

1 **The magnitude and risk factors of intestinal parasitic infection in relation to Human**
2 **Immunodeficiency Virus infection and immune status, at ALERT hospital, Addis Ababa,**
3 **Ethiopia**

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18 **Abstract**

19 Human Immunodeficiency Virus (HIV) and intestinal parasitic infections are among the main
20 health problems in developing countries like Ethiopia. Particularly, co-infections of these diseases
21 would worsen the progression of HIV to Acquired Immunodeficiency Syndrome (AIDS). The
22 purpose of this study was to determine the magnitude and risk factors for intestinal parasites in
23 relation to HIV infection and immune status. The study was conducted in (1) HIV positive on
24 antiretroviral therapy (ART) and (2) ART naïve HIV positive patients, and (3) HIV-negative
25 individuals, at All African Leprosy and Tuberculosis (TB) Eradication and Rehabilitation Training
26 Center (ALERT) hospital in Addis Ababa, Ethiopia. Study participants were interviewed using
27 structured questionnaires to obtain socio-demographic characteristics and assess risk factors
28 associated with intestinal parasitic infection. Intestinal parasites were identified from fecal samples
29 by direct wet mount, formol ether concentration, and modified Ziehl–Neelsen staining techniques.
30 The immune status was assessed by measuring whole blood CD4 T-cell count. The overall
31 magnitude of intestinal parasite was 35.08%. This proportion was different among study groups
32 with 39.2% (69/176), 38.83 % (40/103) and 27.14 % (38/140) in ART naïve HIV positives
33 patients, in HIV negatives, and in HIV positive on ART patients respectively. HIV positive
34 patients on ART had significantly lower magnitude of intestinal parasitic infection compared to
35 HIV negative individuals. Intestinal helminths were significantly lower in HIV positive on ART
36 and ART naïve patients than HIV negatives. Low monthly income, and being married, divorced or
37 widowed were among the socio-demographic characteristics associated with intestinal parasitic
38 infection. No association was observed between the magnitude of intestinal parasites and CD4 T-
39 cell count. However, *Cryptosporidium parvum*, and *Isospora belli* were exclusively identified in
40 individuals with CD4 T-cell count of ≤ 350 cells/mm³. Regular provision of mass preventive

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

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45 **Keywords**

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

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59 **1. Introduction**

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

67 On the other hand, intestinal parasitic infection caused by helminths and protozoan parasites are
68 among the most frequent worldwide infection in humans, being highly widespread in developing
69 countries [3, 4]. Intestinal parasitic infection is one of the main problems for HIV infected
70 patients, as their immune response to intestinal helminths would shift the T-helper 1 (Th1)/Th2
71 balance to Th2, thus accelerating the progress from HIV infection to AIDS [5]. In addition,
72 intestinal protozoan parasites like *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium*
73 *parvum*, and *Isospora belli* would cause severe and threatening diarrhea in HIV/AIDS patients [6,
74 7].

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

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

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

87 Here, we reported the magnitude, risk factors and distribution of intestinal parasites in three
88 groups of HIV status (HIV positive patients with and without treatment and HIV negatives) and
89 the distribution of individual intestinal parasites in relation to immune status (CD4 T-cell count <
90 350 cells /mm³, 351-500 cells /mm³, and > 500 cells /mm³).

91 **2. Materials and Methods**

92 **2.1. Study design, site and participants**

93 A comparative cross-sectional study was conducted among patients attending the clinical
94 laboratory of All African Leprosy and Tuberculosis (TB) Eradication and Rehabilitation Training
95 Center (ALERT) hospital, Addis Ababa, Ethiopia. The patients were referred from three distinct
96 hospital's clinics namely: the Antiretroviral Therapy (ART) clinic, the Voluntary Counseling and
97 Testing (VCT) center, and Provider Initiative Counseling and Testing (PICT) center from May 9th
98 to August 31st, 2007. The hospital is found in the Kolfe Keranio sub-city of Addis Ababa which
99 has a population size of 546, 219 in 61.25 km² area [20]. In the sub-city, the ALERT hospital is
100 the main referral center for the surrounding health centers and clinics for ART service. Patients
101 attending the clinical laboratory of the hospital for CD4 T-cell count and HIV testing were
102 involved in the study. The study participants were selected systematically, i.e. every third HIV

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

114 **2.2. Data collection for socio-demographic and risk factors**

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

120 **2.3. Fecal sample collection and processing**

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

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

138 **2.4. CD4 T-cell count**

139 The immune status of the participants were evaluated by measuring the CD4 T-cell count and
140 classified into three groups (≤ 350 cells /mm³, 351 to 500 cells /mm³ and > 500 cells /mm³)
141 according to the new WHO guideline [21]. Results of CD4 T-cell count were obtained from the
142 laboratory registration book corresponding to each HIV positive study participant. For HIV
143 negative individuals, upon knowing their status at VCT clinic, every 2nd HIV negative individual
144 was asked to participate in the study. Voluntary participants gave signed consent so their HIV
145 tested blood samples could be used for CD4 T-cell count. HIV screening results were ready within
146 30 minutes and CD4 T-cell counts were performed within 2 hours of sample collection. All blood
147 and fecal samples were collected in the morning and the results were ready in the early afternoon
148 of the same day.

149 **2.5. Quality assurance**

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

157 **2.6. Data analysis**

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

164 **2.7. Ethical Consideration**

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

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

173 **3. Results**

174 **3.1. Socio-demographic data**

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

184 **3.2. Magnitude and risk factors of intestinal parasitic infection**

185 The overall magnitude of intestinal parasites was 35.08 % (147/419). Of the 147 infected patients
186 80.95 % (119/147), 17.69 % (26/147), and 1.36 % (2/147) had single, double and triple infections
187 respectively. The overall magnitude of diarrhea was 18.6 % (78/419) and parasitic infection among
188 patients with diarrhea was higher 42.31 % (33/78) than patients without diarrhea 33.43 %
189 (114/341) (p=0.051).

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

194 magnitude of intestinal parasites was 39.20% (69) in ART naïve HIV positive patients, 38.83 %
195 (40/103) in HIV negatives, and 27.14 % (38/140) in HIV positive on ART patients. The magnitude
196 of intestinal parasitic infection was slightly higher in ART naïve HIV positive individuals than
197 HIV positive on ART and HIV negatives.

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

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

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216 **3.3. Distribution of individual intestinal parasites in relation to HIV status**

217 The present study identified a total of 11 pathogenic intestinal parasites shown in detail in Table
218 3.2. The distribution of individual intestinal parasites varied with HIV status of study participants.
219 Any helminths (p=0.02), *Ascaris lumbricoides* (p=0.005) and Hookworms (p=0.021) were lower
220 in HIV positive patients than HIV negative controls, while *Giardia lamblia* was significantly
221 higher in HIV positives (p=0.001). Similarly, the distribution of helminthic and protozoan
222 parasites was found to be different in three groups of HIV status. Protozoan parasites were more
223 common in HIV positive ART naïve patients (p=0.05) while helminthic infections were higher in
224 HIV negative individuals than the other groups (p=0.02) (Table 3.2). However, after adjusting for
225 all other variables and intestinal parasites, infections with *Ascaris lumbricoides* and any helminths
226 were found to be associated with HIV status (Table 3.3). Compared to HIV negative individuals,
227 HIV positive on ART and ART naïve HIV positive patients have low magnitude of helminthic
228 infection.

229 **3.4. Distribution of individual intestinal parasites in relation to CD4 T-cell count**

230 Out of 419 study participants with CD4 T-cell count, 216, 62, and 141 subjects had CD4 T-cell
231 count ≤ 350 cells/mm³, 351-500 cells/ mm³, and > 500 cells/ mm³, respectively (Table 3.4). As
232 expected, 91.26 % (94/103) of HIV negative individuals had CD4 T-cell count > 500 cells/ mm³.
233 On the other hand, the majority of HIV positive patients had CD4 T-cell count ≤ 350 cells/mm³
234 (p<0.001).

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

238 show significant difference with CD4 T-cell count category (Table 3.4). Furthermore, intestinal
239 parasitic co-infections (single, double and triple infections) were not associated with CD4 T-cell
240 count category. However, opportunistic parasites like *Cryptosporidium parvum* and *Isospora belli*
241 were identified exclusively in patients with CD4 T-cell count ≤ 350 cells/mm³. We have also seen
242 whether intestinal parasitic co-infection (double or triple infections) were associated with HIV or
243 immune status. Patients with double or triple parasitic infection were neither associated with HIV
244 status (p=0.26) nor with immune status (p=0.42) of the study participants.

245 **4. Discussion**

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

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

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

265 Lower proportion of intestinal parasites in the current study to HIV positive patients than HIV
266 negative controls was in contrast with other studies in Bahir Dar [14], Jimma [13, 15], Hawassa
267 [8], and Cameron [22]. On the other hand, the lower magnitude in HIV positive on ART patients
268 was in agreement with studies conducted by Missaye et al [23] and Bachur et al [24]. Significantly
269 reduced magnitude of intestinal parasites in HIV positive patients on ART than HIV negatives
270 could be due to provision of anti-helmenthic drugs and prophylactic agents like cotrimoxazole for
271 patients on ART or the direct effect of ART on intestinal parasites [24, 25]. Furthermore, the
272 frequent advice given to HIV positive patients on ART on how to care for their overall health by
273 healthcare providers during their frequent visit could contribute for lower magnitude of intestinal
274 parasites.

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

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

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

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

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

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

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

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

311 In conclusion, our findings showed that the overall magnitude of intestinal parasites is high in the
312 study area. The magnitude of intestinal parasites was significantly lower in HIV positive patients
313 on ART than HIV negative individuals. On top of these, intestinal helminths were significantly
314 lower in HIV positive on ART and ART naïve patients than HIV negative controls. The
315 distribution of individual parasites in different groups of immune status also revealed none of the
316 intestinal parasites were significantly associated with CD4 T-cell count. However,
317 *Cryptosporidium parvum*, and *Isospora belli* were exclusively found in immunocompromised
318 patients with CD4 T-cell count ≤ 350 cells/mm³. Since regular provision of mass preventive
319 chemotherapy would reduce helminthiases in both HIV positives and negatives, deworming needs
320 to be reinforced in the country. Moreover, routine examination and treatment of protozoan
321 parasites shouldn't be neglected in HIV positive patients. There is also a need to extend the
322 organized health education on intestinal parasites currently offered to individuals living with
323 HIV/AIDS to HIV negatives to curb the burden of intestinal parasitic infection in the community.
324 Emphasis should also be given to laboratory diagnosis and identification of opportunistic intestinal
325 parasites in patients with lower CD4-Tcell count.

326

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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
Dirtyies 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)	
<i>Entamoeba histolytica/dispar</i>	82	22(15.71)	40(22.73)	20(19.42)	0.295
<i>Giardia lamblia</i>	18	3(2.14)	15(8.52)	0(0.00)	0.001*
<i>Ascaris lumbricoides</i>	25	5(3.57)	7(3.98)	13(12.62)	0.005
<i>Strongyloides stercoralis</i>	14	7(5.00)	6(3.41)	1(0.97)	0.210*
<i>Trichuris trichiura</i>	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*
<i>Taenia species</i>	6	1(0.71)	2(1.14)	3(2.91)	0.390*
<i>Hymenolepis nana</i>	4	2(1.43)	0(0.00)	2(1.94)	0.167*
<i>Enterobius vermicularis</i>	1	0(0.00)	1(0.57)	0(0.00)	1.000*
<i>Cryptosporidium parvum</i>	4	2(1.43)	1(0.57)	1(0.97)	0.825*
<i>Isospora belli</i>	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 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
<i>Entamoeba histolytica/dispar</i>	0.547 (0.235, 1.269)	0.805 (0.371, 1.743)	1
<i>Giardia lamblia</i>	-	-	-
<i>Ascaris lumbricoides</i>	0.119 (0.025, 0.560)	0.144 (0.036, 0.566)	1
<i>Strongyloides stercoralis</i>	7.010 (0.425, 115.499)	3.494 (0.227, 53.686)	1
<i>Trichuris trichiura</i>	0.419 (0.026, 6.720)	0.767 (0.071, 8.223)	1
Hookworm	-	-	-
<i>Taenia species</i>	-	-	-
<i>Hymenolepis nana</i>	-	-	-
<i>Enterobius vermicularis</i>	-	-	-
<i>Cryptosporidium parvum</i>	-	-	-
<i>Isospora belli</i>	-	-	-
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			P-value
		≤ 350 (n=216)	351-499 (n=62)	≥ 500 (n=141)	
Over all parasitic infections	147	70 (32.41)	26 (41.94)	51 (36.17)	0.362
<i>Entamoeba histolytica/dispar</i>	82	40 (18.52)	17 (27.42)	25 (17.73)	0.237
<i>Giardia lamblia</i>	18	12 (5.56)	2 (3.23)	4 (2.84)	0.481*
<i>Ascaris lumbricoides</i>	25	8 (3.70)	4 (6.45)	13 (9.22)	0.085*
<i>Strongyloides stercoralis</i>	14	9 (4.17)	2 (3.23)	3 (2.13)	0.562*
<i>Trichuris trichiura</i>	11	3 (1.39)	4 (6.45)	4 (2.84)	0.069*
<i>Hookworm</i>	8	2 (0.93)	0 (0.00)	6 (4.26)	0.065*
<i>Taenia species</i>	6	1 (0.46)	1 (1.61)	4 (2.84)	0.163*
<i>Hymenolepis nana</i>	4	1 (0.46)	1 (1.61)	2 (1.42)	0.474*
<i>Enterobius vermicularis</i>	1	0 (0.00)	1 (1.61)	0 (0.00)	0.148*
<i>Cryptosporidium parvum</i>	4	4 (1.85)	0 (0.00)	0 (0.00)	0.211*
<i>Isospora belli</i>	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