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# Prevalence of intestinal parasitic helminths and its associated risk factors in Mekanesselam Town, South Wollo, Ethiopia

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## Abstract

**Background** Intestinal parasitic (IP) infections caused by helminths are among the most significant public health concerns that mainly affect deprived people in Sub-Sahara African countries. The current study aimed to determine the prevalence and associated risk factors of intestinal parasitic helminths among patients attending Mekanesselam hospital.

**Method** In this cross-sectional study conducted from August 2022 to February 2023, stool specimens were collected and examined microscopically to detect intestinal helminths using direct wet-mount and formal-ether concentration techniques. A structured questionnaire was employed to obtain information regarding the socio-demographic characteristics and associated risk factors. Data were analyzed via appropriate univariate and multivariable logistic regression methods using SPSS version 25.0.

**Result** The overall prevalence of the parasitic helminths was 51 (12.6%) out of 404 patients attending in Mekanesselam town during the study period. In this study, seven species of intestinal helminths were detected, with *Ascaris lumbricoides* (5.7%) being the most prevalent followed by *Trichuris trichiura* (2.2%). Significant positive associations were observed between intestinal helminths infection and the socio-demographic characteristics including marital status ( $\chi^2 = 7.97, p = 0.047$ ), educational level ( $\chi^2 = 9.34, p = 0.025$ ) and residence ( $\chi^2 = 3.90, p = 0.048$ ). The odds of being infected with IP were three times higher among divorced patients than married individuals (AOR = 3.21, CI = 1.15–8.96,  $p = 0.03$ ). Illiterate individuals were three times (AOR = 2.61, CI = 1.24–5.49,  $p = 0.011$ ) and those who attended primary school were two times (AOR = 2.3, CI = 1.029–5.143,  $p = 0.042$ ), more likely to have helminthic infections. Participants who did not wash their hands after using the toilet were five times more likely to acquire IP helminths than those who did (AOR = 4.36, CI = 2.83–6.72,  $p = 0.000$ ). In the case of the feeding habit, study subjects who ate unwashed vegetables were more likely to acquire helminths than those who did not eat unwashed vegetables (AOR = 5.43, CI = 4.33–23.77,  $p = 0.000$ ).

**Conclusion** This study highlighted a substantial prevalence of intestinal helminths infections (12.6%) in the study area, warranting the urgent need for attention and interventions from relevant public health authorities.

**Keywords** *Ascaris lumbricoides*, Mekanesselam town, Intestinal parasitic helminths, Prevalence, Risk factors

## Introduction

Intestinal parasitic (IP) infections caused by helminths commonly known as neglected tropical diseases, are among the most significant socioeconomic and health problems affecting many people throughout the world [1]. They are the major health concerns responsible

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for high levels of morbidity and mortality, nutritional deficiency including iron deficiency, seizures, portal hypertension, chronic diarrhea, impaired physical and cognitive developments in children etc. [2]. The most predominant intestinal helminths includes the roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*), and hookworms (*Necator americanus* and *Ancylostoma duodenale*). Other species, such as *Schistosoma mansoni*, *Hymenolepis nana*, *Enterobius vermicularis* (*E. vermicularis*) and *Strongyloides stercoralis*, also present public health challenges [3]. More than 1.5 billion people worldwide, or 24% of the world's population are infected by at least one of the most common intestinal helminths [4]. These infections affect the most deprived communities in low-income countries, with the highest prevalence reported from sub-Saharan Africa, China, South America, and Asia. People from resource-poor settings and children are the most affected population groups. The three intestinal helminths, commonly known as soil transmitted helminths (STH), are responsible for the most common parasitic infections. They are considered as neglected tropical diseases (NTDs). Thus, about 819 million people are infected with *Ascaris lumbricoides* (*A. lumbricoides*), 465 million with *Trichuris trichiura* (*T. trichiura*), and 439 million with hookworms. Besides, globally about 800 million individuals are at risk of intestinal schistosomiasis, and around 200 million people (of which 160 million live in Sub-Saharan Africa) are estimated to be infected with *Schistosoma mansoni* (*S. mansoni*) [5].

These intestinal helminthic infections are among the top ten public health problems in developing countries. Such infection are mostly common in the tropical and subtropical areas of Africa, where access to clean water, hygienic and sanitation facilities are poor [6]. The associated risk factors such as increasing population density, poverty, contaminated food, unhygienic environment, inadequate health services, inadequate health education on mechanisms of transmission, inadequate toilet facilities, low living standards, poor environmental sanitation, unsafe human waste disposal systems, incorrect finger nail trimming, inadequate and unsafe water supplies, low socio economic status and poor deworming practice result in high prevalence rates [7, 8].

To this end, Ethiopia is a country with the lowest quality of drinking water supply (34%) and latrine coverage (7.1%) in the world. More than half of the population in the country still uses open defecation, and most individuals in urban settings utilize unimproved sanitation facilities [9, 10]. Hence, the prevalence of IPs in Ethiopia is unacceptably high infecting more than half of the population. In Ethiopia around 81 million people live in endemic areas of STH infections, of which 25.3 million

are school-age children [5]. For instance, based on the trend analysis of soil-transmitted helminths in Ethiopia (2000–2018), the pooled prevalence of intestinal parasites was 52.0%, where Amhara region with the highest in prevalence rate (60.3%). Among the helminthic infections reported in this study, *Ascaris lumbricoides* (11.2%) was the highest in pooled prevalence followed by hookworms (10.4%) and *Trichuris trichiura* (3.6%) [11]. However, a systematic review and meta-analysis conducted in 2022, on intestinal helminths parasitic infections in Ethiopia reported the pooled prevalence of intestinal helminthic infections in Ethiopia as 33.35%, with *Ascaris lumbricoides* the highest in prevalence rate (10.84%) [12]. Another study in 2022 reported the pooled prevalence of STH infections in Ethiopia as 36.78% where *Ascaris lumbricoides* had the highest pooled prevalence of 17.63%, followed by hook worm and *Trichuris trichiura* with a prevalence rate of 12.35% and 7.24% respectively [13]. These findings are against the national goal set by Federal Ministry of Health to eliminate the three STHs (ascariasis, hookworm infection, and trichuriasis) as public health problems by 2025 [14].

The predisposing factors associated with the high prevalence rate of intestinal parasitic infections in Ethiopia are similar to other Sub-Sahara African countries [15]. For instance, in a recent study conducted in northwest Ethiopia, the overall prevalence of intestinal parasite infection in schoolchildren was 58%, of these parasitic infections, prevalence of hookworm's accounts (13.8%), *S. mansoni* (10.3%), *Hymenolepis nana* (*H. nana*) (4.2%), *Taenia* species 3% and *A. lumbricoides* 0.73% [16]. Another cross sectional study conducted in Shahura health center, northwest Ethiopia revealed the overall prevalence of intestinal parasite infection in patient was 56.9%; among the detected parasites, the prevalence of hookworm species was (11.8%), *A. lumbricoides* (2.2%), and *S. mansoni* 1.4% [17].

To address the burden of intestinal parasitic helminths, Ethiopia has implemented several control programs and interventions, focusing on both preventive measures and treatment strategies. The nation carries out mass drug administration (MDA) campaigns targeting at-risk populations, particularly school-age children. MDA campaigns have demonstrated success in reducing the prevalence and intensity of helminths infections in various regions of Ethiopia [18]. Besides, water, sanitation, and hygiene (WASH) interventions enhancing access to clean water, adequate sanitation facilities, and promoting good hygiene practices. WASH programs involve the construction of latrines, provision of safe drinking water sources, and hygiene education to promote hand washing and proper waste disposal. These interventions have shown positive

results in improving sanitation and hygiene practices, although challenges in sustainability and coverage remain [19]. In this regard, the recent review (2020) specifically on the prevalence of STH infection in school age children reported that the pooled prevalence of STH reduced from 35.9% to 30.6% after the launch of the national STH control program in Ethiopia. However, more than one-third of the school age children in Ethiopia are still harbouring STH infections [20].

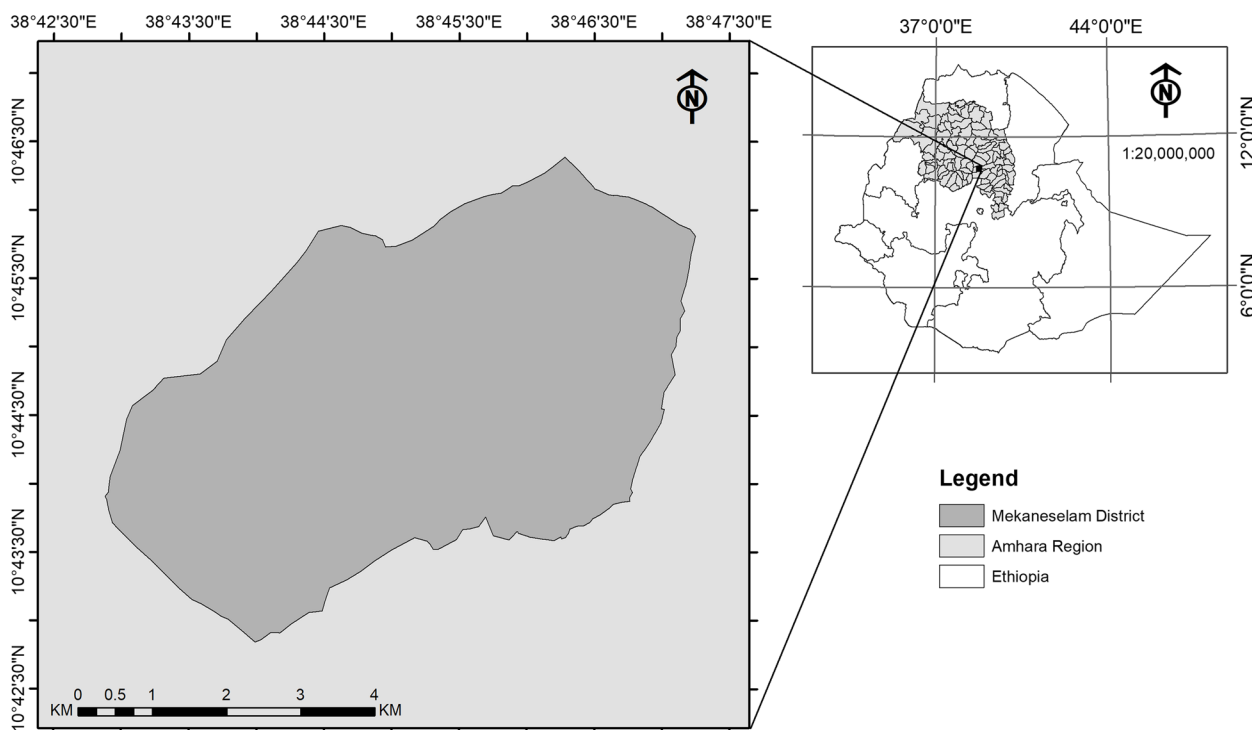
Although several studies have been conducted on the distribution and prevalence of intestinal helminths in Ethiopia, there are still several specific localities for which adequate epidemiological information is not available [21]. Therefore, studies on the prevalence of intestinal helminthic infections in various untouched geographic areas are vital for developing proper control policies. In this regard, the Amhara region is the second most populous region in Ethiopia, where intestinal helminthic infections are listed as the top reasons for people visiting the health centers in the region. Nevertheless, there are no sufficient studies conducted on the prevalence and associated risk factors of IP helminths in most parts of the districts in the region, of which Mekaneselam town is among those neglected areas. There is no sufficient data on the prevalence and associated risk factors of intestinal parasitic helminths infection in this unnoticed district.

Therefore, based on the gaps and needs, the current study aimed to determine the prevalence rate of intestinal helminths and their associated risk factors, among patients attending Mekaneselam hospital south Wollo, Amhara region, Ethiopia. The findings of the study provide information on the most vulnerable groups for intestinal parasitic helminths and on significant predictors of the infections. The outcome of this study can significantly support health officials to plan intervention programs in order to minimize the burden of the disease by identifying the risk factors. Additionally, it can guide public health officers on prevention and control strategies for intestinal helminthic infections in Mekaneselam town. Furthermore, it may serve as a stepping stone for other interested researchers to conduct more extensive studies on this topic in the stated specific localities.

**Materials and methods**

**Study area**

The study was conducted at Mekaneselam town, south Wollo, Ethiopia. It is located at the geographical coordinates of 10° 42' 30'' -10° 46' 30'' N and 38° 42' 30'' - 38° 47' 30'' E, northeast from Addis Ababa at about 580 kms (Fig. 1). Based on Mekaneselam town land administration (MTLA) office annual report in 2022, the elevation of the study area is around 1827 m above sea level [22]. The total population of the town is 101,592, of which



**Fig. 1** Location map of the study area

51,305 are males and 50,287 females [23]. The Borena Woreda Agricultural Bureau (BWAB) annual report indicated that climatic condition of Mekaneselam is subtropical (“wainadega”), with the average rain fall of 1270 mm in the main rainy season (June- August), and mean daily temperature of 23 °C [24].

Information about the elevation, climate, and rainfall is relevant to the study of intestinal parasitic helminths, because these factors can influence the prevalence and transmission of these parasites. For instance elevation can affect the distribution of helminths because different species of helminths have specific environmental requirements. For example, certain helminth species may thrive in low-lying areas or regions with high humidity, while others may prefer higher elevations or drier climates. Besides, climate can directly or indirectly affect the survival, development, and transmission of intestinal parasitic helminths. For instance, temperature can influence the development and viability of helminths eggs and larvae. Some helminths require specific temperature ranges for their eggs to hatch and larvae to survive. Furthermore, rainfall patterns are crucial for the survival and distribution of helminths, particularly those that rely on external environments outside the host. Adequate rainfall can create suitable conditions for helminths eggs and larvae to thrive in the environment. Heavy rainfall can increase soil moisture, creating favorable breeding grounds for certain helminths vectors, such as flies. These vectors can transmit helminths larvae to humans through contaminated food and water. Moreover, rainfall can impact the availability and quality of water sources, which can influence the transmission of waterborne helminths.

### Study design and population

A cross-sectional study design was employed to determine the prevalence of intestinal parasitic helminths and associated risk factors among patients attending Mekaneselam primary hospital from August 2022 to February 2023. In this study, the source population were all residents living in Mekaneselam town; and the study population comprised patients visiting Mekaneselam primary hospital and requested for stool sample examination by a doctors during the study period.

### Sample size determination and sampling technique

For this particular study, the sample size ( $n$ ) was determined using the single population proportion formula for cross sectional study [25].

$$n = \frac{z^2 * p(1 - p)}{d^2}$$

where;  $n$  = the required sample size;  
 $z$  = standard value;

$p$  = expected prevalence of intestinal parasite infection in the study area;

$d$  = marginal error, at 95% confidence interval  $Z=1.96$  and  $d=5\%$ .

Since there was no similar study previously conducted in the study area, 50% prevalence rate of IPIs was assumed, assuming that IP helminths are significantly prevalent among patients attending Mekaneselam primary hospital. Therefore, by substituting the values in the formula, the required number of sample size ( $n$ ) was calculated as,  $n = (1.96)^2 * 0.5 (1-0.5) / (0.05)^2 = 384$ . To compensate for the non-respondents and to minimize errors arising from non-compliance, 5% of the sample size was added giving a final sample size of 404. Simple random sampling technique was employed to include all consented patients requesting stool examination until the achievement of the expected sample size was obtained in Mekaneselam primary hospital during the study period.

### Data collection methods

#### Questionnaires

A structured questionnaire was developed to collect data on socio-demographic characteristics and potential risk factors associated with intestinal parasitic helminths. The questionnaire was initially drafted in English, translated into Amharic (the local language) by a language expert, and then back-translated into English to ensure consistency and clarity. This translated version was then pre-tested on a sample of 20 patients (5% of the study subjects) not included in the main study to assess its clarity, comprehensibility, and cultural appropriateness. Based on the pre-test feedback, minor modifications were made to the wording and sequencing of questions. The final questionnaire captured information on variables such as age, sex, residence, marital status, education level, occupation, income, latrine availability and usage, sources of drinking water, shoe-wearing habits, and hygiene practices. Hand washing habits were assessed by asking participants about the frequency of hand washing with soap and water before meals and after using the toilet. Similarly, consumption of unwashed vegetables was determined by asking participants about their frequency of consuming raw vegetables without washing them thoroughly.

#### Microscopic examination

##### Stool sample collection procedures

Fresh stool samples were collected from 404 study subjects by experienced laboratory technologists from Mekaneselam primary hospital. The participants were instructed properly and given clean labeled stool collection cups along with applicator sticks, and informed to bring sufficient stool enough for direct saline wet mount

and formal-ether concentration technique. At the time of collection, the date of sampling, the participants name, age, and sex was recorded for each subject on a recording format.

#### **Direct wet mount method**

A small portion of the stool sample (about 2 mg equivalent to the size of a match head) was emulsified with normal saline (0.85% NaCl solution). Then, a drop of the emulsified sample was placed on a clean microscopic glass slide, a few drops of iodine solution were added to the stool sample, mixed with this reagent, then it was covered with a cover slip at an angle of 45° [26]. Finally, the samples were examined using light microscope under 10× and 40× objective lenses by experienced laboratory technologists from Mekaneselem primary hospital.

#### **Formal-ether concentration method**

A portion of the stool sample was processed by the formal-ether concentration technique. In brief, using an applicator stick, about 1–1.5 g of stool sample was placed in a clean 15 ml conical tube containing 10 ml of 10% formalin. The sample was suspended and mixed thoroughly with the applicator stick. The resulting suspension was filtered through mesh sieve (2 layers of wet surgical cotton gauze) into a beaker, and the filtrate was poured into the same tube. 10% of formalin was added to the suspension to bring the volume to 10 ml. Subsequently, 3 ml of ether was added to the mixture and hand shaken vigorously for 10 s; the content was centrifuged at 500 g for 3 min. The three upper layers were poured off in a single movement in five seconds. Iodine stain preparation was made from the sediments that have mixed with a drop of saline. Finally, the entire area under the cover slip was examined using 10× and 40× objective lenses under the microscope [26].

#### **Methods of data analysis**

Throughout the process of data collection, thorough checks were conducted to ensure the completeness, appropriateness, and precision of every answer while gathering data through the questionnaire and during putting it into MS Excel. The collected data was analyzed using SPSS Version 22. Descriptive statistics and Chi square statistical tests were used to assess presence and absence of association between risk factors and IP helminthic infections. Univariate logistic regression analysis was used for analyzing socio demographic factors and personal lifestyle associated with IP helminths. Furthermore, risk factors associated with IP helminths was analyzed by multivariate logistic regression. Then, COR was calculated as it is crucial in interpreting the magnitude and direction of relationships between variables, where

COR represents the expected change in the dependent variable for each one-unit increase in the independent variable, while holding other variables constant. Furthermore, the Adjusted Odds Ratio (AOR) was used to measure the impact of predictor variables on the odds of a binary outcome. The AOR indicates the change in odds associated with a one-unit increase in the predictor variable, adjusted for the influence of other variables in the model. The p-value for all tests was set at  $p \leq 0.05$ . Summary of statistical interpretation and percentage values are presented in Tables.

## **Results**

### **Socio-demographic characteristics of the study participants**

Among the 404 study subjects, 210 (52%) were males and 194 (48%) were females. Regarding their age categories, 72 (17.8%), 133 (32.9%) and 199 (49.3%) of the study participants were in the age groups 5–14 years, 15–24 years, and  $\geq 25$  years, respectively. In the case of residence area, 168 (41.6%) of the study subjects were urban and 236 (58.4%) were rural dwellers. The marital status of the study participants was 124 (30.7%) single, 243 (60.1%) married, 28 (6.9%) divorced and 9 (2.2%) were widowed. Out of the total 404 respondents, 204 (50.5%), 95 (23.5%), 57 (14.1%), 48 (11.9%) respondents were illiterate, attended primary school, secondary school, and diploma and above, respectively (Table 1).

### **Prevalence of some identified intestinal parasitic helminths infections**

Out of the 404 study subjects, 51 were positive for helminthic cases, and the overall prevalence rate of parasitic helminths infection was 12.6%. Based on the microscopic examination of stool specimens, seven intestinal parasitic helminths were identified. In this study *A. lumbricoides* accounted for 23 (5.7%), *T. trichiura* 9 (2.2%), *E. vermicularis* 7 (1.7%), hookworm species 5 (1.2%), *H. nana* 5 (1.2%), *S. mansoni* 1 (0.2%), and the cases for *Taenia* species was 1 (0.2%) (Table 2). However, double and triple parasitic infections were not recorded. The overall intestinal helminths prevalence was higher among males 34 (8.4%) than females 17 (4.2%). On the other hand, the highest percentage of *A. lumbricoides* prevalence was found also in male participants (Table 2).

### **Prevalence of intestinal helminths infections in relation to different socio-demographic characteristics**

The findings revealed significant positive association between infection of intestinal helminths and some socio-demographic characteristics of the study participants. For instance, regarding the marital status divorced individuals had a significantly higher prevalence

**Table 1** Socio-demographic characteristics of study participants ( $n = 404$ )

Characteristics	Categories	Frequency (n)	Percentage (%)
Sex	Male	210	52
	Female	194	48
Age group	5-14	72	17.8
	15-24	133	32.9
Residence	≥ 25	199	49.3
	Urban	168	41.6
	Rural	236	58.4
Marital status	Single	124	30.7
	Married	243	60.1
	Divorced	28	6.9
	Widowed	9	2.2
Education level	Illiterate	204	50.5
	Primary school	95	23.5
	Secondary school	57	14.1
	Diploma & above	48	11.9
Occupational status	Government employer	80	19.8
	Merchant	28	6.9
	Farmer	196	48.5
	House wife	22	5.4
	Student	78	19.3
Family size	≤ 3	162	40.1
	4-6	176	43.6
	7-9	39	9.7
	>9	27	6.7
Income level in ETB	Lower (<3000)	216	53.5
	Medium (3000-5000)	96	23.8
	High (>5000)	92	22.8

( $\chi^2 = 7.97$ ,  $p = 0.047$ ). In the case of educational level illiterate individuals had a significant higher prevalence rate ( $\chi^2 = 9.34$ ,  $p = 0.025$ ) and residence ( $\chi^2 = 3.90$ ,  $p = 0.048$ ). However, with regard to sex, there was no statistically significant difference in the prevalence of intestinal helminths infections between male and female ( $\chi^2 = 5.04$ ,  $p = 0.16$ ), age ( $\chi^2 = 0.63$ ,  $p = 0.731$ ). Similarly, occupation status ( $\chi^2 = 4.07$ ,  $p = 0.396$ ), family size ( $\chi^2 = 2.77$ ,  $p = 0.429$ ), and monthly income level ( $\chi^2 = 3.57$ ,  $p = 0.168$ ) had no statistically significant association with intestinal helminths infections (Table 3).

### Risk factors associated with intestinal parasitic infection

#### Socio-demographic factors

Univariate analysis of the socio-demographic characteristics exhibited that patients coming from rural areas were two times more likely to be infected with IP helminths than patients coming from urban areas (COR=6.70, CI=4.49–9.98,  $p = 0.049$ ). Regarding the marital status, divorced patients were three times more infected with IPIs than those who were married (COR=2.73, CI=1.03–7.19,  $p = 0.009$ ); illiterate patients were four times more likely to be infected with IP helminths than patients who attended diploma and above (COR=2.77, CI=1.37–5.63,  $p = 0.005$ ), patients who attended primary school were three times (COR=2.37, CI=1.10–5.13,  $p = 0.027$ ), and patients who attended secondary school were two times more likely to have the helminthic infection than patients who were diploma and above (COR=3.10, CI=1.35–7.16,  $p = 0.008$ ) respectively (Table 4).

#### Personal life style

Life style related factors such as habit of eating unwashed vegetables and frequency of shoe wearing had statistically significant associations with intestinal helminths infections. The study subjects who ate unwashed vegetables

**Table 2** Socio-demographic characteristics (sex and age) of patients and the identified helminths ( $n = 404$ )

Types of Intestinal Parasites	Sex			Age			
	Male + ve (%) (%)	Female + ve (%) (%)	Total + ve (%) (%)	5–14 + ve (%) (%)	15–24 + ve (%) (%)	> 25 + ve (%) (%)	Total + ve (%) (%)
<i>A.lumbricoides</i>	17(4.2)	6(1.5)	23(5.7)	9(2.2)	8(2.0)	6(1.5)	23(5.7)
<i>E.vermicularis</i>	5(1.2)	2(0.5)	7(1.7)	2(0.5)	4(1.0)	1(0.2)	7(1.7)
<i>T.trichiura</i>	5(1.2)	4(1.0)	9(2.2)	2(0.5)	4(1.0)	3(0.8)	9(2.2)
Hookworms	3(0.8)	2(0.5)	5(1.2)	0	1(0.2)	4(1.0)	5(1.2)
<i>H.nana</i>	3(0.8)	2(0.5)	5(1.2)	0	1(0.2)	4(1.0)	5(1.2)
<i>Taenia species</i>	0	1(0.2)	1(0.2)	0	1(0.2)	0	1(0.2)
<i>S.mansonii</i>	1(0.2)	0	1(0.2)	0	1(0.2)	0	1(0.2)
Total	34(8.4)	17(4.2)	51(12.6)	13(3.2)	21(5.2)	17(4.2)	51(12.6)

**Table 3** Prevalence of intestinal parasitic helminths in relation to different socio demographic factors ( $n = 404$ )

Risk factors	Categories	N (%)	Positive (%)	Negative (%)	$\chi^2$ , p-value
<b>Sex</b>	Male	210(52)	34(16.2)	176(83.8)	5.04, 0.16
	Female	194(48)	17(8.8)	177(91.2)	
<b>Age group</b>	5–14	72(17.8)	13(18.1)	59(81.9)	0.63, 0.731
	15–24	133(32.9)	21(15.8)	112(84.2)	
	≥ 25	199(49.3)	17(8.5)	182(91.5)	
<b>Residence</b>	Urban	168(41.6)	16(9.5)	152(90.5)	3.90, 0.048*
	Rural	236(58.4)	35(14.8)	201(85.2)	
<b>Marital status</b>	Married	243(60.1)	22(9.1)	221(90.9)	7.97, 0.047*
	Single	124(30.7)	18(14.5)	106(85.5)	
	Divorced	28(6.9)	9(32.1)	19(67.9)	
	Widowed	9(2.2)	2(22.2)	7(77.8)	
<b>Educational Level</b>	Illiterate	204(50.5)	31(15.2)	173(84.8)	9.34, 0.025*
	Primary	95(23.8)	12(12.6)	83(87.4)	
	Secondary	57(14.1)	6(10.5)	51(89.5)	
	Diploma and above	48(11.9)	2(4.2)	46(95.8)	
<b>Income level</b>	< 3000	216(53.5)	36(16.7)	180(83.3)	3.57, 0.168
	3000–3000	96(23.8)	13(13.5)	83(84.5)	
	> 5000	92(22.8)	2(2.2)	90(97.8)	
<b>Risk factors</b>	<b>Categories</b>	<b>N (%)</b>	<b>Positive (%)</b>	<b>Negative (%)</b>	<b><math>\chi^2</math>, p-value</b>
<b>Family size</b>	≤ 3	162(40.1)	17(10.5)	145(89.5)	2.77, 0.429
	4–6	176(43.6)	21(11.9)	155(88.1)	
	7–9	39(9.7)	9(23.1)	30(76.9)	
	> 9	27(6.7)	4(14.8)	23(85.2)	
<b>Occupation status</b>	Government employers	80(19.8)	3(3.8)	77(96.2)	4.07, 0.396
	Merchants	27(6.7)	5(18.5)	22(81.5)	
	Farmers	196(48.5)	22(11.2)	174(88.8)	
	House wives	22(5.4)	5(22.7)	17(77.3)	
	Students	78(19.3)	16(20.5)	62(79.5)	

\*Statistically significant association between socio-demographic factors ( $p < 0.05$ )

were more likely to be infected with intestinal helminths than those who did not eat unwashed vegetables (COR=4.90, CI=3.28–7.32,  $p=0.000$ ). Similarly, study subjects who wear shoes sometimes were more likely to be infected with IP helminths than those who always wear shoes (COR=5.73, CI=3.72–8.83,  $p=0.012$ ) (Table 5).

#### Personal hygiene

Hygiene related factors such as presence of finger trimming (decoration), presence of latrine at home, habit of hand washing after using toilet, and frequency of hand washing after visiting toilet were significantly associated with IP helminths (Table 6). Patients who had finger trimming were more likely to be infected with IP helminths than those who did not have finger trimming (COR=5.17, CI=3.43–7.78,  $p=0.002$ ); patients who did not have latrine at home were three times more likely to

be infected with IP helminths than those who had latrine at home (COR=5.46, CI=3.66–8.17,  $p=0.003$ ); Similarly, those patients who did not wash their hands after toilets were five times more likely to acquire IP helminths than those who washed their hands after using toilet (COR=4.63, CI=3.11–6.90,  $p=0.000$ ) (Table 6).

#### Multivariate logistic regression analysis of selected variables

Among the potential risk factors educational status, habit of hand washing after toilet, habit of eating unwashed vegetable, and presence of finger trimming were significantly associated with IP helminths infection ( $p < 0.05$ ). The odds of being infected with IP helminths in those divorced patients were three times more than those who were married (AOR=3.21, CL=1.15–8.96,  $p=0.03$ ). Regarding the educational level illiterate patients were four times more likely to have parasite infection (AOR=2.61, CI=1.24–5.49,  $p=0.011$ ); but

**Table 4** Univariate logistic regression analysis for socio demographic factors associated with IP helminths

Risk factors	Categories	N (%)	IPIs		COR, 95% CI, p-value
			Positive (%)	Negative (%)	
<b>Sex</b>	Male	210(52)	34(16.2)	176(83.5)	0.68–1.49, 0.987
	Female	194(48)	17(8.8)	177(91.2)	1
<b>Age group</b>	5–14	72(17.8)	11(15.3)	61(84.7)	0.79, 0.45–1.41, 0.429
	15–24	133(32.9)	17(12.3)	116(87.2)	0.86, 0.49–1.47, 0.571
	≥ 25	199(49.3)	23(11.6)	176(88.4)	1
<b>Residence</b>	Urban	168(41.6)	16(9.5)	152(90.5)	1
	Rural	236(58.4)	35(14.8)	201(85.2)	6.70, 4.49–9.98, 0.049*
<b>Marital Status</b>	Married	243(60.1)	22(9.1)	221(90.9)	1
<b>Educational</b>	Single	124(30.7)	18(14.5)	106(85.5)	0.80, 0.52–1.23, 0.313
	Divorced	28(6.9)	9(32.1)	19(67.9)	2.73, 1.03–7.19, 0.009*
	Widowed	9(2.2)	2(22.2)	7(77.8)	1.25, 0.32–4.88, 0.748
<b>Income level</b>	Illiterate	204(50.5)	31(15.2)	173(84.8)	2.77, 1.37–5.63, 0.005*
	Primary	95(23.8)	12(12.6)	83(87.4)	2.37, 1.10–5.13, 0.027*
	Secondary	57(14.1)	6(10.5)	51(89.5)	3.10, 1.35–7.16, 0.008*
	Diploma and Above	48(11.9)	2(4.2)	46(95.8)	1
<b>Family size</b>	< 3000	216(53.5)	36(16.7)	180(8.3)	1.05, 0.64–1.73, 0.834
	3000–5000	96(23.8)	13(13.5)	83(86.5)	1.61, 0.90–2.87, 0.105
	> 5000	92(22.8)	2(2.2)	90(97.8)	1
<b>Occupation Status</b>	≤ 3	162(40.1)	17(10.5)	145(89.5)	1
	4–6	176(43.6)	21(11.9)	155(88.1)	1.90, 0.81–4.49, 0.141
	7–9	39(9.7)	9(23.1)	30(76.9)	1.56, 0.66–3.65, 0.310
	> 9	27(6.7)	4(14.8)	23(85.2)	1.39, 0.50–3.87, 0.527
<b>Occupation Status</b>	Government Employers	80(19.8)	3(3.7)	77(96.3)	1
	Merchants	27(6.7)	5(18.5)	22(81.5)	0.75, 0.32–1.77, 0.505
	Farmers	196(48.5)	22(11.2)	174(88.7)	0.59, 0.35–1.00, 0.051
	House wives	22(5.4)	5(22.7)	17(77.3)	0.59, 0.23–1.55, 0.289
	Students	78(19.3)	16(20.5)	62(79.5)	0.74, 0.39–1.38, 0.340

Frequency and percentage values are presented in parentheses

1 = reference value, \* = statistically significant at  $p < 0.05$ , COR Crude odds ratio, N = Total. The p-value for the variable more than two categories in front of reference value for the comparison to entered for multivariate analysis

patients who attended primary school were three times (AOR = 2.3, CI = 1.029–5.143,  $p = 0.042$ ), and those who completed secondary schools were three times (AOR = 3.44, CI = 1.43–8.30,  $p = 0.006$ ) more likely to have IP helminths infection than patients who were diploma and above respectively. Those participants who did not wash their hands after toilet were five times more likely to acquire IP helminths than their counterparts (AOR = 4.36, CI = 2.83–6.72,  $p = 0.000$ ). Regarding the feeding habit, study subjects who ate unwashed vegetables were more likely to acquire helminths than those who did not eat unwashed vegetables (AOR = 5.43, CI = 4.33–23.77,  $p = 0.000$ ). Similarly, patients who

have finger trimming (decoration) were more likely infected with helminths than those have no finger trimming (AOR = 5.63, CI = 2.60–11.32,  $p = 0.001$ ). Moreover, participants who had poor personal hygiene were more likely to acquire IP helminths than those who had good personal hygiene (AOR = 7.01, CI = 4.35–8.95,  $p = 0.015$ ) (Table 7).

## Discussion

Understanding the epidemiological status of IP helminths and identifying their risk factors in a given local community found to be a prerequisite for planning intervention programs. In line with this perspective, the present study



**Table 5** Univariate logistic regression analysis for personal life style associated with intestinal parasitic helminths

Risk factors	Categories	N (%)	IP helminths		COR, 95% CI, P-value
			Positive (%)	Negative (%)	
<b>Hand washing before food</b>	Yes	393(97.3)	42(10.7)	351(89.3)	1
	No	11(2.7)	9(81.8)	2(18.2)	0.69, 0.20–2.42, 0.570
<b>Frequency of hand Washing before food</b>	Always	223(55.2)	31(13.9)	192(86.1)	1
	Sometimes	170(42.1)	20(11.8)	150(88.2)	0.67, 0.45–1.00, 0.51
<b>Shoe wearing habit</b>	Yes	394(97.5)	45(11.4)	349(88.6)	1
	No	10(2.5)	6(60.0)	4(40.0)	0.30, 0.63–1.43, 0.131
<b>Frequency of shoe Wearing</b>	Always	304(77.2)	37(12.2)	267(87.8)	1
	Sometimes	90(22.8)	14(15.6)	76(84.4)	5.73, 3.72–8.83, 0.012*
<b>Habit of soil Contact</b>	Yes	151(37.7)	23(15.2)	128(84.8)	0.69, 0.465–1.03, 0.068
	No	253(62.3)	28(11.0)	225(89.0)	1
<b>Habit of eating unwashed vegetable</b>	Yes	184(45.5)	29(15.7)	155(84.2)	4.90, 3.28–7.32, 0.000*
	No	220(54.5)	22(10.0)	198(90.0)	1
<b>Habit of eating raw Meat</b>	Yes	100(24.8)	40(40.0)	60(60.0)	1.13, 0.72–1.77, 0.610
	No	304(75.2)	11(3.6)	295(97.4)	1
<b>Habit of water Contact</b>	Yes	257(63.6)	43(16.7)	214(83.3)	0.64, 0.36–1.12, 0.118
	No	147(36.4)	8(5.4)	139 (94.6)	1

Frequency and percentage values are presented in parentheses

1 = reference value, \* = statistically significant at  $p < 0.05$ , COR Crude odds ratio, N = Total

**Table 6** Univariate logistic regression analysis for personal hygiene associated with intestinal parasitic helminths

Variables	Categories	N (%)	IP helminths		COR, 95% CI, p-value
			Positive (%)	Negative (%)	
<b>Presence of Finger trimming</b>	Yes	162(40.1)	22(13.5)	140(86.5)	5.17, 3.43–7.78, 0.002*
	No	242(59.9)	29(11.9)	213(88.1)	1
<b>Presence of latrine at Home</b>	Yes	164(40.6)	11(6.7)	153(93.3)	1
	No	240(59.4)	40(16.7)	200(83)	5.46, 3.66–8.17, 0.003*
<b>Frequency of use latrine at home</b>	Always	64(15.5)	4(6.2)	60(93.8)	1
	Sometimes	100(24.8)	7(7.0)	93(93.0)	0.62, 0.33–1.17, 0.136
<b>Personal hygiene</b>	Good	302(74.8)	29(9.6)	273(90.4)	1
	Poor	102(25.2)	22(21.6)	80(78.4)	6.20, 4.17–9.20, 0.018*
<b>Habit of hand washing after using toilet</b>	Yes	192(47.5)	9(4.7)	183(95.3)	1
	No	212(52.5)	42(19.8)	170(88.2)	4.63, 3.11–6.90, 0.000*
<b>Frequency hand washing after using toilet</b>	Always	170(88.5)	3(1.8)	167(98.4)	1
	Sometimes	22(11.5)	6(27.3)	16(72.7)	0.91, 0.36–2.26, 0.832

Frequency and percentage values are presented in parentheses

1 = reference value, \* = statistically significant at  $p < 0.05$ , COR Crude odds ratio. N = Total

attempted to assess the prevalence of different intestinal parasitic helminths and the associated risk factors among patients attending Mekaneselam hospital. In this study, the overall prevalence of IP helminths in the given locality was 12.6%. However, the current finding found much lower than previous studies conducted in different parts of Ethiopia. For instance, it was (20.1%) from Shahura Health Center, Northwest Ethiopia [17], (74.5%) north Gonder [27], (32%) Jawi town, northwest Ethiopia [16]

and (71.2%) Debre Elias, East Gojjam zone [8]. Furthermore, higher prevalence of intestinal parasitic helminths has been reported in Axum town (44.6%) [28], in Jimma town (48.2%) [29], in South Eastern Ethiopia (26.2%) [30], in Benishangul-Gumuz Regional State, Western Ethiopia (35.4%) [31], in Adigrat town (27%) [32]. Nevertheless, the current finding closely aligns with the previous report from the University of Gondar Hospital [33], reported a prevalence rate of 17.3%. These variations may be due

**Table 7** Multivariate logistics regression analysis of selected risk factors associated with IP helminths

Risk factors	Categories	N (%)	IP helminths		AOR, 95%CI, P-value
			Positive (%)	Negative (%)	
<b>Marital status</b>	Married	243(60.1)	22(9.1)	221(90.9)	1
	Single	124(30.7)	18(14.5)	106(85.5)	0.92, 0.57–1.49, 0.739
	Divorced	28(6.9)	9(32.5)	19(67.5)	3.21, 1.15–8.96, 0.030*
	Widowed	9(2.2)	2(22.2)	7(77.8)	1.47, 0.35–6.20, 0.602
<b>Educational Level</b>	Illiterate	204(50.5)	31(15.9)	173(84.8)	2.61, 1.24–5.49, 0.011*
	Primary	95(23.8)	12(12.6)	83(87.3)	2.30, 1.03–5.14, 0.042*
	Secondary	57(14.1)	6(10.5)	51(89.5)	3.44, 1.43–8.30, 0.006*
	Diploma and Above	48(11.9)	2(4.2)	46(95.8)	1
<b>Income level</b>	< 3000	216(53.5)	36(9.0)	180(45.5)	0.834, 0.485–1.432, 0.510
	3000–5000	96(23.8)	13(3.2)	83(20.5)	1.470, 0.780–2.769, 0.233
	> 5000	92(22.8)	2(0.5)	90(22.3)	1
<b>Habit of hand washing after toilet</b>	Yes	192(47.5)	9(4.7)	183(95.3)	1
	No	212(52.5)	42(19.8)	170(88.2)	4.36, 2.83–6.72, 0.000*
<b>Habit of eating Unwashed vegetable</b>	Yes	184(45.5)	29(15.7)	155(84.2)	5.43, 4.33–23.77, 0.000*
	No	220(54.5)	22(10.0)	198(90.0)	1
<b>Presence of finger Trimming</b>	Yes	162(40.1)	22(13.5)	140(86.5)	5.63, 2.60–11.32, 0.001*
	No	242(59.9)	29(11.9)	213(88.1)	1
<b>Reason of water Contact</b>	Swimming	66(16.3)	9(13.6)	57(86.4)	1
	Washing cloth	118(29.2)	10(8.5)	108(91.5)	0.912, 0.470–1.769, 0.784
	Irrigation	36(8.9)	4(11.1)	32(88.9)	0.428, 0.19–0.94, 0.035*
	Washing body	127(31.4)	20(15.7)	107(84.3)	0.499, 0.26–0.98, 0.042*
<b>Personal hygiene</b>	Good	302(74.8)	29(9.6)	273(90.4)	1
	Poor	102(25.5)	22(21.6)	80(78.4)	7.01, 4.35–8.95, 0.0145*

Frequency and percentage values are presented in parentheses

1 = reference value, \* = statistically significant at  $p < 0.05$ ,

AOR adjusted odds ratio (multivariate regression model), N = Total

to differences in the survey season, living and hygiene conditions of the study participants, differences in personal hygienic conditions, level of environmental sanitation, drinking water sources, and geographical factors in the various study areas. Additionally, the variation in IP helminths infection among patients in Mkanselam town compared to the mentioned studies above could be attributed to several factors. These include the variability in the habit of eating raw meat and unwashed vegetables, as well as the presence or absence of a latrine per home. Furthermore, the habit of hand washing after using the toilet and other socioeconomic factors may also contribute to the observed variations.

The first most prevalent parasitic helminth in the current study area was *A. lumbricoides* (5.6%). Nevertheless, its prevalence rate was much lower than the prevalence rate reported in Jimma town [29], and Adigrat town (19.1%) [32]. This difference might be attributed to the differences in drinking water sources, sanitation conditions, hand washing habit before eating food etc. in the

various localities. However, the current finding was much closer to the prevalence rate of *A. lumbricoides* reported in Lake Langano area (6.2%) [34], Axum town, northern Ethiopia (9%) [28]. On the other hand, the prevalence rate of *A. lumbricoides* in the present study found higher than the findings reported in south eastern Ethiopia (4.7%) [35], northwest Ethiopia (2.2%) [17], and in Delo-Mena, south eastern Ethiopia (4.7%) [30]. This might be due to the variability in personal hygiene, consumptions of contaminated food and access to clean water among others. The second intestinal helminthic infection identified in this study was *T. trichiura*, with the prevalence rates of 2.2%. The finding exceeded the reported prevalence rate of *T. trichiura* (1.1%) in Addis Ababa [36]. However, compared to the present finding higher prevalence rate of *T. trichiura* reported previously in Shahura health center, northwest Ethiopia (4.7%) [17]. The third encountered intestinal parasite was *E. vermicularis* with a prevalence rates of 1.7%. This result revealed a higher prevalence rate than the reported 0.69% for *E. vermicularis* at Axum

St. Mary Hospital in Axum town [37]. However, the current finding was lower than the reports in Bereka medical center southeast Ethiopia (5.6%) [38]. These differences in the prevalence rate of IP helminths infections might be due to the level of sanitary conditions, latrine ownership, latrine coverage in the household surroundings, degree of environmental contamination, and level of awareness about parasitic infections and mechanism of parasite transmission among the various local communities and other socio-economic factors.

In this study, hookworm species (1.2%) and *H. nana* (1.2%) found the fourth prevalent parasitic helminths identified. This finding was lower than the previous reports in Teda health center northeast Ethiopia [39], who reported a prevalence rate of 6.6% for hookworm species and that of 1.5 for *H. nana*. Similarly the study conducted in Axum town, northern Ethiopia [28] reported higher prevalence rates [(hookworm species (2.7%) and *H. nana* (6.2%)] than the current findings. On the other hand, the current findings was higher than that of the previous study conducted in Bereka medical center southeast Ethiopia who reported a prevalence rate of hookworm species (0.9%) [26]. Likewise a study conducted at Chelaleki health center around east Wollega zone reported lower prevalent rate 0.3% for *H. nana* [40]. The other prevalent parasites detected in the current study were *S. mansoni* (0.2%) and *Tania* species (0.2%). Compared to this findings higher prevalence rate of these two intestinal parasitic helminths were reported in different parts of Ethiopia, like Jawi town, northwest Ethiopia, where the prevalence rate for *S. mansoni* was 0.3% and 3% for *Tania* species [16]. Similarly a study from Shahura health center, northwest Ethiopia reported a prevalence rate of 1.4% for *S. mansoni* [7]. These variations in prevalence rates of *S. mansoni* and *Tania* species might be due to the difference in socio-economical, demographical, geographical, and other differences including climate conditions.

The interpretation of the findings clearly demonstrated that the predisposing factors for IP helminths infections among the study subjects were residence area, marital status, education level, habit of eating unwashed vegetables, presence of dirt matter under nails, lack of latrine at home, and habit of hand washing after toilet visit. In this study IP helminths were significantly associated with residence, and the likelihood of acquiring IP helminths among patients coming from rural areas was two times higher than patients coming from urban areas. This might be due to poor personal and environmental hygiene, the frequent contamination of water bodies, and close contact with animals and soil etc. in the rural areas than urban community. The other observed significant factor associated with IP helminths infection in the study

area was hand washing practices after toilet. Those participants who did not wash their hands after defecation were five times more likely to acquire IPIs than those who washed their hands after defecation (Table 7). This was in consistent with previous reports from a study conducted in Teda health center, northwestern Ethiopia [39]. This might be attributed to the habit of washing hands with water without soap and inappropriate handling of ready-made foods and drinks.

With regard to the feeding habit, study subjects who ate unwashed vegetable were more likely to acquire IPIs than those who did not eat unwashed vegetables (Table 7). This agrees with the report in Benishangul-Gumuz, western Ethiopia [31]. This might be due to contamination of vegetables with fecal materials in the farm and contamination of the vegetables at home. Presence of finger trimming was another significant factor associated with IPIs in the present study. Participants who have finger trimming were more likely to be infected with intestinal parasites than those who have finger trimming (Table 7). Similar association of IP helminths infection with the presence of finger trimming was reported in a study conducted in northwest Ethiopia [40]. This could be due to the fact that individuals who have finger trimming might get their nails contaminated easily with soil. The soil can contain cysts and eggs of parasitic organisms, which can lead to intestinal helminths infections.

Educational status also found important factor that exposed patients for IP helminths infection in this study area. Illiterate patients were four times more likely to have parasite infection than patients who were diploma and above (Table 7). This finding disagreed with the previous study conducted in Teda health center, northwestern Ethiopia [39], where they reported that the prevalence of IP helminths were not significantly associated with educational status. However, it could be argued with the fact that higher level of education is usually associated with higher level of awareness and better hygienic practices, which might reduce the vulnerability for IP helminths infection. Surprisingly, in the present study, no significant differences in IP helminths infections among those study subjects who have hand washing practices than those didn't before food ( $p > 0.05$ ). This might be related with the immunity level of individuals and a matter of probability. This was in agreement with a study conducted in Delgi, northern Gondar [27]. Regarding gender, the proportions of IP helminths infection in males (28.7%) found higher than that of females (26.5%). Similar result was reported in Jimma town Ethiopia [29]. The higher prevalence in males might be due to their everyday work habits in outdoor activities or frequent contact with soils and less hygienic practices than females which makes them more vulnerable for parasitic infections.

### Limitation of the study

The study has limitations because of unavailability of previous study on prevalence of intestinal infection in the study area. Besides, it was cross-sectional; thus, it may not truly reflect the dynamic nature of socio-behavioral factors. Moreover, due to resource, financial and time constraints, we did not perform molecular techniques to identify the helminths. Only microscopy technique was used to determine the prevalence intestinal parasitic helminths infection in this study.

### Conclusions and future perspectives

The overall prevalence of intestinal parasitic helminths infection among patients attending Mekaneselam hospital was significant (12.6%) and deserves to implement intervention measures as public health concern. The most important prevalent intestinal parasitic helminths infection in this study area were *A. lumbricoides*, *T. trichiuria* and *E. vermicularis*. In this study, presence of finger trimming, hand washing habit after toilet, the habit of eating unwashed vegetables, marital status, personal hygiene and educational level were important predictors variables significantly associated with the occurrence of intestinal helminthic infections among patients in the study area. The finding in this study showed that intestinal helminths infections are important public health problems in Mekaneselam town. The high prevalence rate of intestinal infection in men may be related to the habit of soil contact, the lack of hand washing practice before meal during field work in the farm etc. Important hygienic practices such as washing of hands after toilet, personal hygiene, using latrine and protecting water supply from contamination could reduce the intestinal parasite infection burden in the study area.

To reduce the risk of helminths infection around Mekaneselam town, stakeholders such as, public health officers, education institutions and the town administrators etc. have to create awareness and implement health education programs on the transmission and effective prevention methods including environmental and personal hygiene, sanitation, avoiding eating unwashed vegetable. There should be a provision of safe water for drinking and cooking, and other household activities. Besides, integrated control programs including provision of personal and environmental hygiene facilities are vital. Furthermore, to determine the burden of intestinal parasitic helminths infection further detailed studies must be conducted by considering extensive samples and wider area coverage.

### Abbreviations

IP	Intestinal parasite
IPIs	Intestinal parasite infections
AOR	Adjusted odd ratio
COR	Crude odd ratio
CI	Confidence interval
N (%)	Number and percentage

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### Authors' contributions

Moges Kibret Wondimagegn and Lulit Tegegne Hailu conceived the research idea, formulated the design and interpret the findings, and eventually wrote the paper. Lulit Tegegne Hailu, wrote the proposal, conducted the field and lab work, collected data, analyzed the data, and wrote the draft results. Moges Kibret Wondimagegn and Lulit Tegegne Hailu reviewed and approved the manuscript.

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### Data availability

Data are available from the corresponding author upon request.

### Declarations

#### Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. The participants of the study were verbally informed about the purpose of the study, type of information to be sought during the interview, risks and benefits, confidentiality, the right to withdraw from the study, and additional study-related information. Written informed consent was obtained from all participants (adults and legal guardians/parents in the case of minors) before the interview. Participation was based on their willingness to participate, and participants could stop at any time without any obligation during the discussion or interview if they felt uncomfortable. The study was conducted after the receipt of ethics approval letter Ref No. WU3161/E-01/22 dated on July 21/2022 from the Institutional Review Board at Wollo University in Dessie, Ethiopia.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

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