



WALLAGA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

**INTESTINAL PARASITIC INFECTIONS AND
ASSOCIATED FACTORS AMONG HIV SEROPOSITIVE
AND HIV SERONEGATIVE POPULATIONS ATTENDING
PUBLIC HEALTH FACILITIES IN GIMBI TOWN,
WESTERN ETHIOPIA**

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**A Thesis Submitted to School of Medical Laboratory Sciences, Institute
of Health Sciences, Wallaga University, in Partial Fulfillment of the
Requirements for the Degree of Master of Medical Parasitology**

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Nekemte, Ethiopia

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APPROVAL SHEET FOR SUBMITTING FINAL THESIS

As members of the Board of Examining of the Final MSc. thesis open defense, we certify that we have read and evaluated the thesis prepared by **Bulcha Emiru Ayana** under the title “Intestinal Parasitic Infections and Associated Factors among HIV seropositive and HIV seronegative Populations attending Public Health Facilities in Gimbi town, Western Ethiopia” and recommend that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Science in **Medical Parasitology**.

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I hereby certify that all the correction and recommendation suggested by the board of examiners are incorporated into the final thesis entitled “Intestinal Parasitic Infections and Associated Factors among HIV seropositive and HIV seronegative Populations attending Public Health Facilities in Gimbi town, Western Ethiopia” by Bulcha Emiru Ayana

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STATEMENT OF THE AUTHOR

I, Mr. **Bulcha Emiru Ayana**, hereby declare and affirm that the thesis entitled **“Intestinal Parasitic Infection and Associated Factors among HIV seropositive and HIV seronegative Populations attending Public Health Facilities in Gimbi town, Western Ethiopia”** is my own work conducted under the supervision of Dr. Geleta Tadele (PhD) and Mr. Fikadu Bekele (MSc). I have followed all the ethical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis. All scholarly matter that were included in the thesis has been given recognition through citation. I have adequately cited and referenced all the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and I have not misrepresented, fabricated, or falsified any idea / data / fact / source in my submission. This thesis is submitted in partial fulfillment of the requirement for a degree from the Post Graduate Studies at Wallaga University. I further declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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ABBREVIATIONS AND ACRONYMS

AIDS:	Acquired Immune Deficiency Syndrome
AOR:	Adjusted Odds Ratio
ART:	Anti-Retro viral Therapy
CD4:	Cluster of Differentiation 4
CI:	Confidence Interval
COR:	Crude Odds Ratio
EDTA:	Ethylene Di-amine Tetra Acetic Acid
HIV:	Human Immunodeficiency Virus
NTD:	Neglected Tropical Diseases
IPI:	Intestinal parasitic Infections
MDA:	Mass Drug Administration
ODP:	Open Defecation Practices
ODF:	Open Defecation Free
PITC:	Provider initiated testing and counseling
PLHIV:	Peoples living with HIV
SOP:	Standard Operational Procedures
SPSS:	Statistical Package for Social Sciences
VCT:	Voluntary Counseling and testing
WASH:	Water safe, Sanitation and Hygiene
WHO:	World Health Organization

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ABSTRACT

Background: The co-morbidity of intestinal parasitic infection and HIV/AIDS remain public health concern worldwide. Intestinal parasitic infections are among the public health challenges, particularly in developing Countries including Ethiopia.

Objective: the aim of this study was to assess the prevalence and associated factors of intestinal parasitic infection among HIV seropositive population and HIV seronegative populations attending Public Health Facilities in Gimbi town.

Methods: A comparative cross-sectional study was conducted at public health Facilities in Gimbi town from January to March 2025. Systematic random sampling technique was used to select participants. This study included 318 HIV seropositive and 240 HIV seronegative participants. Interviewer-administered questionnaires were used to collect data on Socio-demographic and other factors. Microscopic examination of stool and CD4+ Cells counts were performed. Association was assessed using Logistic regression. $P < 0.05$ was considered statistically significant.

Result: The prevalence of intestinal parasitic infection was 38.68% (123/318) among HIV seropositive and 28.33% (68/240) among HIV seronegative respondents. The detected intestinal parasites were *G. lamblia* (55(44.7%) and 34(50%)), *E. histolytica/dispar* (51(41.5%) and 24(35.2%)), *A. lumbricoids* (6(4.9%) and 8(11.8%)), and *Hookworm* (2(1.6%) and 1(1.5%)) among HIV seropositive and HIV seronegative, respectively. *Cryptosporidium spp.* (3.3%) and *I. belli* (1.6%) were detected exclusively among HIV seropositive participants. Rural residence, lack of hand washing after toilet, lack of hand washing with soap and water before meal and not washing fruits before eating were significantly associated with intestinal parasitic infections among both study groups ($p < 0.05$). CD4+ Cells $< 200/\mu\text{L}$ and $200-499/\mu\text{L}$ were found significantly associated with intestinal parasitic infection among HIV seropositive participants ($P < 0.05$).

Conclusion

Prevalence of intestinal parasitic infection was found higher for HIV seropositive than HIV seronegative. *G. lamblia* was the leading parasite identified followed by *E. histolytica/dispar*. Routine screening and treatment, improved sanitation and hygiene, health education & ART adherence among HIV seropositive are crucial to reduce intestinal parasitic infection among study populations.

Key words: Intestinal parasitic infection, HIV seropositive, HIV seronegative, Associated Factors

1. INTRODUCTION

1.1. Background

Intestinal parasitic infections (IPIs) are infections caused by different intestinal parasitic helminths and protozoa. The medically important helminths (worms) that infect human intestine include: *Ascaris lumbricoides* (Ascariasis), *Trichuris trichiura* (Trichuriasis), Hookworms, intestinal *Schistosoma* spp. (cause of intestinal schistosomiasis), *Strongyloides stercoralis* (Strongyloidiasis), *Enterobius vermicularis* (Enterobiasis), *Taenia* spp. (Taeniasis), *Hymenolepis nana* (Hymenolepiasis) and *Diphyllobothrium latum* (Fish tapeworm). Among parasitic protozoa that infect human intestine, *Entamoeba histolytica*, that cause amoebiasis and *Giardia lamblia* (Giardiasis) are the common parasitic pathogens. On the other hand, HIV-positive individuals are commonly affected by opportunistic parasites, such as *Cryptosporidium* spp., *Cyclospora cayetanensis*, *Isospora belli* and *Microsporidia* spp.(1-3).

Common risk factors such as low level of hygiene, poor sanitation, contaminated food and water and close human-to-human or zoonotic contact are related to spread of IPIs (4). Furthermore, peoples with lowered immunity are more susceptible to develop these infections once they are exposed (5). The life cycle of those parasites depends on the type of species. Life cycle of protozoa such as *E. histolytica* and *G. lamblia*, comprised of cyst and trophozoite and require one host only. The cyst stage is infective and transmitted via contaminated hand, food or water (6). Furthermore, intestinal coccidia (*Cryptosporidium*, *Isospora* and *Cyclospora*) have the oocyst stage which is infective when transmitted directly from infected person to health individual or via food and water (7).

The developmental stages of helminths (worms) include egg, larva and adult worm. *A. lumbricoides*, *T. trichiura* and hookworms (*Ancylostoma duodenale* and *Necator Americanus*) are known as soil transmitted helminths (STHs), where the former two are transmitted and infective via their egg stage; the later infect human via its infective larva penetrating the skin (8). *S. stercoralis* has larval and adult worm developmental stage complex life cycle including free living and parasitic forms. It affects immunocompromised individuals, manifesting as hyper-infection and disseminated disease (9).

The life cycle of *Schistosoma spp.* involves fresh water snail as intermediate host and human as definitive host, where the adult worm lives (10). Contact with water containing the infective stage, called Cercariae, is responsible for transmission of the parasite (11). Tapeworms, such as *Taenia saginata*, *Taenia solium*, and *D. latum*, are transmitted to humans via the consumption of raw or undercooked infected beef, pork, and fish, respectively (12).

Most of the cases of intestinal parasitic infections (IPIs) are asymptomatic (13). The signs and symptoms of intestinal parasitic infections among symptomatic cases are abdominal cramps, nausea, vomiting, low-grade fever, and diarrhea that vary in severity and frequency. They are more frequent and severe in children and other immune-compromised individuals, including patients of Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) (14, 15).

Diagnosis of intestinal parasites, like other infectious diseases, utilizes one of the laboratory techniques, including the microscopic method, molecular techniques or serology. A microscope is the gold standard for the diagnosis of most intestinal parasites, particularly for routine use. The molecular method is the most sensitive and reliable technique ever to exist for the diagnosis of those parasites yet expensive (16, 17).

Prevention and control of IPIs is the effective means for reducing their burden and eliminate them as public health problem. The WHO recommends strategic interventions including Preventive Chemotherapy and WASH to overcome those intestinal parasitic infections that are part of neglected tropical diseases (NTDs). Preventive chemotherapy (PC) is the use of chemotherapeutic drugs such as Albendazole, Ivermectin and Praziquantel that target, particularly, helminthic infections. It is known as mass drug administration (MDA), to the risk population, regardless of their status of infection with these parasites (18, 19). Furthermore, a clean water supply, Hygiene and sanitation (WASH) as well as vector control and health education can interrupt the spread of IPIs (20).

1.2. Statement of the problem

Intestinal parasitic infections (IPIs) remain among the major public health problems throughout the world. Globally, an estimated 450 million people suffered from intestinal parasitic infections (15) and more than 200,000 annual deaths are attributed to these infections (21). Consequently, the health and socioeconomic burden due to these parasites is higher in tropical and subtropical countries (22). The Sub-Saharan Africa (SSA) shares the greatest burden from the negative impact of IPIs, which is significantly linked to poverty, a low standard of living, a suitable climate for those parasites, and a low level of health behavior practices (23). In low and middle income countries, the occurrence of IPIs is commonly associated with poor Socio-economic status, a lack of pure water supply, poor sanitation, inadequate healthcare, poor community awareness (24).

The chronic effect of intestinal parasitic infection leads to serious complications, particularly among HIV/AIDS patients. These complications include under-nutrition, anemia, weight loss, low birth weight, stunted growth, delayed cognitive development, and psychological and social impact (25, 26). IPIs are the leading cause of morbidity and mortality in HIV/AIDS patients. HIV suppresses immunity, altering the clinical manifestations and outcomes of IPIs including the opportunistic infections. In 2022, an estimated 630,000 people died from AIDS-related illnesses (27). Unfortunately, the higher proportion of this burden is, particularly, from sub-Saharan countries (28, 29).

The co-infection of intestinal parasites and HIV/AIDS has become a major public health concern in Ethiopia, where there is low socioeconomic status, poor hygiene practices, and a low standard of living (30). Ethiopia ranked second after Nigeria, with an estimate of 50,000 deaths annually attributed to IPIs (31, 32). Several studies in the country proved that intestinal parasitic co-infection common among this group of population (33, 34).

In Ethiopia, an estimated 40% of people living with HIV were co-infected with intestinal parasitic infections in 2022 (35). A study conducted at Nekemte Specialized Hospital reported that the prevalence of intestinal parasitic infection among HIV positive patients and HIV seronegative population were 62.2% and 18.3%, respectively (34). This indicates that the problem is higher, with more than threefold higher among HIV-positives than HIV-negative populations.

Intestinal parasitic infections need special emphasis in developing countries. Epidemiological studies and their relationship with environmental and social factors are essential to overcome the negative impact they impose on health and socioeconomic aspects.

Undoubtedly, parasitic diseases play an important role in limiting most developing countries' economic and social growth and development, as they cause a great waste of capital, time, and energy every year (15). Unless a continued survey is conducted that enables to identify the magnitude of the problem and take proper action, it could aggravate the situation and spread to the community. This calls attention to the need to conduct surveys and screen those individuals before their progression leads to a severe condition.

Studies conducted in Ethiopia found that the problem prevails in the country. Despite the relationship between HIV and intestinal parasitic infection, there was no comparative study that clearly shows the difference in prevalence, species distribution and associated risk factors of IPIs among HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town. The lack of such valuable data makes it difficult to take timely intervention in this population. The scarcity of data in this area means that communities are affected continuously and these infectious diseases continue to spread. Therefore, this study was aimed to fill the existing gap.

Hence, the overall goal of this study was to determine the magnitude of intestinal parasitic infections and the associated factors among HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town.

1.3. Significance of the Study

As the aim of this study was to determine the magnitude of Intestinal parasitic Infections and associated factors, the results precisely illustrated the magnitude of these infections among study populations. Furthermore, this study identified potential factors related to the occurrence and spread of intestinal parasites in the study populations.

The results of this study were primarily indicated for the study subjects who were affected by these parasites. Understanding the differences in intestinal parasitic infection between HIV seropositive and HIV seronegative populations can improve clinical management, especially in HIV care settings, where prophylactic and therapeutic decisions could differ based on risk of parasitic infection. The findings can help health care providers and managers allocate resources more efficiently understanding the high-risk group and prioritizing them.

The finding of this study in identifying the prevalence and types of intestinal parasites in both HIV seropositive and HIV seronegative populations would provide essential epidemiological data that can guide local and national health programs. The identified factors related to occurrence of intestinal parasitic infection in this study, is crucial in formulating evidence-based comprehensive strategies for control and prevention of intestinal parasitic infection.

The comparative nature of this study, where it simultaneously studied both HIV seropositive and HIV seronegative populations, contributes to the existing literature by illustrating a clearer picture of the interplay between immune status and susceptibility to intestinal parasitic infection. Furthermore, this study enhances our knowledge of how HIV affects the epidemiology of intestinal parasitic infection. This understanding helps to improve the health outcomes and to implement more effective public health interventions.

2. LITERATURE REVIEW

2.1. Intestinal Parasitic Infection among HIV/AIDS Patients

Recently, immunosuppressive diseases like HIV/AIDS made opportunistic parasites significant in clinical and public health settings. Intestinal parasitic infections are commonly detected in HIV seropositive population (36, 37).

Study conducted in North Iran identified *E. bieneusi* with a prevalence of 20% and 6% in HIV+ patients and HIV seronegative individuals, respectively. Accordingly, the odd of infection with Microsporidiasis was 7 times more among HIV+ patients when compared with HIV- control (17). Another study in Southwest Iran reported that the rate of infection with intestinal parasites was 46.8% among HIV/AIDS patients and 16% in HIV seronegative controls. The isolated parasites were *G. lamblia* and *Entamoeba coli*, each 29.8%, whereas, *B. hominis*, *Cryptosporidium spp.*, *I. belli* and *Sarcocystis spp.*, detected with rate of 19.9%, 16.3%, 5.9%, and 2%, respectively. This finding reported that none of the intestinal *Coccidia spp.* was detected in the HIV seronegative control group. The reported rate of infection with *Cryptosporidium spp.* among HIV infected Participants was 10.6% (38). Furthermore, study conducted in Lorestan province in West Iran, reported that prevalence of IPIs, particularly, *Cryptosporidium spp.* and *Microsporidia spp.* was significantly higher among patients with HIV (15).

In the study carried out among HIV/AIDS patients in North East India, the overall prevalence of intestinal parasites was 40.99%, with a higher proportion (85.13%) of *Coccidia* parasites. The detected intestinal opportunistic parasites in this report were *C. parvum*, which was reported to be the most frequently isolated parasite (60.14%), followed by *I. belli* (20.27%) and *C. cayetanensis* (4.73%). The report included the pathogenic parasites like *A. lumbricoides*, hookworm, *G. lamblia*, and *E. histolytica* (39).

A study conducted in India reported that the rate of intestinal parasitic infection was 52.04% among HIV seropositive and 53.33% among HIV seronegative participants. According to this report, the Parasites detected were detected were *A. lumbricoides*, *Cryptosporidium spp.*, *E. histolytica/dispar*, *G. lamblia*, *Microsporidia spp.*, Hookworm, *H. nana*, *S. stercoralis*, *I. belli* and *C. cayetanensis*.

Patients with lower CD4 counts <200cells/ μ L had a higher incidence of infection due to intestinal coccidian and *microsporidia spp.*(40). Another study conducted among HIV positive patients in Eastern India reported that the prevalence of intestinal parasitic infection was 12.59%. This report revealed that intestinal parasites such as *A. lumbricoides*, *Cryptosporidium spp.*, Hookworm, *I. belli*, *T. trichiura*, *G. lamblia*, *Strongyloides stercoralis*, *Taenia spp.*, and *E. histolytica* were detected (41).

According to a study done in Argentina, it was reported that *Cryptosporidium spp.*, *Microsporidia spp.*, *I. belli*, *G. lamblia*, *S. stercoralis*, *C. cayetanensis* and *E. bienewisi* were detected among HIV-seropositive participants (42). According to study report from study carried out in Algeria it was reported that 33 out of 350 participants infected by *Cryptosporidium spp.*(43).

A study conducted in Nigeria in 2018 found that intestinal parasitic infections were present in 20.9% of 891 individuals living with HIV and 52.7% of 150 HIV seronegative study participants. According to this report, the prevalence was higher in HIV negative participants than those HIV positive individuals. The detected intestinal parasites included *Taenia spp.*, *E. coli*, *G. lamblia*, *E. histolytica*, *B. coli*, *Blastocystis hominis*, *E. bienewisi*, hookworm, *S. stercoralis*, *A. lumbricoides*, and *T. trichiura*. Also it was declared that *B. hominis* and *C. parvum* infected all the participants with a CD+4 count less than 200 cells/ μ L (2).

A study conducted in Nigeria in 2021 among 170 individuals living with HIV, found that 44.7% were infected with intestinal parasites. The identified intestinal parasites in this report included *A. duodenale*, *A. lumbricoids*, *S. stercoralis*, *H. nana*, *T. trichiura* and *Cryptosporidium spp.* (44). In Ghana, a cross-sectional study in 2021 involving 335 HIV positive participants reported an intestinal parasitic infection rate of 5.97%. The authors reported that the most frequently detected intestinal parasite was *G. lamblia* followed by *A. lumbricoids*, *T. trichiura* and *E.histolytica/dispar* (1).

Another cross-sectional study from Uganda, conducted among HIV positive patients Masaka Regional Referral Hospital ART Clinic (45), found that *Cryptosporidium spp.* was accounted for 71.4%, followed by *G.lambli*a (20.4%)and *S. stercoralis* (8.2%).

In Ethiopia, a pooled analysis estimated an overall prevalence of intestinal parasitic infection among HIV seropositive populations to be 39.15%. According to this report, the most common intestinal parasites detected intestinal parasites were *E. histolytica/dispar*, *Cryptosporidium spp.*, *G. lamblia*, *A. lumbricoides* and *I. belli* (36).

A cross sectional study at Dessie Referral Hospital in 2019 found 21.1% of 223 study participants were infected with intestinal parasites. Eleven species detected dominated by *E. histolytica*, followed by *E. vermicularis*, *G. lamblia*, *A. lumbricoides*, *Cryptosporidium species*, *Hookworm*, *H. nana*, *S. stercolaris*, *Taenia spp.*, *I. belli* and *S. mansoni* (46).

A study conducted among HIV+ clients on ART at Debretabor General Hospital reported that 25.3% of 383 respondents were co-infected. The species isolated were *A. lumbricoides*, *S. stercolaris*, *Taenia spp.*, *H. nana*, *E. vermicularis*, *G. lamblia*, *E. histolytica*, *Hookworm*, *T. trichiura* and *S. mansoni* (33).

A study at University of Gondar Hospital, found 24.7% 316 participants infected by intestinal parasite. In this study, *A. lumbricoides*, *Cryptosporidium spp.*, *E. histolytica/dispar*, *G. lamblia*, *T. trichiura*, *Microsporidia spp.*, *Hookworm*, *S. stercolaris*, *Taenia spp.*, *C. cayetanensis* and *S. mansoni* were the intestinal parasites isolated (47).

Another systematic review and meta-analysis conducted in Ethiopia, the estimated prevalence of IPIs among peoples living with HIV/AIDS on ART was 40.24%. On the base of sub-group analysis by region, the highest to the lowest pooled prevalence was found in the Tigray regional state 45.7%, then Oromia regional state 42.2%, SNNPs regional state 38.8% and Amhara regional state 37.99% (37).

A study conducted among HIV positive patients on ART at Bule Hora General Hospital in 2021, enrolled 179 individuals of whom 29.1% were infected with Intestinal Parasites. *Giardia lamblia* and *Ascaris lumbricoides*, respectively, were isolated from most of the cases followed by, *Entamoeba histolytica/dispar*, *Strongyloides stercoralis*, *Hookworm* and *Taenia spp.* (48).

2.2. Intestinal Parasitic Infections in HIV seronegative patients

While HIV infection is known to increase susceptibility to intestinal parasitic infection including the opportunistic parasites, studies indicated that HIV seronegative individuals also experience notable rates of these infections. Despite lower prevalence rates compared to HIV seropositive individuals, the morbidity associated with intestinal parasitic infections in HIV seronegative populations remains a public health concern. According to study conducted in Khammam, India, 12% of HIV seronegative individuals were found to be infected with intestinal parasites such as *G. lamblia*, *E. histolytica* and *A. lumbricoids* (49).

Study done in Cameroon found that the prevalence of IPI among HIV seronegative population was 22.4%. This report included the parasites such as *A. lumbricoids*, *E. histolytica/dispar*, *Blastocystis spp.*, *Iodamoeba buetschlii*, *Endolimax nana*, *Entamoeba coli*, *pentatrichomonas hominis* and *Cryptosporidium spp.* (50). Another study in Cameroon, 32.3% of 167 the HIV negative patients were infected with intestinal parasites (51).

According to study done among 150 HIV seronegative individuals in Nigeria, the prevalence of intestinal parasitic infection was 52.7%. In this report, intestinal parasites such as *G. lamblia*, *E. histolytica*, Hookworm, *A. lumbricoids*, *Taenia spp.*, *T. trichiura*, *S. stercoralis* (1.5%), *Entamoeba coli* and *Balantidium coli* were included. However, this report finding did not include the opportunistic parasites such as *Cryptosporidium spp.*, *I. belli*, *Cyclospora spp.* and *Microsporidium spp.* (52).

In a study report from Ghana the prevalence of intestinal parasitic infection among HIV seronegative population (IPI) was 13.3%, which was lower compared to prevalence of IPI among HIV seropositive, 25.2%. In this report *G. lamblia* was found the most frequent parasite detected, accounted for 11.8% among HIV seronegative participants. The intestinal parasites including *A. lumbricoids*, Hookworm, *Enterobius vermicularis* and coinfection of *G. lamblia* & *E. histolytica* in one case were reported. Unlike for HIV seropositive study participants, the opportunistic intestinal parasites like *Cryptosporidium spp.*, *I. belli*, *Cyclospora cayetanensis* and *Microsporidia* were not reported for HIV seronegatives(53)

2.3. Factors Associated with Intestinal Parasitic Infections

Intestinal parasitic infections (IPIs) are prevalent in various regions, particularly in developing countries, and are influenced by multiple associated factors. Key determinants include socio-economic status, hygiene practices, and educational levels, which significantly impact the prevalence of these infections.

Concerning age and gender, children bear the highest burden of Intestinal Parasitic infections than other age groups, while males are more likely affected than females, likely due to greater exposure to environmental risks (54). Study by Seid et al on the effect of hand hygiene compliance found factors such as lack of formal education and poor compliance with hand hygiene were significantly associated with incidence of IPIs (4).

A study conducted in Quetta, Pakistan, demonstrated that 48% of infected participants had attained primary education or less, showing significant association of low educational attainment with incidence of intestinal parasitic infections among the study population (54). Study also found that rural residency to be associated with intestinal parasitic Infections (55).

Similarly, low level of hygiene, like Poor hand hygiene and lack of food safety are found to be critical risk factor. A systematic review and meta-analysis showed that open defecation practices, and drinking water from unprotected sources were identified as risk factors for intestinal parasitic infections (55). Study by Kebede et al found the use of spring water for drinking were more likely predispose the occurrence of intestinal parasitic Infections (56)

According to study by Karim et al, 62% of infected individuals did not practice regular hand washing (54). Similarly, in a study that was done at Debarq, Ethiopia, those who did not wash hands after using the toilet had significantly higher odds of infection (57). Consumption of unwashed vegetables was linked to increased infection rates, with an estimated 10 times higher incidence among study participants in the Ethiopian study (57).

A cross sectional study among schoolchildren in Jaragedo Town, South Gondar Zone, found 65.4% of them infected with Intestinal Parasites. Factors including consumption of river water, rural residency, farming, and a family's low income were found to be associated factors (58)

According to a systematic review and meta-analysis in Ethiopia, factors such as lack of hand washing habits before meals, age below 14 years, open field defecation practices, eating vegetables and fruits without washing, low level of income, drinking water from unprotected sources, swimming, walking barefoot and playing with soil were found to be risks of acquiring intestinal helminthic parasites (23).

A systematic review and meta-analysis showed that rural residency, open defecation practices, and drinking water from unprotected sources were identified as risk factors for intestinal parasitic infections (55). Study by Kebede et al found the use spring water for drinking were more likely infected (56).

Lack of hand washing habit after latrine, being a farmer and walking barefoot were significantly associated with IPIs where the pregnant women lacking habit of hand washing after latrine, being a farmer and walking barefoot were 5.36, 7.3 and 6.13 times more often infected with intestinal parasitosis than their counterparts, respectively (59).

Special groups of populations, including children, adolescents, pregnant women, and immunocompromised individuals, are more likely to be affected by intestinal parasitic infections as compared with their counterparts. Several studies conducted in these populations found the burden to be significantly higher (24, 46, 55, 60).

Children are at greater risk of contracting IPIs due to their immature immunity and behavioral factors. This group bears the heaviest burden of intestinal parasitic diseases, leading to malnutrition, malabsorption, and impaired physical and cognitive development (61, 62).

The correlation of open defecation, playing with soil and lack of regular shoes wearing with the occurrence of STH infection was revealed in a study conducted among children in northwest Ethiopia. Children who were wearing shoes sometimes were 12 times and children playing with soil were about five times at greater risk compared to those wearing shoes always and who did not play with soil, respectively. Similarly, the children in ODF-declared Kebeles had a 49% decreased risk of STH infection as compared with children in Kebeles practicing open defecation (63). There was significant association between hand washing habit after latrine, habit of eating raw vegetables and CD4 cell count less than 200 cells/ μ L and intestinal parasitic infections (46). Study showed that CD4+ T-cell counts of less than 200cells/ μ L and unavailability of a latrine were significantly associated with intestinal parasitic infections (36).

Those patients with CD4 counts <200 cells/ μL were four times and those with CD4 counts 200-499 cells/ μL were approximately three times at risk of contracting intestinal parasitic infection as compared to patients with CD4 counts of > 499 cells/ μL (44).

2.4. Conceptual Framework

Sources (41, 54, 55, 57, 63)

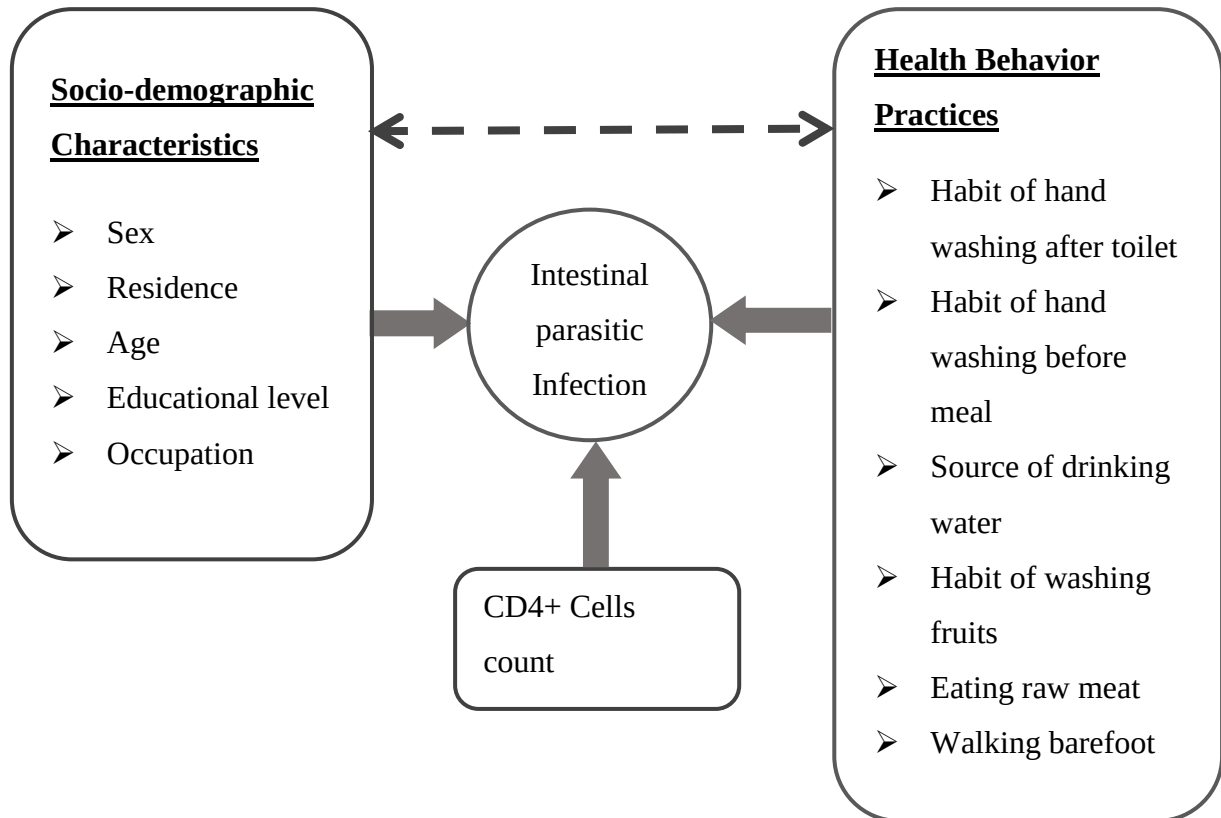


Figure 1: Conceptual Framework depicting relationship of sociodemographic characteristics and health related behaviors with intestinal parasitic infection.

3. OBJECTIVE OF THE STUDY

3.1. General Objective

- The overall aim of this study was to determine the prevalence of Intestinal Parasitic Infections and their associated factors among HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town from January to March 2025

3.2. Specific Objectives

- Determining the prevalence of Intestinal Parasitic Infections among HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town from January to March 2025.
- Identifying factors associated with Intestinal Parasitic Infections among HIV seropositive populations and HIV seronegative populations attending Public Health Facilities in Gimbi town from January to March 2025.

4. METHODS AND MATERIALS

4.1. Study Area

This study was conducted at Public Health Facilities in Gimbi town, West Wallaga Zone. Gimbi town is located at a distance of 444 km to the west from Addis Ababa, the capital City of Ethiopia. It is located at a latitude of 9°10'N and longitude of 35°50'E with an elevation between 1845 and 1930 meters above sea level. The mean annual temperature and rainfall the area gets is 14.76°C and 88.61mm, respectively.

There are two public health facilities in Gimbi town: Gimbi General Hospital and Gimbi health center. These health facilities are serving the communities in Gimbi town and from other localities. These Institutions are providing health services including; curative, preventive and rehabilitative health services to the community. Furthermore, they are serving as ART Center for HIV monitoring and Follow-up for peoples living with HIV. All confirmed peoples living with HIV, who are ready and willing to initiate the service as they claim through their consent, are soon attached to the ART Clinics of these Health Facilities. There were 426 and 336 HIV seropositive peoples on follow up at ART Clinics of Gimbi General Hospital and Gimbi Health Center, respectively, during Data collection. The ART Clinics of these Facilities also conduct HIV testing, prevention and counseling for clients seeking these services (64, 65).

4.2. Study Design and Period

A comparative cross-sectional study was carried out at Public Health Facilities in Gimbi town from January to March 2025.

4.3. Population

4.3.1. Target population

All HIV seropositive populations on-ART follow up and HIV seronegative populations attending Public Health Facilities in Gimbi town.

4.3.2. Study population

HIV seropositive individuals, who were on regular follow up at ART Clinics of Public Health Facilities in Gimbi town from January to March 2025. HIV seronegative populations who were attending HIV Voluntary Counseling and testing (VCT) Clinics and Provider initiated testing and counseling at Public Health Facilities in Gimbi town from January to March 2025.

Their HIV sero-status was known after attending Provider initiated testing and counseling/Voluntary Counseling and testing of HIV VCT Clinics' laboratories of the respective Health Facilities.

4.4. Eligibility Criteria

4.4.1. Inclusion criteria

Those HIV positive individuals and HIV seronegative individuals, who were not receiving anti-parasitic treatment(s) for intestinal parasitic infection within two weeks during data collection (66).

4.4.2. Exclusion criteria

Individuals who were unable to participate due to physical and/or cognitive impairments were excluded.

4.5. Sample Size Determination

Sample size for this study was estimated using double population proportion formula with 5% level of significance (alpha) and power of 80%. The prevalence of 52.6% and 42.3% among HIV sero-positive and HIV sero-negative populations, respectively, from previous study (67) were used to calculate the sample size.

$$n_1 = n_2 = \frac{(Z_{\frac{\alpha}{2}} + Z_{\beta})^2 (P_1(1-P_1) + P_2(1-P_2))}{(P_1 - P_2)^2} = 365$$

During Data collection, there were 426 and 336 peoples attending ART Clinics of Gimbi General Hospital and Gimbi Health Center, respectively. There were no ART naïve HIV seropositive at these facilities. The sample was corrected using the following formula (68).

$$n_{corr} = \frac{n}{1 + \frac{n}{N}}$$

Then by substituting these numbers into the formula and adding 10% non-respondents, the corrected sample size for HIV seropositive group was 272. The sample size was proportionally allocated based on the number of peoples on-ART in each facility. Hence, sample size was allocated as (426x272)/762= 152 participants from Gimbi General Hospital and (336x272)/762=120 from Gimbi Health Center.

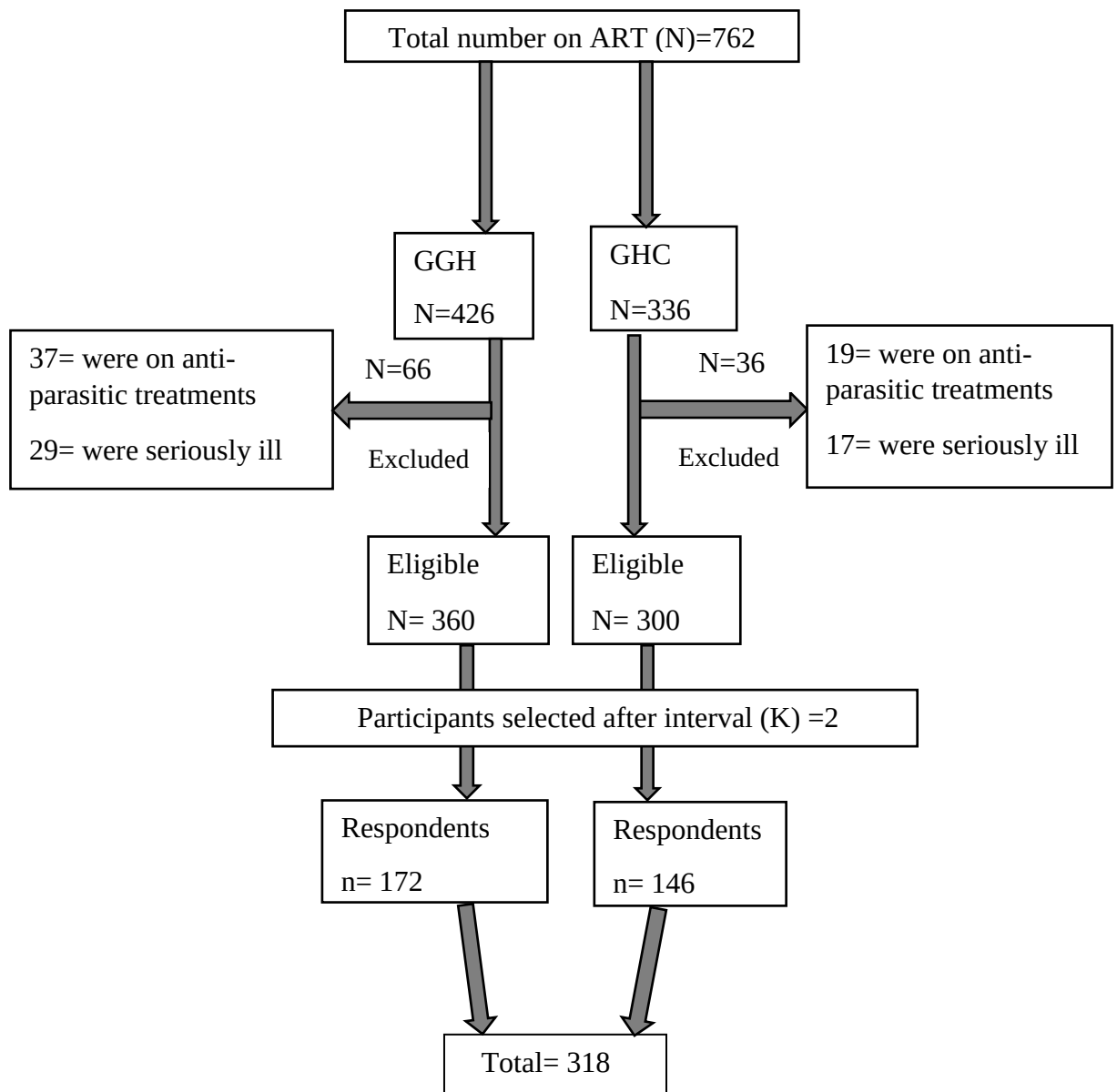
The number of HIV sero-negative population was estimated using previous 60 days' data from logbook and found 5 clients per day at Gimbi General Hospital and 3 clients per day at Gimbi Health Center. Hence, the calculated population size at each health facility was 300 from Gimbi General Hospital and 180 from Gimbi Health Center. The sample size corrected for HIV seronegative population was 228 after adding 10% non-respondents. This was allocated to Gimbi General Hospital as $(228 \times 300) / 480 = 142$ and Gimbi Health Center as $(228 \times 180) / 480 = 86$.

4.6. Sampling Technique

Systematic Random Sampling was used to select HIV seropositive study participants from both facilities. The interval was calculated for each health facility. The interval (k) was determined by dividing number of study population in each Facility by respective sample size. It was 2.8 for HIV seropositive populations in both Health Facilities. The interval was rounded off to 2, after which every subject was selected except the first study unit that was selected by lottery method from the first 2 individuals in the sampling frame. Similarly, the interval, k , was also estimated for HIV seronegative participants, giving 2.1, which was rounded off to 2 for each Health Facility.

However, in this study, every subject after interval of 2 was selected from the eligible Populations of each study group in each Health Facility. Hence, 318 HIV seropositive respondents were composed of 172 from Gimbi General Hospital and 146 from Gimbi Health Center (Figure 2). Conversely, 12 HIV seropositive (8 from GGH and 4 from GHC) refused to participate. On the other hand, 240 HIV seronegative participants, composed of 150 from Gimbi General Hospital and 90 from Gimbi Health Center were included in this study (Figure 3). HIV seropositive study participants were selected from the list of ART follow up record as a sampling frame. HIV seronegative subjects were selected from the order in which they came to attend HIV testing services at the respective Health Facilities.

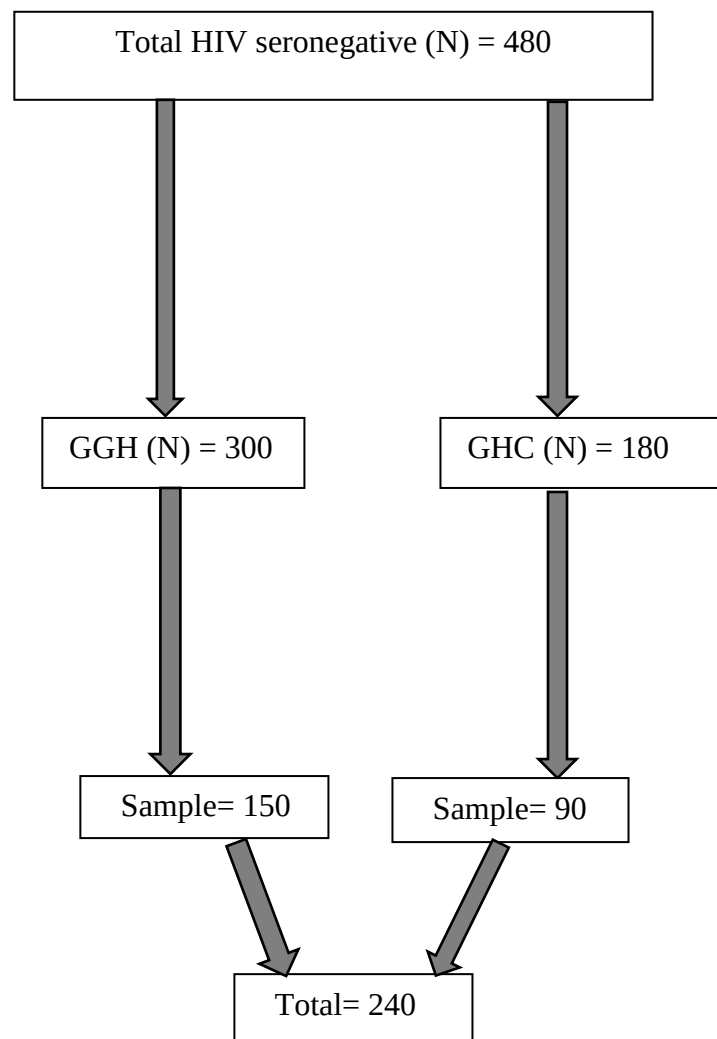
Diagram illustrating sampling procedure for HIV Seropositive population



GGH-Gimbi General Hospital; **GHC**-Gimbi Health Center

Figure 2: Diagrammatic illustration of sampling procedures for HIV seropositive population

Diagram illustrating sampling procedure for HIV Seronegative population



GGH-Gimbi General Hospital; **GHC**-Gimbi Health Center; **N**-Number

Figure 3: Diagrammatic illustration of sampling procedures for HIV seronegative population

4.7. Data Collection

4.7.1. Data on Socio-demographic and other factors

Data of socio-demographic characteristics along with hygiene and health behavior practices, were gathered using interviewer-administered questionnaires ([Appendix-A](#)).

4.7.2. Laboratory Examination

Direct saline wet mount: Stool sample was collected from each participant in a clean, dry, leak proof and wide-mouthed stool caps that was labeled with participant's Id, date and time of data collection. A drop of normal saline was placed in the center of the Microscope slide. Using applicator stick, match-head sized stool sample was mixed with normal saline in the center of microscope slide. The smear was covered with Coverslip gently. The slide was examined under 10X and 40X objective lenses. The results were recorded.

Formol-ether sedimentation technique: About 1 gram (pea-size) of stool sample was emulsified in 4mL of 10% formalin and mixed in a beaker. Then the content was filtered through gauze into a 15mL conical centrifuge plastic tube to remove larger debris. Further, 4mL of 10% Formalin was added to the content in the centrifuge tube after which 3mL of diethyl ether was transferred to the mixture. The tube was sealed tightly with stopper. The mixture was shaken vigorously for 1 minute to mix the contents thoroughly. The mixture was centrifuged at 3000 revolution per minute for 1 minute. Using applicator stick, the fecal debris was loosen from the side of the tube and the supernatant layer decanted. The tube was returned to its upright position and the sediment was re-suspended and mixed gently. Then a drop of the sediment was placed on microscopic slide, covered with coverslip and examined using 10X and 40X Objective lenses. The result was recorded (69).

Modified Ziehl-Neelsen (Zn) method: Fecal smears were prepared and fixed in methanol for 3 minutes. Then it was stained with Carbol-fuchsin for 15 minutes. It was washed thoroughly off in tap water. The smear was de-colored using 1% acid alcohol for 15 seconds. Then it was rinsed thoroughly in tap water. The smear was counter stained with 0.5% methylene blue for 1 minute, rinsed thoroughly and air dried. Finally, it was examined using 40X and 100X objective lenses. Acid fast parasites (i.e. *Cryptosporidium spp.* and *I. belli*) stained pink-red while the background appeared blue (69).

CD4+ Cells count

Qualified medical laboratory staff conducted cluster of differentiation 4 (CD4+) cell counts using fluorescence-activated cell sorting (BD FACS, Becton Dickinson, USA), following the manufacturer's instructions. Blood samples were aseptically drawn via venipuncture into ethylene diamine tetra acetic acid (EDTA) containing vacuum tubes. The samples were mixed thoroughly to avoid clotting, properly labeled and placed on a gentle rocker to maintain even distribution before analysis.

After quality control checks were completed and passed, CD4+ T-Cells analysis was carried out using a FACS count automated system (Becton Dickinson, USA). Each pair of reagent tubes was labeled and vortexed in both upright and inverted positions for approximately 5 seconds. Then, 50µL of anticoagulated blood was added to each tube using a coring station, followed by five gentle inversions. The tubes were vortexed upright for another 5 seconds and incubated at room temperature in the dark for an hour. Subsequently, 50µL of fixative solution was added, mixed again for 5 seconds using the vortex and left to incubate for 30 minutes. The samples were then run on the FACS machine and the results were printed.

4.8. Data Quality Control

Data was collected by two BSc. nurses from ART Clinics staffs, in each health facility and two laboratory professionals, similarly from both health facilities. To ensure quality, data collectors received training before starting data collection. The entire data collection process was closely supervised. Stool caps which were dry, leak-proof and free from grease and labeled with participant's Id, date and time of stool sample collection was used. All laboratory materials and reagents were inspected for their expiration dates and stored correctly. All participants were informed to provide adequate stool samples free from contamination by water, soil and urine. A direct wet mount was prepared and examined within 30 minutes of stool sample collection. All microscopic observations and questionnaires' responses were encoded and recorded.

4.9. Study Variables

4.9.1. Dependent variable

- ❖ Prevalence of intestinal Parasitic Infections

4.9.2. Independent variables

- ❖ Socio-demographic variables: Sex, Age, Educational status, Occupation and Residence
- ❖ Health behavior practices: Hand washing before meal, Hand washing after toilet, Source of drinking water, Consumption of raw meat, habit of washing fruits and walking barefoot
- ❖ Variables about clinical status of HIV positive Clients: CD4+ Cells count

4.10. Statistical Analysis

Data was entered using Epidata version 4.6 and transferred to Statistical Package for Social Science (SPSS) Version 26 for analysis (IBM Corporation, Armonk, NY, USA). Descriptive statistics was performed to organize, summarize and present the overall information of independent and dependent variables. Tables, Charts and Graphs were used to present the results of descriptive analysis. Logistic regression was employed to determine the association between factors and outcome variables. Bivariate logistic regression was used to select candidate variables at p value less than 0.25. Multivariate logistic regression was performed to determine associated factors using adjusted odds ratio (AOR) along its 95% confidence interval. Pearson chi-square test was used to compare intestinal parasitic infections between HIV sero-positive and HIV sero-negative populations. P value less than 0.05 was considered statistically significant.

Assumptions of the logistic regression model such as absence of the multi-collinearity and model fitness were checked and satisfied. Regarding multi-collinearity, VIF was 1.08-1.96 for data from HIV seronegative participants and 1.06-2.67 for HIV seropositive participants. Hosmer and Lemeshow statistic found statistically insignificant for each study group implying the data fit the model ($P > 0.05$).

4.11. Operational Definition

CD4+ cell count: Absolute CD4+ cell count per μL was performed and recorded for each individual study participant. CD4+ cell count per μL then categorized into less than 200/ μL , 200 to 499/ μL and greater 499 CD4+ cell/ μL (34).

Intestinal parasitic infection: a study participant is said to be infected if he/she is infected with atleast a single species of intestinal parasite. If parasite present, it was categorized as positive and if the parasite absent, it was categorized as negative (70).

4.12. Ethical consideration

This study was ethically approved and clearance (Ref: [IHSREC/006/053/2025](#)) was obtained from the Research Ethics Review Committee, Institute of Health Sciences, Wallaga University. Letters of Permission was taken from the West Wollega Zonal Health Bureau and Health facilities' managers before contacting study populations. All study participants with age 18 years and above were informed about the study and confidentiality ([Appendix-B](#)). Their participation was only after they their consent obtained ([Appendix-C](#)).

For children, aged less than 18 years old, the objective of the study, the confidentiality of their information and anonymity of the data were explained to their parents or legal guardians ([Appendix-D](#)). Adequate information was given to the children concerning the study and its purpose, as well as their rights and confidentiality of their information ([Appendix-E](#)). Then, informed consent was obtained from parents or legal guardians of those children ([Appendix-F](#)) in addition to their child's assent ([Appendix-G](#)). Hence, data was obtained only after consent and/or assent was obtained.

5. RESULTS

5.1. Sociodemographic characteristics of study participants

In this study, 318 (96.36%) HIV seropositive and 240 (100%) HIV seronegative individuals were participated. The mean age of HIV seropositive population was 36.65 ± 12.42 (95%CI: 35.28, 38.02); whereas that of HIV seronegative population was 36.36 ± 12.29 (95%CI: 34.80, 37.92). There was no significant difference in mean age between the two study populations ($t= 0.27$ at $df=556$, 95%CI: -1.79 to 2.37, P value= 0.78).

Majority of study participants were female (64.5%, 64.2%), age 31 to 49 years (55%, 55.8%), urban residents (79.2%, 78.7%), achieved secondary level of education (45.6%, 48.3%) and merchant (28.9%, 30.0%) for HIV seropositive and HIV seronegative respondents, respectively ([Table 1](#)).

There was no statistically significant difference between HIV seropositive and HIV seronegative populations with respect to Sex ($X^2= 0.01$, $P=0.94$), Age group ($X^2=1.09$, $P= 0.78$), Residence ($X^2= 0.02$, $P= 0.89$), Educational status ($X^2=2.49$, $P= 0.48$) and Occupation ($X^2=0.46$, $p= 0.99$) ([Table 1](#)).

Table 1: Sociodemographic characteristics of HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town, January to March 2025.

Variables	HIV seropositive N (%)	HIV seronegative N (%)	X²	P value
Sex				
Male	113 (35.5)	86 (35.8)	0.01	0.94
Female	205 (64.5)	154 (64.2)		
Age Group				
<15 years	11 (3.5)	12 (5.0)	1.09	0.78
15-30 years	83 (26.1)	61 (25.4)		
31-49 years	175 (55.0)	134 (55.8)		
> 49 years	49 (15.4)	33 (13.8)		
Residence				
Urban	252 (79.2)	189 (78.7)	0.02	0.89
Rural	66 (20.8)	51 (21.3)		
Education				
No formal education	23 (7.2)	14 (5.8)	2.49	0.48
Primary level	89 (28.0)	56 (23.3)		
Secondary level	145 (45.6)	116 (48.3)		
College & above	61 (19.2)	54 (22.5)		
Occupation				
Farmer	34 (10.7)	28 (11.7)	0.46	0.99
Daily laborer	70 (22)	51 (21.3)		
Soldier	32 (10.1)	23 (9.6)		
Merchant	92 (28.9)	72 (30.0)		
Student	30 (9.4)	24 (10.0)		
Driver	26 (8.2)	19 (7.9)		
Employee	34 (10.7)	23 (9.6)		

Statistical difference was assessed using Pearson Chi squared (X²) test at 95% confidence level. N: number of observations in each category

5.2. Prevalence of intestinal parasitic infection among study participants

The overall prevalence of intestinal parasitic infection was 38.68% (123/318) (95%CI: 33.29%, 44.06%), among HIV seropositive study participants (Figure 4). The prevalence was lower with wetmount, 30.2% (96/318) compared to Formol-ether sedimentation method, 36.8% (117/318). Modified Ziehl-Neelsen indicated that 2.8% (9/318) (95% CI: 1.3%, 5.3%) of HIV seropositive participants were infected with opportunistic parasites, of which majority was *Cryptosporidium spp.* (7/9) followed by *Isospora belli*.

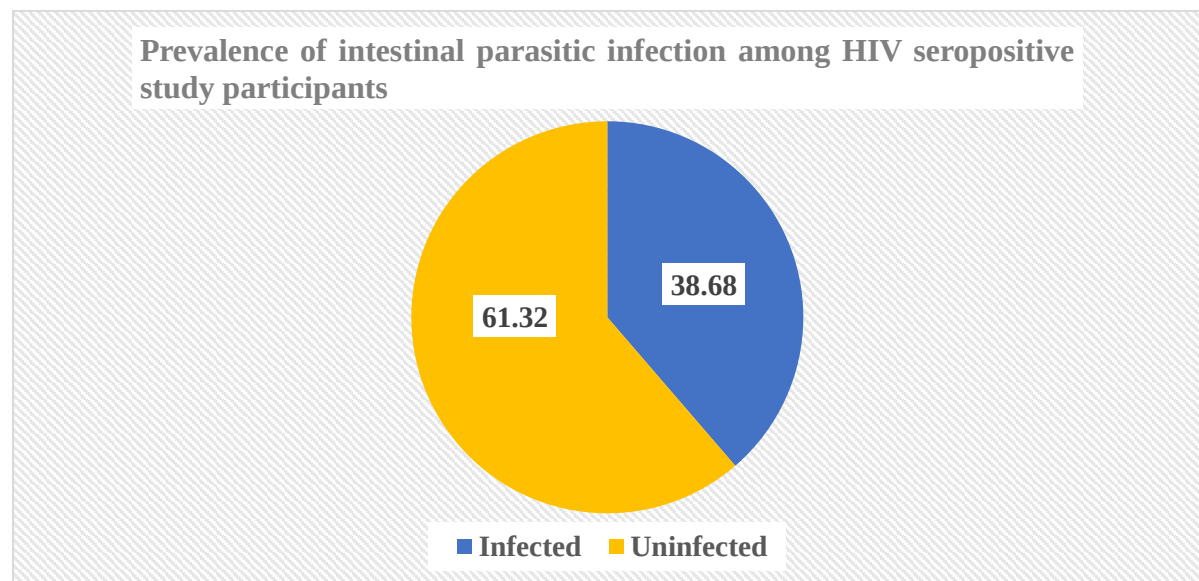


Figure 4: Intestinal parasitic infection among HIV seropositive study participants at Public Health Facilities in Gimbi town, January to March 2025.

Among HIV seronegative participants, 28.33% (68/240) (95% CI: 22.59%, 34.08%) were infected with intestinal parasites (Figure 5). The prevalence was 19.6% (47/240) with wetmount and 27.5% (66/240) with Formol-ether sedimentation. None of the HIV seronegative study participants infected with intestinal coccidia parasites as tested by Modified Ziehl-Neelsen staining procedure. The prevalence of intestinal parasitic infection in this study was higher for HIV seropositive participants compared to HIV seronegative study group. There was significant difference in prevalence of intestinal parasitic infection between HIV seropositive and HIV seronegative study participants ($X^2=6.5$, $P=0.01$).

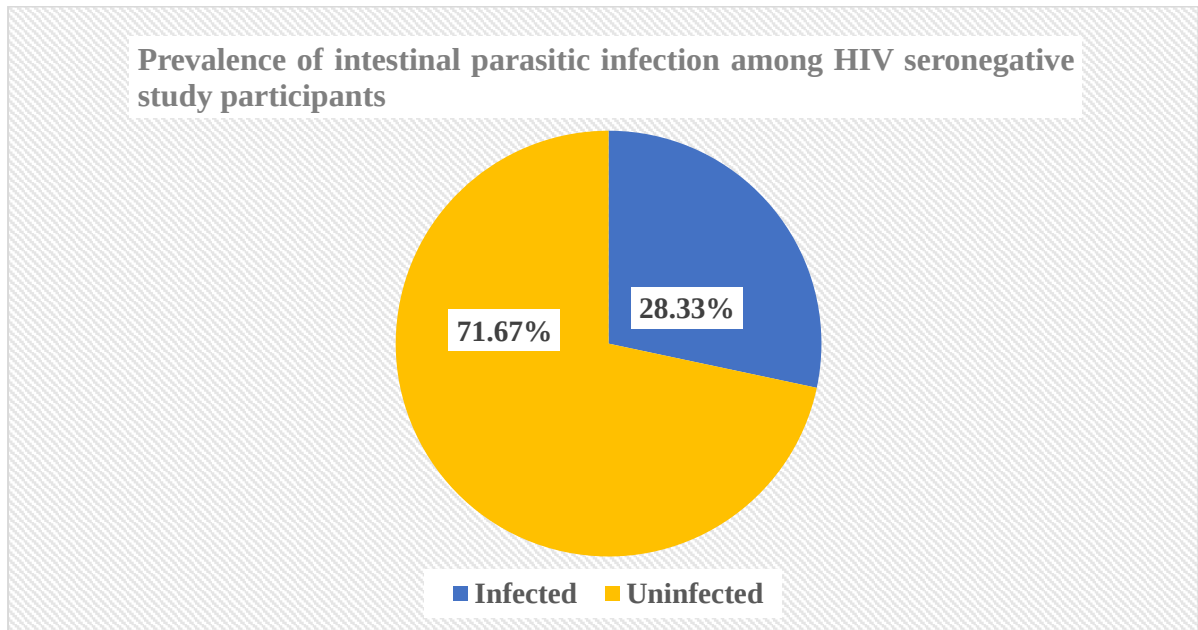


Figure 5: Intestinal parasitic infection among HIV seronegative study participants at Public Health Facilities in Gimbi town, January to March 2025.

In this study, intestinal parasites including *Giardia lamblia*, *Entamoeba histolytica/dispar*, *Ascaris lumbricoids* and *Hookworm* were isolated from both study groups. However, the opportunistic intestinal Coccidia, *Cryptosporidium species* and *Isospora belli*, were detected in HIV seropositive participants. Co-infection of *Cryptosporidium spp.* and *G. lamblia* was identified in HIV seropositive participants.

Of the detected intestinal parasites, *G. lamblia* was the most frequent, followed by *E. histolytica/dispar*, in both study groups. However, the number was higher for HIV seropositive populations compared to HIV seronegative participants. On the contrary, infection with *A. lumbricoids* was found higher among HIV seronegative than that of HIV seropositive respondents.

Distribution of intestinal parasites among infected HIV seropositive study participants

The most frequent intestinal parasite was *G. lamblia* (55/123, 44.7%), after which *E. histolytica/dispar* (51/123, 41.5%), *A. lumbricoids* (6/123, 4.9%), *Cryptosporidium* spp. (4/123, 3.3%), *Hookworm* (2/123, 1.6%) and *I. belli* (2/123, 1.6%). Co-infection of *G. lamblia* and *Cryptosporidium* spp. was detected in 2.4% (3/123) of HIV seropositive study participants infected (Figure 6).

Distribution of intestinal parasites among infected HIV seronegative study participants

Among identified intestinal parasites, *G. lamblia* was the leading (34/68, 50%), followed by *E. histolytica/dispar* (24/68, 35.2%), *A. lumbricoids* (8/68, 11.8%), and *Hookworm* (1/24, 1.5%) while one case was identified with co-infection of *A. lumbricoids* and *Hookworm* (1/24, 1.5%) (Figure 6).

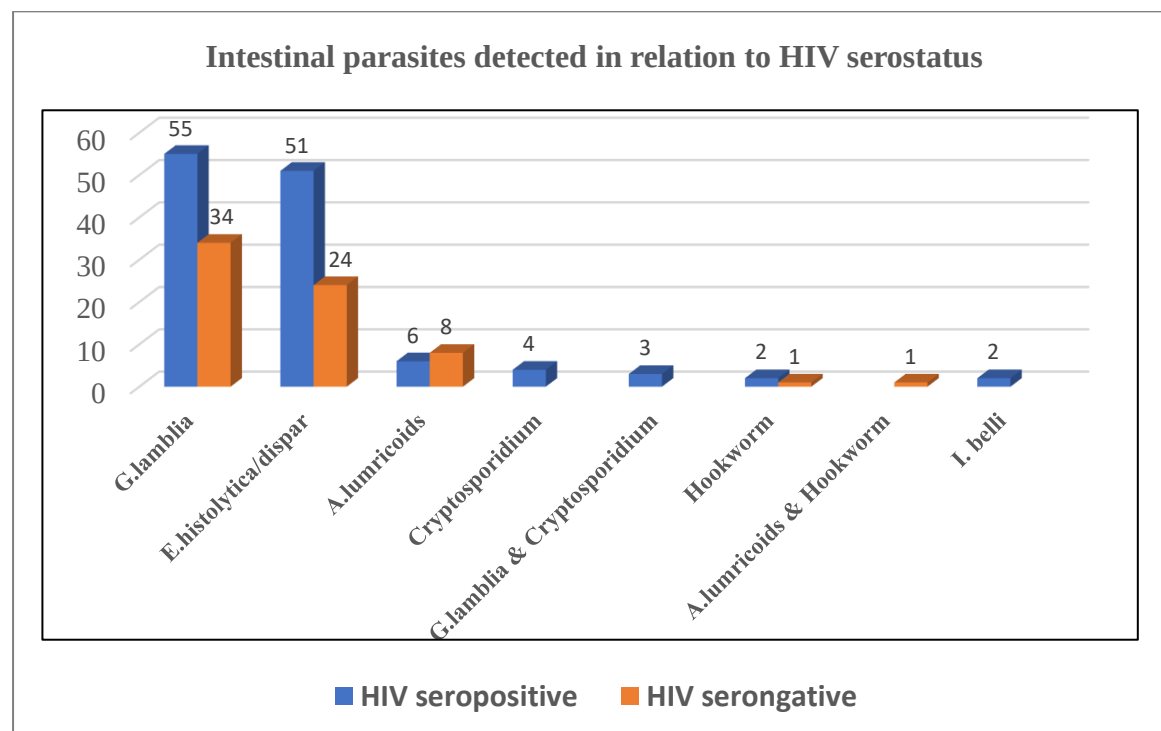


Figure 6: Distribution of intestinal parasites detected in relation to HIV serostatus of study participants at Public Health Facilities in Gimbi town, January to March 2025.

5.3. Health Behaviors Practices of study participants

Most of the HIV seropositive and HIV seronegative study participants, respectively, drunk from pipe water (60.7% and 58.8%), had habit of washing their hands sometimes after toilet (41.5% and 38.8%), had habit of washing their hands with soap and water always before meal (43.4% and 46.3%), wash fruits always before they eat (65.7% and 65.4%), do not eat raw meat (82.4% and 87.5%) and never walk barefoot (74.8% and 81.7%) ([Table 2](#)).

Source of drinking water ($X^2=0.63$, $p=0.89$), habit of hand washing with soap after toilet ($X^2=0.91$, $p=0.82$), habit of hand washing with soap before meal ($X^2=0.48$, $p=0.79$), washing Fruits before consumption ($X^2=1.45$, $p=0.48$) and eating raw meat ($X^2=2.29$, $p=0.13$) showed no significant difference between the two study groups. However, there was significant difference in walking barefoot between HIV seropositive and HIV seronegative study participants ($X^2=6.24$, $p=0.044$) ([Table 2](#)).

The mean CD4+ cells count of HIV seropositive population was 639.93 ± 227.29 CD4+ Cells/ μ L (95%CI:614.85-665.00). Majority of HIV seropositive respondents had CD4+ Cell counts higher than 499 CD4+ Cells/ μ L followed by CD4+ Cell count 200-499/ μ L of whole blood.

Table 2: Variables related to health behavior practices among HIV seropositive and HIV seronegative populations attending Public Health Facilities in Gimbi town, January to March 2025.

	HIV seropositive	HIV seronegative		
Variables	N (%)	N (%)	X ²	P value
Source of drinking water				
Bottled water	23 (7.2)	17 (7.1)	0.63	0.89
Pipe water	193 (60.7)	141 (58.8)		
Ground water	53 (16.7)	39 (16.2)		
Surface water	49 (15.4)	43 (17.9)		
Hand washing with soap after toilet				
Always	79 (24.8)	61 (25.4)	0.91	0.82
Sometimes	132 (41.5)	93 (38.8)		
Use water only	41 (12.9)	37 (15.4)		
Not wash at all	66 (20.8)	49 (20.4)		
Hand washing with soap before meal				
Always	138 (43.4)	111 (46.3)	0.48	0.79
Yes, sometimes	117 (36.8)	85 (35.4)		
Use water only	63 (19.8)	44 (18.3)		
Washing fruits				
Always	209 (65.7)	157 (65.4)	1.45	0.48
Sometimes	76 (23.9)	51 (21.3)		
No	33 (10.4)	32 (13.3)		
Eat raw meat				
No	262 (82.4)	209 (87.1)	2.29	0.13
Yes	56 (17.6)	31 (12.9)		
Walking bare foot				
Always	12 (3.8)	12 (5.0)	6.24	0.044*
Sometimes	68 (21.4)	32 (13.3)		
No	238 (74.8)	196 (81.7)		
CD4+ Cells Count		ND	—	—
>499/μL	224 (70.4)	—		
200-499/μL	78 (24.5)	—		
<200/μL	16 (5)	—		

Statistical difference was assessed using Pearson Chi squared (X²) test at 95% confidence level.

N: number of observations in each category; * statistically significant; ND: Not Done

5.4. Factors Associated with Intestinal Parasitic Infection among HIV seropositive populations

Bivariable logistic regression of sociodemographic characteristics revealed that residence, educational level and occupation were selected for multivariate logistic analysis ($p < 0.25$). However, only residence was associated with occurrence of intestinal parasitic infection ($p < 0.05$). Odd of intestinal parasitic infection was found 2.36 times higher for rural residents compared to urban residents among HIV seropositive study participants (AOR: 2.36, 95%CI:1.19-4.68; $P=0.014$) (Table 3).

Table 3: Association of Sociodemographic factors among HIV Seropositive populations at public Health Facilities in Gimbi town, January to March, 2025.

	Intestinal parasitic infection					
Variables	positive	Negative	COR (95%CI)	P value	AOR (95%CI)	P value
Sex						
Male	48 (39.0)	65 (33.3)	1.28 (0.80-2.05)	0.30	-	-
Female	75 (61.0)	130 (66.7)	1			
Age Group						
<15 years	5 (4.1)	6 (3.1)	2.31 (0.60-8.86)	0.22	-	-
15-30 years	35 (28.5)	48 (24.6)	2.02 (0.94-4.36)	0.07	-	-
31-49 years	70 (56.8)	105 (53.8)	1.85 (0.91-3.73)	0.09	-	-
>=50 years	13 (10.6)	36 (18.5)	1			
Residence						
Rural	38 (30.9)	28 (14.4)	2.67 (1.53-4.64)	0.001*	2.36(1.19-4.68)	0.014*
Urban	85 (69.1)	167 (85.6)	1		1	
Education						
No formal	15 (12.2)	8 (4.1)	4.47 (1.62-12.41)	<0.004*	3.91 (0.83-18.51)	0.09
Primary	46 (37.4)	43 (22.1)	2.56 (1.28-5.09)	0.008*	1.92 (0.57-6.44)	0.29
Secondary	44 (35.8)	101 (51.8)	1.04 (0.54-2.00)	0.91	-	-
College	18 (14.6)	43 (22.1)	1		1	
Occupation						
Farmer	15 (12.2)	19 (9.7)	1.89 (0.69-5.15)	0.21		
Daily Laborer	37 (30.1)	33 (16.9)	2.69 (1.12-6.45)	0.026*	1.28 (0.26-5.57)	0.81
Soldier	12 (9.7)	20 (10.3)	1.44 (0.52-4.03)	0.49	-	-
Merchant	29 (23.6)	63 (32.3)	1.11 (0.47-2.61)	0.82	-	-
Student	13 (10.6)	17 (8.7)	1.84 (0.65-5.15)	0.25	-	-
Driver	7 (5.7)	19 (9.7)	0.88 (0.28-2.76)	0.83	-	-
Employee	10 (8.1)	24 (12.3)	1			

AOR: Adjusted Odds Ratio, CI: Confidence Interval, COR: Crude Odds Ratio * statistically significant

Bivariable logistic analysis of variables related to health behavior practices and CD4+ cells count showed that hand washing after toilet, hand washing before meal, habit of washing fruits before consumption and CD4+ Cells count were significantly related to occurrence of intestinal parasitic infection ($p < 0.05$). In multivariate logistic regression, hand washing after toilet, hand washing before meal, habit of washing fruits before eating and CD4+ Cells count were significantly associated with intestinal parasitic infections ($P < 0.05$) (Table 4).

Study participants who did not have habit of hand washing after toilet were 3.59 times (AOR=3.59, 95%CI:1.57 to 8.24; $p=0.003$) more likely infected with intestinal parasites compared to those who wash their hands with water and soap always after latrine. Furthermore, the odd of intestinal parasitic infection was over five times higher among those who wash their hands with water only compared to participants who wash their hands using water and soap always before meal (AOR=5.11, 95%CI:2.42-10.78). HIV seropositive study participants who did not wash fruits were 4.39 times more likely infected with intestinal parasitic infection compared to those who wash fruits always (AOR=4.39; 95%CI: 1.62-11.96; $p=0.004$). HIV seropositive participants with CD4+ Cells count $< 200/\mu\text{L}$ were 3.69 times (AOR= 3.69; 95%CI=1.09-12.56; $P=0.03$) and whose CD4+ Cells count 200-499/ μL were 3.54 times (AOR=3.54, 95%CI:1.89-6.60; $P < 0.001$) more likely infected with intestinal parasites compared to those with CD4+ Cells count $> 499/\mu\text{L}$ (Table 4).

Table 4: Association of health behavior practices and CD4+ counts among HIV Seropositive populations at public Health Facilities in Gimbi town, January to March, 2025.

	Intestinal parasitic infection					
Variables	Positive	Negative	COR (95%CI)	P value	AOR (95%CI)	P value
Hand washing with soap after toilet						
Not wash at all	38 (30.9)	28 (14.4)	2.77 (1.41-5.45)	0.003*	3.59(1.57-8.24)	0.003*
Use water only	19 (15.4)	22 (11.2)	1.76 (0.81-3.81)	0.15	2.34 (0.92-5.93)	0.075
Yes, sometimes	40 (32.6)	92 (47.2)	0.89 (0.49-1.61)	0.69	-	-
Yes, always	26 (21.1)	53 (27.2)	1		1	
Hand washing with soap before meal						
Use water only	43 (35.0)	20 (10.3)	5.66 (2.96-10.83)	<0.001*	5.11 (2.42-10.78)	0.000*
Ye, sometimes	42 (34.1)	75 (38.5)	1.47 (0.87-2.51)	0.153	-	-
Yes, always	38 (30.9)	100 (51.3)	1		1	
Washing Fruits						
No	26 (21.1)	7 (3.6)	8.05 (3.32-19.48)	<0.001*	4.39 (1.62-11.96)	0.004*
Sometimes	31 (25.2)	45 (23.1)	1.49 (0.87-2.57)	0.153		
Always	66 (53.7)	143 (73.3)	1			
Eat Raw meat						
Yes	23 (18.7)	33 (16.9)	1.13 (0.63-2.03)	0.69	-	-
No	100 (81.3)	162 (83.1)	1			
Source of drinking Water						
Surface water	24 (19.5)	25 (12.8)	1.80 (0.65-5.02)	0.26	-	-
Ground Water	22 (17.9)	31 (15.9)	1.33 (0.48-3.68)	0.58	-	-
Pipe water	69 (56.1)	124 (63.6)	1.04 (0.42-2.59)	0.93	-	-
Bottled water	8 (6.5)	15 (7.7)	1			
Walk barefoot						
Always	6 (4.9)	6 (3.1)	1.67 (0.52-5.35)	0.39	-	-
Sometimes	28 (22.8)	40 (20.5)	1.17 (0.68-2.03)	0.57	-	-
Never	89 (72.4)	149 (76.4)	1			
CD4 Cells count						
<200/μL	11 (8.9)	5 (2.6)	5.62 (1.88-16.83)	0.002*	3.69 (1.09-12.56)	0.036*
200-499/ μL	49 (39.8)	29 (14.9)	4.32 (2.51-7.44)	<0.001*	3.54 (1.89-6.60)	0.000*
>499/ μL	63 (51.3)	161 (82.5)	1		1	

AOR= Adjusted Odds Ratio, CI= Confidence Interval, COR= Crude Odds Ratio; * statistically significant

5.5. Factors Associated with Intestinal Parasitic Infection among HIV seronegative populations

In bivariable logistic analysis, residence, education and occupation were selected among variables related to sociodemographic characteristics. Multivariable logistic regression showed that residence was significantly associated with intestinal parasitic infection ($P < 0.05$). In the present study, among HIV seronegative study participants, rural residents were 3.65 times more likely infected compared to urban residents ($AOR = 3.65$, $95\%CI = 1.37-9.75$; $P = 0.01$) (Table 5).

Table 5: Association of sociodemographic characteristics among HIV Seronegative population at public Health Facilities in Gimbi town, January to March, 2025.

	Intestinal parasitic infection					
Variables	Positive	Negative	COR (95%CI)	P value	AOR (95%CI)	P value
Sex						
Male	26 (38.2)	60 (34.9)	1.16 (0.65-2.07)	0.63	-	-
Female	42 (61.8)	112 (65.1)	1			
Age Group						
<15 years	6 (8.8)	6 (3.5)	2.30 (0.59-8.90)	0.23	-	-
15-30 years	10 (14.7)	51 (29.7)	0.45 (0.17-1.23)	0.12	-	-
31-49 years	42 (61.8)	92 (53.5)	1.05 (0.46-2.40)	0.91	-	-
>49 years	10 (14.7)	23 (13.4)	1			
Residence						
Rural	27 (39.7)	24 (14)	4.06 (2.12-7.78)	<0.001*	3.65 (1.37-9.75)	0.01*
Urban	41 (60.3)	148 (86)	1		1	
Education						
no formal education	8 (11.8)	6 (3.5)	4.67 (1.35-16.09)	0.02*	2.32(0.39-13.84)	0.36
Primary level	17 (25.0)	39 (22.7)	1.53 (0.65-3.59)	0.34	-	-
secondary level	31 (45.6)	85 (49.4)	1.28 (0.59-2.74)	0.53	-	-
College and above	12 (17.6)	42 (24.4)	1		1	
Occupation						
Farmer	15 (22.1)	13 (7.6)	4.15 (1.20-14.33)	0.24*	0.613 (0.08-4.44)	0.628
Daily Laborer	16 (23.5)	35 (20.3)	1.65 (0.52-5.22)	0.39	-	-
Soldier	6 (8.8)	17 (9.9)	1.27 (0.33-4.93)	0.73	-	-
Merchant	12 (17.6)	60 (34.9)	0.72 (0.22-2.32)	0.58	-	-
Student	9 (13.2)	15 (8.7)	2.16 (0.59-7.85)	0.24	-	-
Driver	5 (7.4)	14 (8.1)	1.29 (0.31-5.33)	0.73	-	-
Employee	5 (7.4)	18 (10.5)	1		1	

AOR= Adjusted Odds Ratio, CI= Confidence Interval, COR= Crude Odds Ratio; * statistically significant

Hand washing after toilet, hand washing before meal and habit of washing fruits were selected among variables related to health behavior practices ($P<0.25$). Furthermore, in multivariable logistic regression, hand washing after toilet, hand washing before meal and habit of washing fruits were significantly associated with occurrence of intestinal parasitic infection among HIV seronegative participants ($p<0.05$) ([Table 6](#)).

HIV seronegative participants who did not have habit of hand washing after toilet were 3.6 times ($AOR=3.6$, $95\%CI=1.29-10.06$; $P=0.014$) more likely infected with intestinal parasites compared to those who wash their hands always after toilet. Odd of intestinal parasitic infection was 3.61 times higher among study participants who had habit of washing their hands with water only ($AOR=3.61$, $95\%CI=1.39-9.38$; $P=0.008$) when compared with study participants who had habit of washing their hands with water and soap always before meal. In addition, the odd of intestinal parasitic infection was found 3.21 times more among HIV seronegative study participants who did not have habit of washing fruits compared to those who did wash fruits always ($AOR= 3.21$, $95\%CI=1.19-8.68$; $P=0.02$) ([Table 6](#)).

Table 6: Association of health Behavior practices among HIV Seronegative populations at public Health Facilities in Gimbi town, January to March, 2025.

Variables	Intestinal parasitic infection		COR (95%CI)	P value	AOR (95%CI)	P value
	Positive	Negative				
Hand washing with soap after toilet						
Not wash at all	24 (35.3)	25 (14.5)	3.92 (1.69-9.12)	0.002*	3.60 (1.29-10.06)	0.014*
Use water only	18 (26.5)	19 (11.0)	3.87 (1.57-9.54)	0.003*	2.24 (0.73-6.86)	0.16
Yes, sometimes	14 (20.6)	79 (5.9)	0.72 (0.31-1.69)	0.46	-	-
Yes, always	12 (17.6)	49 (28.5)	1		1	
Hand washing with soap before meal						
Use water only	26 (38.2)	18 (10.5)	6.57 (3.04-14.22)	<0.001*	3.61 (1.39-9.38)	0.008*
Yes, sometimes	22 (32.4)	63 (36.6)	1.59 (0.80-3.15)	0.19		
Yes, always	20 (29.4)	91 (52.9)	1		1	
Washing Fruits						
No	16 (23.5)	16 (9.3)	3.76 (1.70-8.29)	0.001*	3.21 (1.19-8.68)	0.02*
Sometimes	19 (27.9)	32 (18.6)	2.23 (1.12-4.43)	0.02*	1.84 (0.78-4.35)	0.16
Always	33 (48.6)	124 (72.1)	1		1	
Eat Raw meat						
Yes	11 (16.2)	20 (11.6)	1.47 (0.66-3.25)	0.69	-	-
No	57 (83.3)	152 (88.4)	1			
Source of drinking Water						
Surface water	21 (30.9)	22 (12.8)	1.75 (0.55-5.59)	0.35	-	-
Ground Water	8 (11.8)	31 (18.0)	0.47 (0.13-1.67)	0.25	-	-
Pipe water	33 (48.5)	108 (62.3)	0.56 (0.19-1.63)	0.29	-	-
Bottled water	6 (8.8)	11 (6.4)	1			
Walk barefoot						
Always	5 (7.4)	7 (4.1)	1.93 (0.59-6.34)	0.28	-	-
Sometimes	10 (14.7)	22 (12.8)	1.23 (0.55-2.76)	0.62	-	-
Never	53 (77.9)	143 (83.1)	1			

AOR= Adjusted Odds Ratio, COR= Crude Odds Ratio, CI= Confidence Interval.

* statistically significant

6. DISCUSSION

Information regarding the magnitude of intestinal parasitic infection and factors leading to their distribution is crucial for planning and implementing appropriate intervention for their control and prevention. The aim of this study was to determine the prevalence of intestinal parasitic infection and to identify factors associated with IPI among HIV seropositive and HIV seronegative populations attending Public health facilities in Gimbi town.

In this study the prevalence of Intestinal parasitic infection was 38.68% (95%CI: 33.29%, 44.06%) among HIV seropositive study participants, which was found higher compared to that of HIV seronegative study participants, 28.33% (95% CI: 22.59%, 34.08%).

Similarly, higher prevalence of intestinal parasitic infection among HIV seropositive than HIV seronegative populations were reported in previous studies conducted in Nekemte (62.2% vs 18.3%) (34) & Dessie (23.2% vs 20.7%) (14), Ethiopia. As the immune system is instrumental for protecting against infectious diseases, its failure unquestionably results in susceptibility to those infections, including intestinal parasites. The higher Prevalence of IPI in HIV seropositive compared to HIV seronegative participants was likely due to lowered immune response to intestinal parasites among HIV seropositive population.

In contrast to the present finding, higher prevalence of intestinal parasitic infection among HIV seronegative than HIV seropositive participants were reported in a study conducted in Nigeria, where the prevalence of intestinal parasitic infection was 52.7% in HIV seronegative and 20.9% in HIV seropositive (2) & Gabon, in which the prevalence was 72.1% in HIV seronegative and 42.6% in HIV seropositive participants (71). This paradox could be related to variability in sociodemographic, socioeconomic status and/or difference in level of exposure between HIV seropositive and HIV seronegative populations studied.

Compared to the prevalence of IPIs among HIV seropositive participants in the current study, different studies reported Lower prevalence of intestinal parasitic infection. Previous studies in Ethiopia including, 29.1% from Bule Hora (48), 13.9%, Kombolcha (72), 20%, Gondar (73), 31.5%, Mizan Tepi (74), 28.18%, Arba Minch (75); and from Africa: 11.95% from Uganda (45), 5.97% from Ghana (1), 28.5% & 25.7% from Nigeria (28, 76) and 30%,

Cape town (77) and South America: Colombia (29.2%) (78) reported lower rate of intestinal parasitic infection than the finding in the present study.

Higher prevalence of intestinal parasitic infection among HIV seropositive population was reported in Niger Republic (79). The difference between these findings could be due to geographical location, socioeconomic status and hygienic practices. Research findings confirmed that geographical location (80), socioeconomic status(81), and hygienic practices(82) impact the distribution of intestinal parasitic infection.

In the current study, *G. lamblia* was found the most frequent intestinal parasite detected followed by *E. histolytica/dispar* among both study populations This finding was in line with study done in Ethiopia: Nekemte town (34), Bule Hora (48) and from Africa: Uganda (45) and Ghana (1). Similarities in these findings were likely related to similar distribution of intestinal parasites, socioeconomic status and/or similar diagnostic methods employed.

In contrast to this finding, reports from Kombolcha (72) and Gondar (73) in Ethiopia, and India (83) found that *E. histolytica/dispar* was the most frequent followed by *G. lamblia*.

In addition, lower rate of these parasites was reported in studies in Cameroon (51, 84). The observed difference in prevalence of the detected intestinal parasites in these findings was likely related to Geographical difference in distribution of these parasites, or sociodemographic difference among studied population.

The prevalence of *Cryptosporidium spp.* and *I. belli* was 3.3% and 1.6%, respectively among HIV seropositive participants. The prevalence of these opportunistic parasites were lower than previous studies done in Ethiopia: Felege Hiwot Referral Hospital (85), Debreabor Comprehensive Specialized Hospital (86), Gondar University Referral Hospital (73), Arba Minch (75); from Africa: Uganda (45), Cameroon (87), Nigeria (28, 88, 89) and World: Iran (5). Compared to the present finding of *Cryptosporidium spp.* and *I. belli*, lower rate of infection with these parasites among HIV seropositive populations were reported in studies conducted in Ethiopia: Kombolcha (72) and Gondar (73); and World: India(90). The existing difference in these findings could be due to variability in epidemiological distribution of *Cryptosporidium spp.* and *I. belli*, ART access and treatment of opportunistic parasites or difference in study period.

Co-infection of *Cryptosporidium spp* with *G. lamblia* was found 2.4% among HIV seropositive study participants. The co-infection of both parasites among HIV seropositive population was also reported in India (91).

Co-infection of *G. lamblia* and *Cryptosporidium spp.* is a significant concern among HIV/AIDS patients, leading to increased morbidity and complications (92). Furthermore, these could be due to common mode of transmission, weakened immune response or poor hygiene practices.

In this study, rural residence was found significantly linked with occurrence of intestinal parasitic infection among HIV seropositive and HIV seronegative groups. This finding was in line with study reports from Gondar, Ethiopia (93), Nigeria (94), China (95) and Iran (96). The consistent findings in these studies likely due to similar sociodemographic backgrounds, limited access to health care services, poor sanitation and hygiene, cultural and behavioral factors or environmental factors rural residents.

Study indicated that improvements in hygiene and education resulted in reduced incidence of intestinal parasitic infection (97). In contrast to this finding, study done at Dessie Referral Hospital reported that rural residence was not significantly related to occurrence of intestinal parasitic infection (46). This could be due to difference in sociodemographic status, level of hygiene and sanitation as well as awareness as these factors affect the incidence of intestinal parasitic infection.

The present study showed that participants who did not have habit of washing their hands after toilet were more likely infected by intestinal parasites compared to those who wash their hands with soap and water always after toilet among both study groups. Similar findings were reported from Ethiopia, including Debarq (57), Southern Ethiopia (4), Dessie Referral Hospital (46), South Wollo (98) and other regions of the World, such as Iran (96) and China (95). Consistent findings across these studies likely related to similar cultural and behavioral factors, sanitation and hygiene practices.

The current study found that lack of hand washing with soap and water before meal was significantly associated with occurrence of intestinal parasitic infection among both study groups. This finding was in line with the finding of the study conducted at University of Gondar Hospital, Northwest Ethiopia (99), in Southern Ethiopia (4, 100) and Mekelle (101). These consistent findings are possibly related to similar level of sanitation and hygiene, cultural and behavioral resemblances or socioeconomic status.

The odd of intestinal parasitic infection was higher among study participants who did not wash fruits compared to those who wash fruits. This finding was in line with studies done in Mizan-Tepi (74). Likewise, studies conducted in Bule Hora (102), and systematic review and meta-analyses in Ethiopia (103, 104) as well as study in Plateau state, Nigeria (105) revealed that fruits were considerably contaminated by intestinal parasites. The findings across these studies were possibly linked to low level of sanitation and hygiene or low socioeconomic status.

In this study, HIV seropositive study participants with CD4⁺ cells count less than 200/ μ L and 200-499/ μ L were found 3.69 and 3.54 times, respectively, at higher risk of getting intestinal parasitic infection compared to those with CD4⁺ count more than 499/ μ L. The association of lower CD4 counts and intestinal parasite were reported from Bule Hora (48), Dessie (46), Felege Hiwot Referral Hospital (85), Arba Minch (75) and other regions of the World, such as Nepal (106) and India (83).

7. STRENGTH AND LIMITATIONS

This study was conducted on adequate sample size for each study group. The process of data collection and analysis was performed with care. Despite the strength of this study, there were limitations that are noteworthy. This study did not include Baermann method for diagnosis of *S. stercolaris*, Kato-Kats method that is particularly used for soil transmitted helminths due to lack of resources.

Furthermore, molecular technique was not performed for differentiation of *E. histolytica* from *E. dispar* as well as *Cryptosporidium Species*. Hence, these limitations could affect the prevalence and species-specific distribution of those parasites.

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

High prevalence of intestinal parasitic infections was detected among both study populations, but the prevalence was significantly higher for HIV seropositive study participants ($X^2 = 6.5$, $P = 0.01$). *G. lamblia*, *E. histolytica/dispar*, *A. lumbricoids* and Hookworm were isolated in both study participants. *Cryptosporidium spp.* and *I. belli* were detected only among HIV seropositive respondents.

Moreover, rural residence, lack of hand washing after latrine, hand washing with water only before meal and eating fruits without washing were significantly linked to prevalence of intestinal parasitic infection among both study participants. Lower CD4+ Cells count was significantly related with occurrence of intestinal parasitic infection among HIV seropositive participants.

8.2. Recommendation

Based on findings of this study, the following clinical and public health measures are recommended;

- Regular screening and treatment for the intestinal parasites among the study population
- Appropriate strategic intervention targeting rural residents of study population should be in place and implemented.
- Findings of this study were suggestive of low level of hygiene and poor health behaviors practices. Hence, there is need of hygiene improvement like proper hand washing after toilet and before meal and washing fruits before consumption.
- Improving health education on regular hand washing, proper sanitation, and hygiene practices can significantly reduce the spread of these infections.

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10. APPENDICES

Appendix-A: Questionnaires (34)

Instruction: Choose the correct answer for you from the given alternatives and fill the blank space provided for respective questions.

Section 1: Socio-demographic characteristics

S/N	Questionnaires	Response category	Remarks
101	Sex at birth	1. Male 2. Female	
102	How old are you?	_____ year (s)	
103	Where do you live?	1. Rural 2. Urban	
104	What is your occupation?	1. Farmer 2. Daily laborer 3. Soldier 4. Merchant 5. Student 6. Driver 7. Employee (Gov't/NGO)	
105	What is your level of education?	1. No formal education 2. Primary Educational level 3. Secondary education 4. College and above	

Section 2: Variables related to health behavior Practices

S/N	Questionnaires	Response Category	Remarks
201	Do you wash your hand with soap and water after toilet?	1. Yes, Always 2. Yes, Sometimes 3. I wash with water only 4. No, never	
202	Do you wash your hand with soap and water before meal?	1. Yes, Always 2. Yes, Sometimes 3. I wash with water only	
203	Do you wash fruits before you eat them?	1. Yes, always 2. Yes, sometimes 3. No, never	
204	Do you eat raw meat?	1. Yes 2. No	
205	Where do you get water for drinking?	1. Surface water (river, lake, spring) 2. Unprotected Ground water 3. Pipe water 4. Bottled water	
206	Do you walk bare-foot in the field?	1. Yes, always 2. Yes, sometimes 3. No, never	

Section 3: Clinical and Laboratory results data

T/L	Questionnaires	Response category	Remarks
301	CD4 Cells count	_____ per microliter of blood	
302	Intestinal parasite (wetmount)	1. Detected 2. Not detected	
303	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist
304	Intestinal parasite (with FECT)	1. Detected 2. Not detected	
305	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist
306	Modified ZN	1. Detected 2. Not detected	
307	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist

FECT: Formol-Ether Concentration Technique

Appendix-A: Questionnaires (Afan Oromo Version)(34)

Qajeelfama: Gaaffilee dhiyaataniif deebii kan kee filannoowwan kennaman keessaa filachuun ykn bakka banaa kenname guutuun deebisi!

Kutaa 1: Odeeffannoo Waa’ee Hawaassummaa Hirmaataa

T.L.	Gaaffilee	Deebii	Yaada
101	Saala	1. Dhiira 2. Dhalaa	
102	Umuriin kee meeqa?	Waggaa: _____	
103	Bakka jireenyaa kee?	1. Magaalaa 2. Baadiyyaa	
104	Sadarkaa barnootaa keetii?	1. Barnoota idilee hin seenne 2. Sadarkaa 1ffaa 3. Sadarkaa 2ffaa 4. Kolleejjii ykn isaa oli	
105	Hojiin kee maali?	1. Qonnaan bulaa/tuu 2. Hojjetaa guyyaa 3. Loltuu 4. Daldalaa 5. Barataa/ttuu 6. Konkolaachisaa 7. Hojjetaa mootummaa/miti-mootummaa	

Kutaa 2: Odeeffannoo amaleeffannaa shaakala fayyaan wal-qabatan

T/L	Gaaffilee	Deebii	Yaada
201	Mana fincaanii booda harka kee saamunaa fi bishaaniin ni dhiqattaa?	1. Eeyyee, Yeroo hundumaa 2. Eeyyee, yeroo tokko tokko 3. Lakkii, Bishaan qofa fayyadama 4. Lakkii, tasumaa hin dhiqadhu	
202	Nyaata dura harka kee saamunaa fi bishaaniin ni dhiqattaa?	1. Eeyyee, yeroo hunda 2. Eeyyee, yeroo tokko tokko 3. Lakkii, Bishaan qofa fayyadama	
203	Kuduraa fi fuduraa osoo hin nyaachitin ni qulqullessitaa?	1. Eeyyee, yeroo hunda 2. Eeyyee, yeroo tokko tokko 3. Lakkii, hin qulqulleessu	
204	Foon dheedhii ni soorattaa?	1. Eeyyee 2. Lakkii	
205	Bishaan dhugaatiif madda akkamii fayyadamta?	1. Laga, Haroo ykn burqituu 2. Bishaan boollaa 3. Boombaa 4. Bishaan haayilandii	
206	Amala miila qullaa deemuu qabdaa?	1. Eeyyee, Yeroo hunda 2. Eeyyee, yeroo tokko tokko 3. Lakkii, gonkumaa	

Kutaa 3: Odeeffannoo qorannoo kiliniikaa fi laaboraatoorii irraa guutamu

T/L	Questionnaires	Response category	Remarks
301	CD4 Cells count	_____ per microliter of blood	
302	Intestinal parasite (wetmount)	1. Detected 2. Not detected	
303	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist
304	Intestinal parasite (with FECT)	1. Detected 2. Not detected	
305	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist
306	Modified ZN	1. Detected 2. Not detected	
307	If intestinal parasite is detected, specify the species isolated	_____ (list all in cases with mixed infections)	Skip this if the parasite does not exist

FECT: Formol-Ether Concentration Technique

Fedhii fi hayyama keessaaniin Qorannoo kanatti waan hirmaattaniif guddaa galatoomaa!

Appendix-B: Information sheet for adult study participants

Our esteemed study participants,

You are invited to participate in a research study entitled “Intestinal parasitic infections and their associated factors” which is conducted by Mr. Bulcha Emiru. The Ethical approval Letter for this Study has been obtained from Institute of Health Sciences, Wallaga University (Ref. No: IHSREC/006/053/2025). Your Participation in this study entirely relies on your volunteer and consent. Please read the following statements and ask for any unclear points before you agree to participate.

Objective of the Study: The aim of this Study is to determine the prevalence of Intestinal parasitic infections and their associated factors

Voluntary Participation: Your participation in this study is entirely voluntary. If you change your mind after you decided to participate, you could withdraw from the study at any time without any consequences. If you agree to participate, you are required to sign on a provided space to confirm your consent. You will be asked questionnaires to answer; provide stool and blood samples required for laboratory investigation. This will take about half an hour.

Benefit and Risks: Though there is no direct benefit from the study, in case you are infected with intestinal parasite, you will get appropriate treatment immediately. Moreover, the finding of this study was useful for control and prevention of the Intestinal Parasitic Infections. There was no risk you face by participating in this study. The minimal risk with this study is that there may be mild pain when collecting venous blood sample.

Confidentiality: We are strictly confidential with your information. None of information we gather was disclosed to the third person. We are strictly careful for your privacy and any personal identifiers was removed before analysis of the data.

Contact Information: If you have any questions or concerns, please contact me at phone: +251943279471 or Email: ebulcha100@gmail.com

Appendix-C: Informed Consent Form for adult study participants

I undersigned to confirm that, I gave my consent to participate after a clear explanation of the objective of the study in the language I understand. I clearly understood, with recognition of my right to withdraw from participating in the study if I change my mind. Therefore, I do give consent to answer the questions and give samples.

Name of participant: _____ signature: _____ Date: _____

Name of person obtaining the informed consent: _____

Signature: _____ Date: _____

Appendix-D: information sheet for parents or legal guardians of child

Dear parent(s)/Guardian(s) of the child,

Your Child is invited to participate in a research study entitled “Intestinal parasitic infections and their associated factors” which is conducted by Mr. Bulcha Emiru. The Ethical approval Letter for this Study has been obtained from Institute of Health Sciences, Wallaga University (Ref. No: IHSREC/006/053/2025). Your child's participation in this study requires your consent in addition to his/her agreement. Before you decide on behalf of your child to participate, it is important for you to understand the purpose of this study; what is required from the child when participating in this study and how it was done. Please read the following information carefully to get the points and ask any questions you may have for further clarification.

Purpose of the Study: The objective of this study is to determine the prevalence of intestinal parasitic Infections and to identify their associated factors

Procedures: If you agree to allow your child to participate in this study, he/she will answer questions and provide blood and stool samples for Laboratory examination. This will take approximately half an hour.

Benefits and Risks: Your child may not receive direct benefit; however, the information we gather and analyze was useful for control and prevention of the problem. Nevertheless, if the child is infected with intestinal parasite, he/she will get appropriate treatment immediately. There may be mild pain when collecting venous blood sample. This may make your child feel uncomfortable.

Confidentiality: All information collected was kept confidential and used only for the purposes of this study. Your child’s identity will not be revealed in any reports or publications.

Contact Information: If you have any questions or concerns, please contact me at phone: +251943279471 or Email: ebulcha100@gmail.com

Appendix-E: information sheet for children study participants

Dear participant,

You are invited to participate in a research study entitled “Intestinal parasitic infections and their associated factors” which is conducted by Mr. Bulcha Emiru. The Ethical approval Letter for this Study has been obtained from Institute of Health Sciences, Wallaga University (Ref. No: IHSREC/006/053/2025). Before you decide to participate, please read the following information carefully and ask any questions you may have.

Objective of the study: The purpose of this study is to assess the prevalence of intestinal parasitic Infections and to identify their associated factors

Voluntary Participation: Your participation in this study is entirely voluntary. If you change your mind after you decided to participate, you could withdraw from the study at any time without any consequences. If you agree to participate, you will be asked questionnaires to answer; provide stool and blood samples required for laboratory investigation. This will take about half an hour.

Benefit and Risks: If you are infected with intestinal parasite, you will get appropriate treatment immediately. The information we gather and analyze was useful for control and prevention of the Intestinal Parasitic Infections. The minimal risk with this study is that there may be mild pain when collecting venous blood sample.

Confidentiality: None of information we gather was disclosed to the third person. We are strictly confidential concerning your privacy and any personal identifiers was removed before analysis of the data.

Contact information: If you have any questions or concerns, you can contact on +251943279471 or Email: ebulcha100@gmail.com

Appendix-F: Consent form for parents or legal guardians of children

I undersigned to confirm that, I gave my consent for my child to participate in the study conducted by Mr. Bulcha Emiru. I made this decision after a clear explanation of the objective of the study in the language I understand. I clearly understood, with recognition of the right to withdraw from participating in the study at any time during data collection. Therefore, I do give consent on behalf of my child in addition to child's assent to answer the questions and give blood and stool samples.

Name of parent/Guardian: _____ Signature: _____ Date _____

Name of person obtaining the informed consent: _____

Signature: _____ Date _____

Appendix-G: Child assent form

I undersigned to show my permission after my parents' consent to participate in a study by Mr. Bulcha Emiru. Based on the information provided for me, I have understood about this study and its purpose. I clearly understood, with recognition of my right to withdraw from participating in the study if I change my mind. Therefore, I do give my permission to take part in this study by answering questions and providing blood and stool samples.

Child's Name: _____ Signature: _____ Date: _____

Name of person obtaining the informed consent: _____

Signature: _____ Date_____

Unka Odeeffannoo fi hayyama hirmaattotaa (Afan Oromo version)

Appendix-B: Unka Odeeffannoo hirmaattota waggaa 18 fi isaa oliif

Kabajamoo hirmaataa Qorannoo keenyaa,

Qorannoo mata dureen isaa “**Dhibee maxxantoota mar’immaaniitiin namatti dhufan fi wantoota Dhibee kanaaf nama saaxilan**” jedhu kan Obbo Bulchaa Immiruutiin gaggeeffamu keessatti akka qooda fudhattaniif afeeramtanii jirtu.

Qorannoo kana gaggeessuuf Xalayyaan qulqullina naamusa Qorannoo Koree Dhimma Naamusa Qorannoo Inistitiyuutii Saayinsii Fayyaa Yuunivarsitchaa irraa kennamee jira (Lakkoofsa Xalayyaa kennamee: [IHSREC/006/053/2025](#)). Qorannichatti isin hirmaachisuuf guutumaatti fedhii fi hayyama keessan nu barbaachisa. Maaloo, Qorannoo kanatti hirmaachuuf waligaluun dura yaada qorannichaa sirriitti hubachuuf waan isiniif hin galle gaafadhaa.

Kaayyoo Qorannichaa: Kaayyoon Qorannoo kanaa baayyina namoota maxxantoota mar’immaanii qaban adda baasuu fi wantoota dhibee kanaaf nama saaxilan qorachuu dha

Hirmaannaan fedhiidhaanii: Qorannoo kanatti hirmaachuun guutumaatti fedhii irratti hundaa’a. Hirmaaachuudhaaf fedhii yoo qabaattan, itti walii galuu keessan mallattoo keessaniin mirkanessitu. Kana gochuu keessaniin gaaffiwwan gaafataman deebisuufi saamuda (sagaraa fi dhiiga) kennuuf hayyamamoo tahuu keessan. Akkasumas, Qorannicha keessatti hirmaachuu addaan kutuuf mirga qabdu.

Odeeffannoo dhuunfaa eeguu: Odeeffannoo keessan hundumaa iccitiidhaan ni qabna. Eenyummaan dhuunfaa bifa maxxansaatiin yookaan kan birootiin hin baafamu. Odeeffannoowwan kanneen kaayyoo qorannichaa qofaaf itti fayyadamna.

Bu’aan qorannoo kanaa wallaansa Dhibee kanaaf ta’u argachuu fi wantoota Dhibee kanaaf isin saaxilan irratti hubannoo argachuuf isin dandeessisa. Akkasumas, bu’aan Qorannoo kanaa dhibeewwan kanneen to’achuu fi ittisuuf ni gargaara. Qorannichaan miidhaan (risk) mudatu hin jiratu. Haa tahu malee, saamudi dhiigaa yeroo fuudhamutti dhukkubbii salphaan isinitti dhagaahamuu dandaa’a.

Gaaffii yoo qabaattan Lakk. Bilbilaa +251943279471/I-meeyilii:
ebulcha100@gmail.com fayyadamuun gaafachuu dandeessu

Appendix-C: Unka hirmaataa umurii waggaa 18 fi isaa ol irratti guutamu

Ani, kaayyoon qorannoo kanaa afaan ani hubadhuun erga naaf ifee booda hirmaachuudhaaf walii galuu koo akka armaan gadiitti mallattoo kootiin mirkaneessa. Yeroon barbaadetti qorannoo kana addaan kutuuf mirga qabaachuu koo sirriitti hubadheera. Kannafuu, Obbo Bulchaa Immiruu qorannoo isaan gochaa jiraniif, gaafiiwwan dhiyaatan deebisuu fi saamuda barbbaachisu kennuuf ittin walii gala.

Maqaa hirmaataa: _____ Mallattoo: _____ Guyyaa: _____

Maqaa nama fudhatee: _____ Mallattoo: _____ Guyyaa: _____

Appendix-D: Unka Odeeffannoo maatii ijoolleetiif

Kabajamtoota maatii ijoollee,

Mucaan keessan Qorannoo Obbo Bulchaa Immiruutiin durfamu kan mata dureen isaa **“Dhibee maxxantoota mar’immaaniitiin namatti dhufan fi wantoota Dhibee kanaaf nama saaxilan”** jedhu keessatti hirmaachuuf afeeramee/tee jira/ti. Qorannoo kana gaggeessuuf Xalayyaan qulqullina naamusa Qorannoo Koree Dhimma Naamusa Qorannoo Inistitiyuutii Saayinsii Fayyaa Yuunivarsitii Wallaggaa irraa kennamee jira (Lakkoofsa Xalayyaa kennamee: [IHSREC/006/053/2025](#)). Qorannoo kanatti hirmaachisuuf fedhii mucaa keessaniitti dabalataan hayyama keessan barbaachisa. Maaloo hayyamuuf murteessuu keessan dursaatii maalummaa fi kaayyoo qorannichaa sirriitti hubadhaa.

Kaayyoo Qorannichaa: Kaayyoon Qorannoo kanaa baayyina namoota maxxantoota mar’immaanii qaban adda baasuu fi wantoota dhibee kanaaf saaxilan qorachuu dha.

Ga’ee hirmaataa: waliigaltee mucaa keessanii fi hayyama keessan hordofuudhaan gaaffilee dhiyaataniif deebisuu fi saamuda sagaraa fi dhiigaa kennuudhaan qorannichaa ni hirmaataa/tti. Kunis hanga daqiiqa 30 fudhachuu dandaa’a. Qorannoo kanatti hirmaachuun guutumaatti fedhaan waan taheef yeroo barbaachisetti adda kutuuf mirga guutuu qaba/di.

Bu’aa fi miidhaa qorannichaan wal-qabatu: Bu’aan Qorannoo kanaa dhibee kanaa to’achuu fi ittisuuf ni gargaara. Qorannoo kana keessatti hirmaataan/ttuun maxxantuu kana qabaate/tte battalumatti wallaansa akka argatu/ttu ni godhama. Qorannichaan miidhaan (risk) mudatu hin jiratu. Haa tahu malee, saamudi dhiigaa yeroo fuudhamutti dhukkubbii salphaan itti dhagaahamuu dandaa’a.

Odeeffannoo dhuunfaa eeguu: Odeeffannoo dhuunfaa mucaa keessanii iccitiidhaan ni qabna. Eenyummaan dhuunfaa bifa maxxansaatiin yookaan kan birootiin hin baafamu. Odeeffannoowwan kanneen kaayyoo qorannichaa qofaaf itti fayyadamna.

Gaaffii yoo qabaattan Lakk. Bilbilaa +251943279471/I-meeyilii:
ebulcha100@gmail.com fayyadamuun gaafachuu dandeessu.

Appendix-E: Unka Odeeffannoo ijoolleef

Kabajamaa hirmaataa qorannoo kanaa,

Qorannoo Obbo Bulchaa Immiruutiin gaggeeffamu kan mata dureen isaa “**Dhibee maxxantoota mar’immaaniitiin namatti dhufan fi wantoota Dhibee kanaaf nama saaxilan**” jedhu keessatti hirmaachuuf afeeramtee jirta. Qorannoo kana gaggeessuuf Xalayyaan qulqullina naamusa Qorannoo Koree Dhimma Naamusa Qorannoo Inistitiyuutii Saayinsii Fayyaa Yuunivarsitii Wallaggaa irraa kennamee jira (Lakkoofsa Xalayyaa kennamee: IHSREC/006/053/2025). Qorannoo kana keessatti si hirmaachisuuf hayyama kee nu barbaachisa. Kanaafuu, hirmaachuuf waliigaluu kee dura maalummaa fi kaayyoo qorannichaa sirriitti hubadhu.

Kaayyoo qorannichaa: Kaayyoon Qorannoo kanaa baayyina namoota maxxantoota mar’immaanii qaban adda baasuu fi wantoota dhibee kanaaf saaxilan qorachuu dha.

Hirmaannaan fedhiidhaanii: Qorannoo kanatti hirmaachuun guutumaatti fedhii kee irratti hundaa’a. Qorannicha keessatti hirmaachuuf ergaa waliigaltee booda yaada kee yoo jijjiirte yeroo barbaadetti addaan kutuuf mirga qabda. Waliigaltee kee hordofuudhaan qorannichaa keessatti gaaffilee gaafatamtu deebisuun fi saamuda sagaraa fi dhiigaa kennuudhaan hirmaatta. Kunis daqiiqa hanga 30 sitti fudhata.

Bu’aa fi miidhaa qorannichaan wal-qabatu: Qorannoo kana keessatti hirmaataan/ttuun maxxantuu kana qabaate/tte battalumatti wallaansa akka argatu/ttu ni godhama. Qorannichaan miidhaan (risk) mudatu hin jiratu. Bu’aan Qorannoo kanaa dhibee kanaa to’achuu fi ittisuuf ni gargaara. Haa tahu malee, saamudi dhiigaa yeroo fuudhamutti dhukkubbii salphaan itti dhagaahamuu dandaa’a.

Odeeffannoo dhuunfaa eeguu: Odeeffannoo dhuunfaa mucaa keessanii iccitiidhaan ni qabna. Eenyummaan dhuunfaa bifa maxxansaatiin yookaan kan birootiin hin baafamu. Odeeffannoowwan kanneen kaayyoo qorannichaa qofaaf itti fayyadamna.

Gaaffii yoo qabaattan Lakk. Bilbilaa +251943279471/I-meeyilii:
ebulcha100@gmail.com fayyadamuun gaafachuu dandeessu.

Appendix-F: Unka waligalteen maatii ijoollee irratti guutamu

Ani, mucaan koo Qorannoo Obbo Bulchaa Immiruutiin godhamu keessatti akka hirmaatuuf/ttuuf itti nan waliif gala. Maalummaa fi Kaayyoo qorannichaa hubadhee, itti hirmaachuuf murteesse jira. Qorannoo kanatti hirmaachisuun fedhaan waan ta'eef yeroo barbaadetti/barbaaddetti addaan kutuuf mirga guutuu qabaachuu sirriitti hubadheen jira. Kanaafuu, mucaan koo qorannichaa keessatti gaaffilee gaafataman deebisuu fi dhiigaa fi sagaraa kennuudhaan akka qooda fudhatuuf/ttuuf hayyamuu koo mallattoo kootiin nan mirkaneessa.

Maqaa maatii: _____ Mallattoo: _____ Guyyaa: _____

Maqaa nama fudhatee: _____ Mallattoo: _____ Guyyaa: _____

Appendix-G: Unka Waliigalteen ijoollee itti guutamu

Ani, maalummaa fi kaayyoon qorannoo kanaa erga naaf ifee booda fedhii kootiin fi haayyama maatii kootiitiin itti hirmaachuudhaaf walii galuu koo akka armaan gadiitti mallattoo kootiin mirkaneessa. Yeroon barbaadetti qorannoo kana addaan kutuuf mirga qabaachuu koo sirriitti hubadheera. Kannafuu, Obbo Bulchaa Immiruu qorannoo isaan gochaa jiraniif, gaafiiwwan dhiyaatan deebisuu fi saamuda barbaaachisu kennuuf ittin walii gala.

Maqaa hirmaataa: _____ Mallattoo: _____ Guyyaa: _____

Maqaa nama fudhatee: _____ Mallattoo: _____ Guyyaa: _____

