-65 years	41	9 (21.95)	0. 492 (0.157, 1.540), 0.223	0. 303 (0. 074, 1.231), 0.095
Sex				
Male	159	52 (32.70)	-	-
Female	260	95 (36.54)	1.184 (0.781, 1.796), 0.425	0.727 (0. 413, 1.280), 0.270
Marital status				
Single	139	39 (28.06)	-	-
Married	178	65 (36.52)	1.474 (0. 913, 2.382), 0.112	2.095 (1.170, 3.752), **0.013**
Divorced	20	12 (60)	3.846 (1.460, 10.126), **0.006**	6.307 (2.112, 18.830), **0.001**
Widowed	64	25 (39.06)	1.643 (0. 880, 3.066), 0.118	3.210 (1.379, 7.474), **0.007**
Separated	18	6 (33.33)	1.282 (0. 449, 3.654), 0.642	1.745 (0. 495, 6.141), 0.386
Religion				
Christians	387	133 (34.37)	-	-
Muslims	32	14 (43.75)	1.485 (0.716, 3.079), 0.288	1.581 (0. 667, 3.745), 0.297
Ethnicity				
Oromo	100	36 (36)	-	-
Amhara	246	86 (34.96)	0. 955 (0.588, 1.552), 0.854	0. 836 (0. 482, 1.450), 0.525

Others	73	25 (34.25)	0. 925 (0. 491, 1.743), 0.812	0. 675 (0. 329, 1.384), 0.284
Educational Background				
Literate	328	113 (34.45)	-	-
Illiterate	91	34 (37.36)	1.134 (0 .700, 1.837), 0. 607	0.784 (0. 439, 1.398), 0.410
Occupation				
Have work	212	73 (34.43)	-	-
Have no work	207	74 (35.75)	1.059 (0.709, 1.582), 0.778	0. 698 (0. 401, 1.215), 0.205
Monthly income				
<$18.75/month	264	103 (39.02)	-	-
$18.75-$75/month	119	41 (34.45)	0. 821 (0 . 522, 1.290), 0.394	0. 782 (0. 414, 1.479), 0.450
>$75/month	20	3 (8.33)	0. 142 (0. 042, 0. 475), **0.002**	0. 120 (0. 031, 0. 457), **0.002**
Source of drinking water				
Pipe	400	140 (35.00)	-	-
Others	19	7(36.84)	1.083 (0 . 417, 2.813), 0.869	1.017 (0. 311, 3.324), 0.977
Use of latrine				
Private latrine	244	74 (30.33)	-	-
Public latrine	151	61 (40.40)	1.557 (1.018, 2.380), **0.041**	1.543 (0. 961, 2.478), 0.073
Open field	24	12 (50.00)	2.297 (0 . 986, 5.350), 0.054	2.742 (0. 954, 7.879), 0.061
Habit of hand washing after use of latrine				
Yes	377	134 (35.54)	-	-
No	42	13 (30.95)	0. 812 (0 . 408, 1.616), 0.555	0. 689 (0. 304, 1.561), 0.372
Habit of hand washing before meal				
Yes	414	146 (35.27)	-	-
No	5	1(20)	0 .458 (0 . 050, 4.143), 0.488	0. 294 (0. 023, 3.684), 0.343
Habit of eating raw meat				
Yes	146	48 (32.88)	-	-
No	273	99 (36.26)	1.161 (0 . 759, 1.775), 0.489	1.358 (0. 824, 2.238), 0.229
Dirties in finger nail				
Yes	215	79 (36.74)	-	-
No	204	68 (33.33)	860 (0 . 575, 1.286), 0.465	0. 813 (0. 521, 1.270), 0.365
Habit of wearing shoe				
Always	391	134 (34.27)	-	-
Sometimes	25	11 (44)	1.506 (0. 665, 3.410), 0.325	2.205 (0. 890, 5.458), 0.087
Not at all	3	2 (66.67)	3.835 (0. 344, 42.687), 0.274	3.356 (0. 153, 73.329), 0.442
Consistency of stool sample				

Non diarrheal	341	114 (33.43)	-	-
Diarrheal	78	33 (42.31)	1.460 (0 . 883, 2.413), 0.140	1.751 (0. 997, 3.075), 0.051

[a] Crude odds ratio, [b] confidence interval, [c] Adjusted odds ratio

Table 3.2

Distribution of intestinal parasite species among HIV positive on ART, HIV positive ART naïve and HIV negative individuals at ALERT hospital Addis Ababa in 2007.

Name of the parasite	Total No of infected patients	Number of patients infected with intestinal parasite according to their HIV status (%)			P-value
		HIV positive on ART (n=140)	HIV positive ART naïve (n=176)	HIV negative (n=103)	
Entamoeba histolytica/dispar	82	22(15.71)	40(22.73)	20(19.42)	0.295
Giardia lamblia	18	3(2.14)	15(8.52)	0(0.00)	**0.001***
Ascaris lumbricoides	25	5(3.57)	7(3.98)	13(12.62)	**0.005**
Strongyloides stercoralis	14	7(5.00)	6(3.41)	1(0.97)	0.210*
Trichuris trichiura	11	2(1.43)	6(3.41)	3(2.91)	0.587*
Hookworm	8	0(0.00)	3(1.70)	5(4.85)	**0.021***
Taenia species	6	1(0.71)	2(1.14)	3(2.91)	0.390*
Hymenolepis nana	4	2(1.43)	0(0.00)	2(1.94)	0.167*
Enterobius vermicularis	1	0(0.00)	1(0.57)	0(0.00)	1.000*
Cryptosporidium parvum	4	2(1.43)	1(0.57)	1(0.97)	0.825*
Isospora belli	1	1(0.71)	0(0.00)	0(0.00)	0.580*
Any protozoan parasites	101	27 (19.29)	53 (30.11)	21 (20.39)	**0.049**
Any helminths	62	17(12.14)	21(11.93)	24(23.30)	**0.020**

*Fisher's exact

Table

Table 3.3

The association of intestinal parasites species with HIV status of the participants after adjusting for socio-demographic and other risk factor variables

Name of the parasites	**HIV positive on ART** AOR (95%CI)	**HIV positive ART naïve** AOR (95%CI)	**HIV negative**
Entamoeba histolytica/dispar	0.547 (0.235, 1.269)	0.805 (0.371, 1.743)	1
Giardia lamblia	-	-	-
Ascaris lumbricoides	**0.119 (0.025, 0.560)**	**0.144 (0.036, 0.566)**	1
Strongyloides stercoralis	7.010 (0.425, 115.499)	3.494 (0. 227, 53.686)	1
Trichuris trichiura	0.419 (0.026, 6.720)	0.767 (0.071, 8.223)	1
Hookworm	-	-	-
Taenia species	-	-	-
Hymenolepis nana	-	-	-
Enterobius vermicularis	-	-	-
Cryptosporidium parvum	-	-	-
Isospora belli	-	-	-
Any protozoan parasites	0.314 (0.067, 1.457)	0.885 (0.238, 3.285)	1
Any helminths	**0.372 (0.155,0.895)**	**0. 280 (0.122, 0.640)**	1

Adjusted odds ratio (AOR), CI (confidence interval)

Table 3.4

Distribution and association of individual intestinal parasites on the bases of immune status of study participants in ALERT hospital, Addis Ababa (2007)

Name of the parasite	Total number of infected patients	Number of patients infected with individual intestinal parasites (%) in their respective CD4 T-cells count category			
		≤ 350 (n=216)	351-499 (n=62)	≥ 500 (n=141)	P-value
Over all parasitic infections	147	70 (32.41)	26 (41.94)	51 (36.17)	0.362
Entamoeba histolytica/dispar	82	40 (18.52)	17 (27.42)	25 (17.73)	0.237
Giardia lamblia	18	12 (5.56)	2 (3.23)	4 (2.84)	0.481*
Ascaris lumbricoides	25	8 (3.70)	4 (6.45)	13 (9.22)	0.085*
Strongyloides stercoralis	14	9 (4.17)	2 (3.23)	3 (2.13)	0.562*
Trichuris trichiura	11	3 (1.39)	4 (6.45)	4 (2.84)	0.069*
Hookworm	8	2 (0.93)	0 (0.00)	6 (4.26)	0.065*
Taenia species	6	1 (0.46)	1 (1.61)	4 (2.84)	0.163*
Hymenolepis nana	4	1 (0.46)	1 (1.61)	2 (1.42)	0.474*
Enterobius vermicularis	1	0 (0.00)	1 (1.61)	0 (0.00)	0.148*
Cryptosporidium parvum	4	4 (1.85)	0 (0.00)	0 (0.00)	0.211*
Isospora belli	1	1 (0.46)	0 (0.00)	0 (0.00)	1.000*
Any protozoan parasites	101	54 (25)	18 (29.03)	29 (20.57)	0.390
Any helminths	62	24 (11.11)	10 (16.13)	28 (19.86)	0.068*

*Fisher's exact