Advanced Journal of Interdisciplinary Studies 9 (2026) 2706-2730

Journal homepage: www.ajids.dmu.edu.et

Volume 9(2), March 2026

Prevalence and Associated Risk Factors of Intestinal Parasitic Infections among Individuals Attending Mekane Eyesus Primary Hospital, Estie District, Northwest Ethiopia

Kindiye Adugnaw[1], Asmamaw Habtamu[1*], Agumas lemlemu[1]

[1]Department of Biology, Debre Markos University, Debre Markos, Ethiopia

Abstract

Gastro-intestinal parasitic infection (GIPI) is on the world concern, affecting more than one billion people annually, with the highest burden observed in under developing counties including Ethiopia. The objective of study was to assess spread of GIPI and its potential determinants within patients attending Mekane Eyesus Hospital, Estie District, Northwest Ethiopia, from April 15 to May 22, 2022. Cross-sectional study design was employed among 240 participants. Stool specimens were screened using formalin-ether concentration techniques as well direct wet mount techniques. The prevalence of IPIs was 40.8%, with 35% attributed to protozoan infections and 10% to helminths infections. Seven parasite species were identified, being *Etnamoeba histolytica /dispar* and *Giardia lamblia* the predominant species. Significant risk factors for infection included rural residence, consumption of unwashed fruits and vegetables, use of unprotected water sources, intake of raw vegetables or meat, and the presence of gastrointestinal symptoms such as diarrhea and abdominal pain ($p < 0.05$). The findings indicate that GIPIs remain a notable health issues in the study area. Strengthening community interventions focused on personal and food safety practices is essential to reduce infection rates.

Keywords: Ethiopia, intestinal parasitic infections, prevalence, risk factors

Corresponding author: asmamaw.habtamu@gmail.com, asmamaw_habtamu@dmu.edu.et
Phone: +251 913332416, ORCID: https://orcid.org/0000-0003-1221-9563

Article information: Received: 28 September 2025 Revised: 20 January 2026
Accepted: 25 February 2026 Available online: 31 March 2026
Doi: http://doi.org/10.20372/ajids.2026.2706

1. Introduction

Gastro-Intestinal parasitic infections (IPIs) are caused by pathogenic parasites residing in gastrointestinal lumen (Gizachewet al., 2020). Although these infections are categorized as neglected diseases (NTDs), they cause health challenge, typically in low-resource settings in which environmental and socioeconomic factors drive transmission (Syllaet al.,2018). GIPIs cause a range of clinical manifestations, including morbidity, abdominal discomfort, intestinal mucosal irritation, mal-absorption, and potentially fetal complications (Mohammed et al.,2022). Worldwide, nearly 3.5 billion individuals are suffering with IPIs, with 200 million experiencing severe clinical manifestations (Saki et al., 2016;WHO, 1987). The burden is highest in low-income regions, particularly sub-Saharan Africa, where 250 million cases are reported annually (Eyayuet al., 2021). Key pathogenic organisms including Protozoa and Nematodes are responsible for the most global GIPIs-related morbidity (Yemataet al.,2020).

GIPIs are prevalent in Ethiopia due to some possible predictors, including poverty, personal and environmental issues, limited education, and untreated drinking water (Eyayuet al.,2021;Liyihet al., 2022; Sitotaw & Shiferaw, 2020). GIPIs disproportionately affect school-age children, pregnant women, immune-compromised individuals, and people with poor hygiene, leading to serious an increased vulnerability to other infections (Alemuet al.,2021). Despite some prevention measures to control GIPIs, these diseases remain among the major causes of death and disorder worldwide (Abate et al.,2013). IPIs contribute to malnutrition, anemia, growth retardation, and increased susceptibility to other infections, which in turn leads to significant morbidity and mortality (Abate et al.,2013, Hailegebriel et al.,2020; Geletoet al., 2020).

Despite these studies, there has been limited research on epidemiology of IPIs among hospitalized patients in Estie district. Observations made by the researcher suggest that the district's residents have habits of consuming raw vegetables, fruits, and meat especially during holidays and drinking unprotected stream or river water. These practices, coupled with a shortage of protected water sources, are common in the area and contribute to the spread of

GIPIs. Furthermore, there are no epidemiological data on GIPIs in the study area. Thus, the study aimed at determining current status IPIs along with its potential contributors among study participants attending Mekane Eyesus Hospital in Estie District, North West Ethiopia, from April 2022 to May 2022.

2 .Materials and Methods

2.1 Study Area

The study was conducted at Mekane Eyesus Hospital in Estie district, Northwest Ethiopia (Figure 1). It is situated at 676 km northwest of Addis Ababa. Its coordinate location is 11° 34′ N latitude and 36° 41′ E longitude, with elevation ranges from 1,500 to 4231 m above sea level. Estie district lies on the area of 1378895.6 km^2. According to the Estie district administration office (2022), the total population number in 2012 was estimated that 217097 (110825 males, 106272 females).

Farming in the area follows a traditional mixed crop livestock system, which is foundational to Ethiopian agriculture, especially in the highlands. The primary crops include wheat, *teff*, barley, vetch, and chickpea, among others. Common livestock reared in the district are cattle, goats, sheep, and poultry. At the district level, health services comprise 11 health centers, 47 health posts, and one primary hospital. Health posts staffed by two health extension workers each are tasked with implementing the national Health Extension Program, operating under the supervision of nearby health centers (Estie district administration office, 2022)

2.2 Research Design

A hospital based cross-sectional study design was conducted from April 15 to May 22/2022.

2.3 The source population

All patients who visited Mekane Eyesus Primary Hospital between April 15, 2022 and May 22, 2022, were considered the source population.

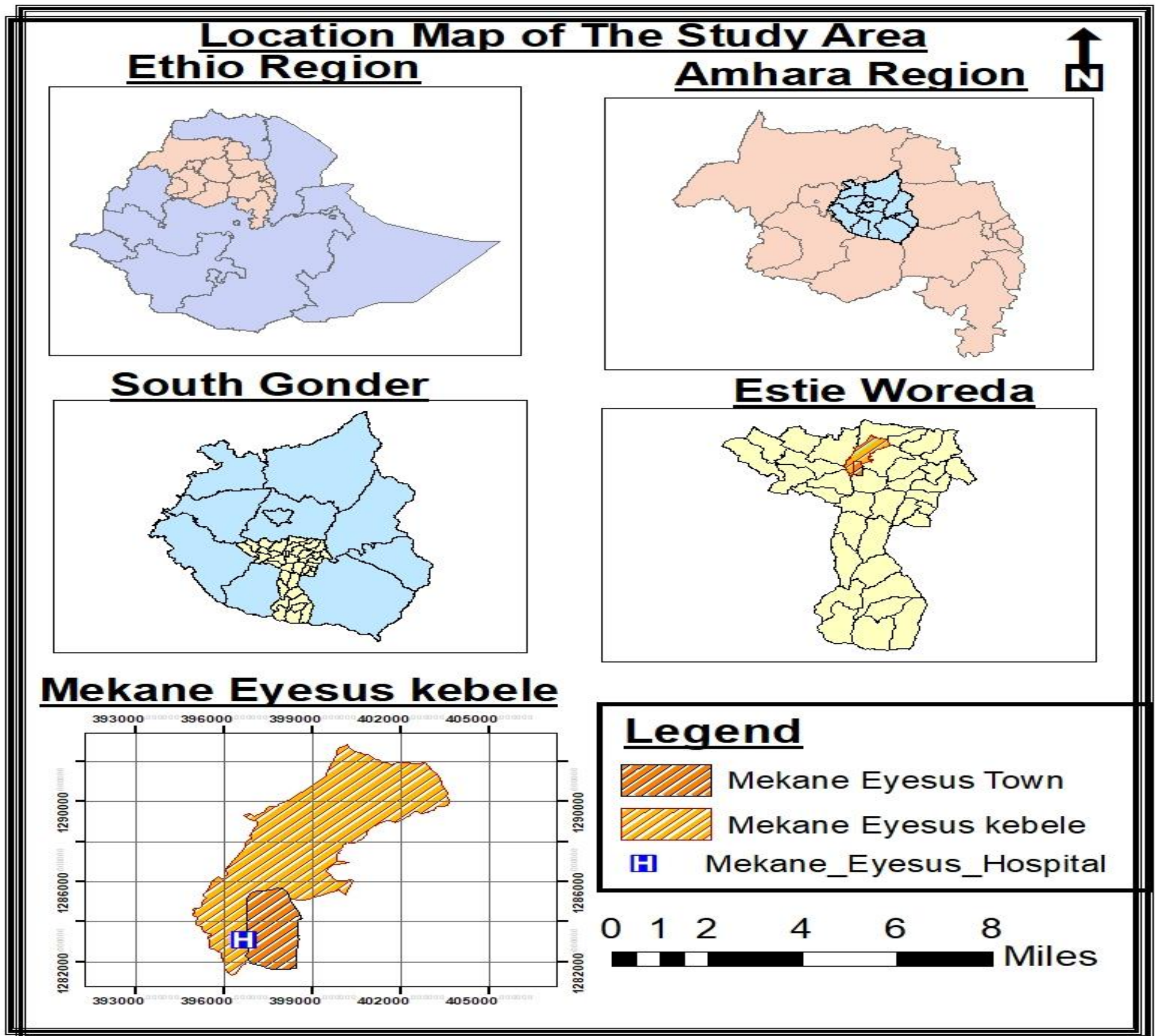

Figure 1 Map of the Study Area

2.4 Study population and period

All individuals exhibiting clinical symptoms including abdominal pain who sought medical care at Mekane Eyesus Hospital between April 15 and May 22, 2022, were considered as the study

population. Accordingly, a total of 650 patients suspected of intestinal parasitic infections were enrolled across the study duration.

2.5 Inclusion and Exclusion Criteria

All individuals in the hospital presenting with gastrointestinal symptoms clinically suggestive of intestinal parasitic infection and who were willing to be a part of study were included. On the other hand, patients who received anti-parasitic treatment within the prior 14 days or whose parents/guardians declined consent were designated for exclusion; however, no such cases were encountered during the study period.

2.6 Determination of Sample Size

The study sample size was determined using the single population formula by Daniel (1999)

$$n = (\frac{ZP(1-p)}{D2}$$

The estimation of the sample size was based on the population and previous studies on the prevalence of intestinal parasitic infections (IPIs) in the study area where:

n = sample size

Z= 1.96 at 95% confidence level

P = the estimated prevalence rate 50%= 0.5

D = margin of error 0.05.

Finally, sample size was

$$no = \frac{(1.96)2 * 0.50(1-0.50)}{(0.05)2} = 384\, patients$$

However, the study population was only 650. Therefore, obtaining 384 samples from this limited population was not feasible. As result, a finite population correction formula was applied (Cochran, 1963).

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$,

where;

N= total population (650)

n_o = initial sample size (384)

n = modified (adjusted sample)

After calculation, the adjusted sample size was 240 (excluding non-response rate).

2.7 Sampling Methods

A Systematic random sampling was used to select participants. The total population (650) was registered in a log book according to their visit order. Representative samples were selected by first calculating the sampling interval (650/240 ≈ 3), then choosing every 3rd registered patient until reaching the desired sample size (240). Each day, 22 patients were registered, and every third individual was selected to participate in the study. Classification of age was done based on World Health Organization (1987).

2.8 Data Collection Tools

2.8.1 Questionnaires

Questionnaires were adopted from Ethiopia Demographic and Health Surveys (2011) to assess socio-demographic conditions, behavioral factors, hygiene practices, dietary habits, and health-related factors. It was 1st prepared in English and translated into the local language (Amharic) for clear communication. Responses were subsequently translated back into English for analysis

2.8.2 Stool Sample

Fresh stool specimens were then collected by qualified laboratory technologists. Participants were instructed to collect stool samples using a wooden applicator stick into clean, leak-proof containers. Laboratory analysis of the samples was conducted at Mekane Eyesus Primary Hospital. Each freshly collected specimen was processed for direct wet mount examination and microscopically inspected for the presence of protozoan trophozoites, cysts, and helminth eggs and larvae.

2.8.3 Direct microscopic examination of stool specimen (wet mount)

0.85% saline was placed at the center of a slide adding drop of iodine solution on the slide. Then stool sample was mixed with the drops and was covered with a cover slip at a 30° angle, and gently putting it onto the slide to prevent air bubbles formation. The specimen was examined

under lower objective lens to identify the ova or larvae of helminths. Additionally, the sample was examined under 40x objectives lens to identify the cyst stages of protozoa (Antenehet al., 2008).

2.8.4 Formalin - Ether centrifugal sedimentation technique

Approximately two pea-sized portions of stool were emulsified in 10 mL of normal saline within a small beaker. The mixture was filtered with gauze and centrifuged at 3,000 rpm for 1 minute. After discarding the supernatant 10 mL of formaldehyde solution was added to the sediment. After allowing standing for 5 minutes, 3 mL of diethyl ether was added and allowed for centrifugation at 1,500 rpm for 1 minute. Following centrifugation, the debris layer was carefully removed using a wooden applicator stick, and the supernatant was decanted. Any residual debris adhering to the tube wall was removed with a cotton swab. Finally, the remaining fluid and sediment were gently mixed by tapping the tube and sample was placed on the slide for microscopic examination (Antenehet al.,2008).

2.9 Data Analysis

The collected data were entered into IBM SPSS Statistics version 21.0. Bivariate and multivariate logistic regression analysis was employed for assess the associations between potential risk factors and determine the strength of its association respectively at $p \leq 0.05$.

2.10 Quality Control

To check data quality, the questionnaire was pretested on 5% of the study population prior to actual data collection. Each completed questionnaire was thoroughly reviewed for completeness and accuracy. Questionnaires were conducted in the local language (Amharic), and participants received clear instructions on specimen collection and handling procedures. Stool samples were properly labeled with unique patient identification numbers to avoid result mix-ups. All samples were labeled with the patient's identification number to prevent result mix-ups. Slides were cross-checked blindly by another laboratory technologist. A colored parasitological atlas was used to ensure accurate parasite-species identification. Finally, data were carefully cleaned, coded, and entered to maintain integrity.

2.11 Ethical clearance

Prior to data collection, informed consent was obtained from all study participants. For participants under 18 years of age, assent was secured from parents or legal guardians. The permission letter was obtained from Estie district Mekane Eyesus primary hospital's manager. All individuals diagnosed with intestinal parasitic infections received appropriate treatment administered by qualified nurses.

3. Results

3.1 Socio-Demographic Variables of the Study Participants

Among 240 participants, most (56.7%) were between 15–44 years old, followed by 21.26% within 5–14 years while only 3.3% were above 64 years of age

Table 1: Socio-demographic profile of patients at Mekane Eyesus Primary Hospital, Estie District, Northwest Ethiopia (April 15 to May 22, 2022).

Variable	Categories	Frequency	% (percent)
	<5	19	7.92
Age	5-14	51	21.26
	15-44	136	56.7
	45-64	26	10.8
	>64	8	3.3
	Can'tread and write	90	37.5
Education level	Able to read and write	47	19.6
	Complete primary education	18	7.5
	Complete secondary school	11	4.6
	Graduate diploma and above	74	30.8
Occupation	agro farming	115	47.9
	Merchant	59	24.6
	Civil servant	66	27.5
	Male	109	45.4

Sex	Female	131	54.6
	Rural	97	40.4
Residence	**Urban**	**143**	**59.6**

. Concerning educational status, 37.5% of the respondents were unable to read and write, whereas 30.8% had attained a diploma or higher education level. With respect to occupation, nearly half of the participants (47.9%) were engaged in agro-farming, followed by civil servants (27.5%) and merchants (24.6%) (Table 1)

3.2 Behavioral, sanitary, feeding and health related characteristics of patients

Among the 240 examined patients, 9% of them never utilize latrine, 5.4% never wear shoes, 17.9% never wash vegetables and fruits before eating, 9.2% had no latrine, 61.3% had a feeling of diarrhea, 90% had abdominal pain, 49.2% had contact with animals, 30.4% used unprotected water sources, 68.3% had the habit of eating raw vegetables, 53.3% had poor knowledge of personal and environmental hygiene, 1.3% never wash their hands before meals, 83.3% utilized water directly from its source without treatment (Table 2).

Table 2: Behavioral, sanitation, dietary, and associated factors of participants attending Mekane Eyesus Hospital, Northwest Ethiopia, between April 15 and May 22, 2022

Variable	Categories	Frequency	% (percent)
Utilization of latrine	Never	22	9
	Sometimes	62	26
	Always	156	65
Frequency of wearing shoe	Never	13	5.4
	Sometimes	58	24.2
	Always	169	70.4
Washing vegetable/fruit/ before eating	Never	43	17.9
	Sometimes	126	52.5
	Always	71	29.6
Type of latrine	No latrine	22	9.2

used	Pit without cover	143	59.6
	Pit with cover	75	31.3
Feeling of diarrhea	Presence	147	61.3
	Absence	93	38.8
Abdominal pain	Presence	216	90.0
	Absence	24	10.0
Contact with animal	Yes	118	49.2
	No	122	50.8
Source of water	Unprotected	73	30.4
	Protected	167	69.6
Latrine availability	No	22	9.2
	Yes	218	90.8
Habit of eating raw vegetable	Yes	164	68.3
	No	76	31.7
hygiene	Poor	128	53.3
	Good	112	46.7
Shoes wearing	No	13	5.4
	Yes	227	94.6
Hand washing before meal	Never	3	1.3
	Sometimes	88	36.7
	Always	149	62.1
Utilization of water from its source	Direct	200	83.3
	Filtering	13	5.4
	Boiling	17	7.1
	using chemical	10	4.2

3.3 The Prevalence of IPIs

The total prevalence of intestinal parasitic infections among the study participants was 40.8%. Of this, 20.4% were male and 20.4% were female. The highest infection was observed among participants aged 15–44 years (19.6%) (Table 3)

Table 3: Distribution of intestinal parasitic infections by sex and age category among patients at Mekane Eyesus Primary Hospital, Estie District, Northwest Ethiopia, between April 15 and May 22, 2022 (n = 240)

Factors	Categories	Number of positive	Prevalence (%)
Sex	Male	49	20.4
	Female	49	20.4
	Total	98	40.8
Age	<5	2	0.8
	5-14	39	16.3
	15-44	47	19.6
	45-64	8	3.3
	>64	2	0.8
	Total	98	40.8

3.4 Identification Intestinal Parasites among Study Participants

Among 240 participants examined, 74 individuals (30.8%) tested positive for one or more intestinal protozoan species, while 20 (8.3%) were infected with helminths. Mixed infections involving both protozoa and helminths were detected in 4 participants (1.7%) (Table 4).

Table 4: The identified intestinal \participants in Mekane Eyesus primary hospital in Estie district, Northwest Ethiopia (n=240), April 15, 2022 to May 22, 2022

Types of parasites detected	Frequency	Prevalence (%)
Single infection	89	37.1
E. histolytica/dispar	34	14.2
G. lamblia	35	14.6
A. lumbricoides	13	5.4
Hookworm	2	0.8
Taenia species	2	0.8
E. vermicularis	2	0.8

H. nana	1	0.4
Double infection	8	3.3
E. histolytica/dispar and *A. lumbricoides (*mixed)	2	0.8
G. lambila and *A. lumbricoides (*mixed)	1	0.4
E. histolytica/dispar and *G. lamblia (*protozoa*)*	5	2.1
Triple infection	1	0.4
E. histolytica/dispar, *G. lambila* and *A. lumbricoides* (mixed)	1	0.4
Only Protozoan infection (single and double)	74	30.8
Only helminth infection (single)	20	8.3
Both protozoa and helminth infection (mixed)	4	1.7
Overall intestinal parasite infection	98	40.8

3.5 Analysis of risk factors for intestinal parasitic infection

3.5.1 Bivariate logistic analysis

Among 240 participants examined, 98 (40.8%) were positive for intestinal parasites. Residence showed a strong association with infection, with rural residents (58.8%) being significantly more affected than urban dwellers ($p < 0.001$). However, several behavioral and environmental factors demonstrated significant relationships with intestinal parasitic infections, including lack of latrine availability, use of unprotected water sources, poor hand washing before meals, and poor personal hygiene ($p < 0.05$). Additionally, individuals who never washed vegetables before eating and those consuming raw food were significantly higher ($p < 0.05$). (Table 5)

Table 5: Bivariate logistic analysis of associated risk factors with intestinal parasitic infection among patients attending at Mekan Eyesus primary hospital in Estie district, Northwest Ethiopia (n=240), April 15, 2022 to May 22, 2022

Variables	Categories	Total (%)	Intestinal parasites Positive(%)	Negative (%)	COR(95%CL)	p-value
Sex	Male	109	49(46)	60(55.04)	1.367(0.82,2.29	0.237
	Female	131	49(37.4)	82(62.6)	Reference	-
Age	<5	5	2(40)	3(60)	0.4(0.07,2.85)	0.392
	5-14	65	39(60)	26(40)	1.262(0.2,7.8)	0.802
	15-44	136	47(34.6)	89(65.4)	1.5(0.21,10.79)	0.687
	45-64	26	8(30.8)	18(69.2)	2(0.18,22.06)	0.571
	>64	8	2(25)	6(75)	Reference	-
Residence	Rural	97	57(58.8)	40(41.2)	3.545(2.06,6.10)	< 0.001*
	Urban	143	41(28.7)	102(71.3)	Reference	-
Occupation	Agro farming	115	55(48)	60(52)	2.265(1.16,4.43)	0.017
	Merchant	59	17(28.8)	42(71.2)	1.410(0.76,2.61)	0.273
	civil servant	66	26(39.4)	40(60.6)	Reference	-
Education level	URAW	90	42(46.7)	48(53.3)	1.5(0.75,3.19)	0.24
	ARAW	47	17(36)	30(63.8)	2.3(0.75,6.91)	0.147
	PS	18	5(27.8)	13(72.2)	1.05(0.29,3.69)	0.939
	SS	11	5(47.5)	6(52.5)	1.4(0.73,2.53)	0.337
	DAA	74	29(39)	45(60.8)	Reference	-
SW	No	13	9(69)	4(31)	3.5(1.04,11.67)	0.043*
	Yes	227	89(39)	138(61)	Reference	-
FWS	Sometimes	58	27(46.6)	31(53.4)	1.4(0.441,4.261)	0.585
	Always	169	65(38.5)	104(61.5)	Reference	-
CA	Yes	118	51(43.2)	67(56.8)	1.22(0.73,2.03)	0.460
	No	122	47(38.5)	75(61.5)	Reference	-

WVAFBE	Never	43	29(67.4)	14(32.6)	2.6(1.25,5.36)	0.01*
	Sometimes	126	56(44.4)	70(55.6)	9.2(3.85,22.21)	< 0.01*
	Always	71	13(18.3)	58(81.7)	Reference	-
LA	Absent	22	15(68.2)	7(31.8%	3.5(1.364,8.904)	0.009*
	Present	218	83(38.1)	135(61.9)	Reference	-
TL	Uncovered Pit	143	71(49.3)	72(50.7)	11.25(3.79,33.43)	< 0.001*
	pit with cover	75	12(16%)	63(84)	Reference	-
SOW	Unprotected	73	55(75.3)	18(24.7)	8.811(4.67,16.63)	< 0.001*
	Protected	167	43(25.7)	124(74.3)	Reference	-
HERVFM	Yes	164	76(46.3)	88(53.7)	2.120(1.18,3.8)	0.012*
	No	76	22(29)	54(71)	Reference	-
HDUW	Yes	108	66(61)	42(39)	4.911(2.82,8.56)	< 0.001*
	No	132	32(24.2)	100(75.8)	Reference	-
KPAEH	Poor	128	71(55.5)	57(44.5)	3.921(2.25,6.84)	< 0.001*
	Good	112	27(24)	85(76)	Reference	-
DF	Presence	147	81(55)	66(45)	5.487(2.96,10.18)	< 0.001*
	Absence	93	17(18.3)	76(81.7)	Reference	-
AP	Presence	216	96(44.4)	120(55.6)	8.8(2.019,38.358)	0.004*
	Absence	24	2(8.3)	22(91.7)	Reference	-
UL	Never	22	18(81.8)	4(18.2)	2.475(0.744,8.232)	0.139
	Sometimes	62	40(64.5)	22(35.5%)	13.05(4.167,40.86)	< 0.001*
	Always	156	40(25.6)	116(74.4)	Reference	-
HWBM	Never	3	2(67)	1(33)	1.034(.090,11.876)	0.978
	Sometimes	88	58(66)	30(34)	5.842(.515,66.264)	0.154
	Always	149	38(25.5)	111(74.5)	Reference	-
UWS	Direct	200	95(47.5)	105(52.5)	10.9(1.39,85.08)	0.023*
	Filtering	13	1(7.7)	12(92.3)	14.5(1.88,111.25)	0.01*
	Boiling	17	1(6%)	16(94)	8.143(1.01,65.48)	0.049*

	using chemical	10	1(10)	9(90)	Reference	-

NB: COR = crude odds ratio; CI = confidence interval; p-value = probability value; * = significant at p < 0.05; SW = shoe wearing; FWS = frequency of shoe wearing; CA = contact with animals; WVAFBE = washing of vegetables and fruits before eating; LA = latrine availability; TL = type of latrine; SOW = source of water; HERVFM = habit of eating raw vegetables/fruits/meat; HDUW = habit of drinking unprotected water; KPAEH = knowledge of personal and environmental hygiene; DF = diarrhea; AP = abdominal pain; UL = utilization of latrine; HWBM = hand washing before meals; UWS = utilization of water from its source.

3.5.2 Multivariate logistic analysis

According to Multivariate logistic analysis, living in rural area, no a habit of washing vegetable and fruits before eating, unprotected source of water, eating raw vegetable/fruit/meat, having diarrhea , and abdominal pain had a significant association with GIPIs (p<0.05) (Table 6).

Table 6: Multivariate logistic analysis of IPIs of participants at Mekane Eyesus primary hospital in Estie district, North West Ethiopia April 15, 2022 to May 22, 2022

Variables	Categories	Total (%)	Intestinal parasite		AOR(95%CL)	p-value
			Positive (%)	Negative (%)		
Residence	Rural	97	57(58.8)	40(41.2)	4.188(1.52-11.52)	0.006*
	Urban	143	41(28.7)	102(71.3)	Reference	-
SW	No	13	9(69)	4(31)	1.5(1.43-14.68)	0.753
	Yes	227	89(39)	138(61)	Reference	-
WVFBE	Never	43	29(67.4)	14(32.6)	5.1(1.56-16.87)	0.007*
	Sometimes	126	56(44.4)	70(55.6)	9.757(2.4-39.54)	0.001*
	Always	71	13(18.3)	58(81.7)	Reference	-
LA	Absent	22	15(68.2)	7(31.8%	0.116(< 0.001,437.72)	0.608
	Present	218	83(38.1)	135(61.9)	Reference	-
TL	Uncover Pit	143	71(49.3)	72(50.7)	15.31(0.004,59264.7)	0.517
	Covered pit	75	12(16%)	63(84)	Reference	-

SOW	Unprotected	73	55(75.3)	18(24.7)	3.02(1.08,8.46)	0.036*
	Protected	167	43(25.7)	124(74.3)	Reference	-
HERVFM	Yes	164	76(46.3)	88(53.7)	8.242(2.80,24.25)	< 0.001*
	No	76	22(29)	54(71)	Reference	-
HDUW	Yes	108	66(61)	42(39)	1.056(0.42,2.69)	0.909
	No	132	32(24.2)	100(75.8)	Reference	-
KPAEH	Poor	128	71(55.5)	57(44.5)	1.208(0.43,3.39)	0.720
	Good	112	27(24)	85(76)	Reference	-
DF	Presence	147	81(55)	66(45)	3.182(1.29,7.88)	0.012*
	Absence	93	17(18.3)	76(81.7)	Reference	-
AP	Presence	216	96(44.4)	120(55.6)	12.07(1.77-82.28)	0.011*
	Absence	24	2(8.3)	22(91.7)	Reference	-
UL	Never	22	18(81.8)	4(18.2)	2.04(0.173-24.072)	0.571
	Sometimes	62	40(64.5)	22(35.5%)	3.597(0.34-38.033)	0.287
	Always	156	40(25.6)	116(74.4)	Reference	-
UWS	Direct	200	95(47.5)	105(52.5)	5.842(0.31-108.79)	0.237
	Filtering	13	1(7.7)	12(92.3)	4.1(0.37-45.42)	0.253
	Boiling	17	1(6%)	16(94)	2.029(0.17-24.03)	0.575
	use chemical	10	1(10)	9(90)	Reference	-

NB: AOR = adjusted odds ratio; CI = confidence interval; p-value = probability value; * = significant at $p < 0.05$; SW = shoe wearing; WVFBE = washing of vegetables and fruits before eating; LA = latrine availability; TL = type of latrine; SOW = source of water; HERVFM = habit of eating raw vegetables/fruits/meat; HDUW = habit of drinking unprotected water; KPAEH = knowledge of personal and environmental hygiene; DF = diarrhea; AP = abdominal pain; UL = utilization of latrine; UWS = utilization of water from its source.

4. Discussions

The overall prevalence of intestinal parasitic infection in our study was 40.8% (95% CI: 34.6, 47.1) which was in line with the study conducted at Hara health center, Tehule Dere District,

northeast Ethiopia, with the prevalence of 42.3% (Endris and Mamo, 2020). However it was relatively lower than similar studies conducted indifferent part Ethiopia, 52% (95% CI: 50.2%-55.5%)at Sanja Primary Hospital, Northwest, Ethiopia (Eyayuet al., 2021); 56.9% at Shahura Health Center Northwest Ethiopia (Tigabuet al.,2019); 45.4% Nefas Mewecha health centerin, South Gondar Zone, Northwest Ethiopia (Yemataet al.,2020); 56% teaching hospitals in Zagazig district, Egypt (Omar and Abdela, 2022); 87% in Libya (Ali, 2021). This lower prevalence in the current study might be due to study period after deworming, moderate climatic condition and latrine availability

On the other hand, it was higher than study which was conducted at Jimma health, Jimma, Ethiopia with prevalence of 20.6% (Alemuet al.,2021); 26.5% at Rural hospital in southern Ethiopia (Ramos *et al.,* 2014); 34.6% at Woldia comprehensive specialized Hospital (Regaet al.,2022); 19% at Bahir Dar and Han Health Centers, Northwest Ethiopia (Mohammed et al.,2022); 4.4% in southern Iran (Teimouriet al.,2022); 10.0% in Ghana (Appiah et al.,2019); 22.83% at Center Region Cameroon (Signabouboet al.,2019). This higher prevalence in the current study might be due to inclusion of all age groups patients, low level of knowledge about personal and environmental hygiene, utilization of unprotected source of water and habit of eating raw vegetable/fruit/meat, higher proportion of farming among the study population as reflected in the study data.

The current study revealed that the prevalence of protozoan parasites (35%) was higher than helminth parasites (10 %). It is supported by study at Woldia Comprehensive Specialized Hospital's reported protozoan parasites 32.9%, and helminth infections 1.7% (Regaet al.,2022); Protozoa 89.0% and helminths 17.9% in rural Haryana (Sangwanet al.,2017). The high prevalence of protozoan parasites may be due to their high proliferation rate and the simple route of infection via contaminated foods and water.

In our study, among the seven identified intestinal parasite *E. histoltica/dispar*/, *G. lambila* and *A. lumbrcodies* were the most predominant in their prevalence. This is supported by Yemataet al.(2020) and Mohammed et al. (2022) that *E. histolytica/dispar,G. lamblia*, and *A. lumbricoides* were the most predominant intestinal parasites.

The prevalence of *G. lamblia* in the current study was 17.5% which is in line with study conducted in a rural hospital in southern Ethiopia was 15.0% (Ramos et al.,2014). On the other hand it is relatively higher as compared with, 7.4% at Shahura Health Center, Northwest Ethiopia (Tigabuet al.,2019); 5.43% Bahir Dar and Han Health Centers, Northwest Ethiopia (Mohammed et al.,2022). This relatively higher prevalence might be due to a habit of eating vegetables and fruits without washing, limited deworming program in our study.

The prevalence of *A. lumbricoides* in the current study was 7.1% which is in line with , 5.0 % in a rural hospital in southern Ethiopia (Ramos et al., 2014) and 6.1% at Hara health center, Tehule Dere District, northeast Ethiopia (Endris and Mamo, 2020). On the other hand its prevalence in our study was relatively higher than, 0.9% at Bahir Dar and Han Health Centers, Northwest Ethiopia (Mohammed et al.,2022); 3.7% in South Gondar Zone, Northwest, Ethiopia was (Yemataet al.,2020); 0.1% in Ghana (Appiah et al.,2019) and 3.9% at Workemeda Health Center, Northwest Ethiopia (Hailu, 2014), 3.6% in Thailand (Sanprasertet al.,2016), 4.3% in Cameroon (Nsagha et al.,2017), 4% in Yifag health center, Northwest Ethiopia (Damtie and Liyih, 2021). The relatively higher prevalence the present study might be due limited practices of personal, environmental hygiene and vegetable washing habit as it was reflected in our data.

Living in rural areas, not washing vegetables and fruits before eating, using unprotected water sources, consuming raw produce or meat, and experiencing diarrhea and abdominal pain were all significantly associated with intestinal parasitic infections in our study. Similarly, having stomach pain and having diarrhea (Tigabuet al.,2019), source of water (Alemuet al.,2021), Residence (Sitotaw and Shiferaw, 2020), no habit of washing fruits and vegetables (Agazheet al.,2021) were significantly associated with intestinal parasitic infection

In present study, residence of study participants was significantly associated with intestinal parasitic infection; participants living in rural area were four times more likely to be infected with intestinal parasitic infection (AOR= 4.188, CL =1.522-11.521; p =0.006) than patients living in urban areas. This result is supported by other study conducted at Hara health center, TehuleDere District, northeast Ethiopia reported that rural residence was two times (AOR2.157, 95% CI 1.178, 3.950, p=0.013) more likely to be infected by intestinal parasitic infection than

urban living (Endris and Mamo, 2020). The higher proportion of intestinal parasitic infection in the rural patients may be attributable to a variety of factors, including agricultural practices and, thereby, migration for labor work, which force them to drink contaminated water and may leave them unable to exercise proper personal and environmental hygiene as indicated in our research data.

The habit of washing vegetable and fruits before eating was significantly associated with intestinal parasitic infection with p =0.007. This was in line with study conducted at Bahir Dar and Han Health Centers, Northwest Ethiopia, reported (Mohammed et al.,2022). The possible reason might be due to the contamination of fruits and vegetables with the infective stages of intestinal parasites.

Patients who used a protected water source were associated with intestinal parasites with p=0.036 in our study. This finding was agreed with study conducted in Merhabete District, Central Ethiopia reported that drinking water source conditions showed significant variation in the prevalence of protozoan parasites among the school children (Dagne and Alelign, 2021).. This might be due to unprotected water sources (river, stream and pond) that were easily contaminated with feces of humans and animal dung. Thereby infective stage of the intestinal parasite would get chances to transmit human host through drinking, washing, and swimming.

The poor habit of eating raw vegetables/fruit/meat was significantly associated with the prevalence of intestinal parasitic infection in our study. Patients who had a habit of eating raw vegetables/fruits/meat were eight times (AOR=8.242) more likely to be infected with intestinal parasitic infection than patients who had no habit of eating. This result was supported by another finding in Merhabete District, Central Ethiopia, students who had a habit of eating raw vegetables was two times (AOR=2.29) more likely to be infected than students who had no habit of eating raw vegetables (Dagne and Alelign, 2021). This might be due to contamination of vegetables/fruits/meat with infectious stage of intestinal parasite in case of open defection.

Diarrhea was significantly associated with intestinal parasitic infections. Patients with the presence of diarrhea were three times (AOR=3.182; CL=1.285 -7.876; P=0.012) more likely to be infected than patients who had no diarrhea. This is in line with study conducted at Shahura

Health Henter, northwest Ethiopia reported that having diarrhea also was significantly associated with parasitic infections (Tigabuet al. ,2019). This may be due to diarrhea causing nature of intestinal parasites.

5. Conclusions

The present study showed that IPIs were moderately prevalent and important health problem among patients attending at Mekane Eyesus Primary Hospital in Estie district, northwest Ethiopia. *E. histolytica/dispar* was the predominant GIPI and followed by *G. lamblia* and *A. lumbricoides*. Living in rural area, poor of washing habit for vegetables and fruits before eating, unprotected source of water, habit of eating raw vegetable/fruit/meat, presence diarrhea and abdominal pain were found to be potential risk factors and significantly associated with intestinal parasitic infection.

6. Recommendation

Based on the findings of the present study, community members should adopt and maintain good personal and environmental hygiene including hand washing, safe food handling, and proper sanitation. The health professional should give health education about IPIs and implement deworming programs. Moreover, further study should be conducted for identifying risk factors for *H.nana* and *Taena* species which were not found in the present study.

Acknowledgments

The authors sincerely thank Debre Markos University for its academic support and scholarship assistance and Mekane Eyesus Primary Hospital for its cooperation throughout the research process. Special appreciation is also extended to all study participants for their willingness to contribute valuable data to this study.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All authors equally contributed to the conception and design drafting of the manuscript. Each author has reviewed and approved the final version.

Funding

This research was conducted without external funding.

Reference

Abate, A., Kibret, B., Bekalu, E., Abera, S., Teklu, T., Yalew, A., Endris, M., Worku, L., & Tekeste, Z. (2013). Cross-sectional study on the prevalence of intestinal parasites and associated risk factors in Teda Health Centre, Northwest Ethiopia.*International Scholarly Research Notices Parasitology*, 2013, 1–5.

Agazhe, M., P., E., Shitu, D., Hune, Y., Mamo, A., Takele, A., Marew, M., Bekele, D., Tesfaye, B., Getaneh, T.,Mengist, B., &Derbie, S. (2021). Intestinal parasitic infection and its associated factors among primary school students in Ethiopia: A systematic review and meta-analysis.

Alemu, M., Kinfe, B., Tadesse, D., Mulu, W., Hailu, T., &Yizengaw, E. (2017). Intestinal parasitosis and anaemia among patients in a health center, North Ethiopia. *BMC Research Notes*, 10, 632.

Alemu, Y., Yemane, T., &Fekadie, M. (2021). Prevalence of intestinal parasite infections and associated risk factors among patients of Jimma Health Center requested for stool examination, Jimma, Ethiopia. *PLoS ONE*, 16(2), e0247063.

Ali, K. S. M. (2021). Prevalence of intestinal parasites among patients attending Zella Central Laboratory, Zella City, Libya.*Journal of Pure and Applied Sciences*, 20(2), 7–11.

Anteneh, T., Giday, A., Alano, A., Awoke, A., W/Chirkos, A., Dibisa, N., Yihdego, D., & Desta, M. (2008). *Intestinal parasitosis: For the Ethiopian health center team* (pp. 5–6). Ethiopian Public Health Training Institute.

Appiah, M. A., Adzaklo, E. E., &Agboli, E. (2019).A retrospective study of intestinal parasite among patients in the Ho Teaching Hospital, Ghana.*International Journal of Tropical Disease & Health*, 37, 1–8.

Cochran, W. G. (1963). *Sampling techniques* (2nd ed.). John Wiley & Sons.

Dagne, N., &Alelign, A. (2021).Prevalence of intestinal protozoan parasites and associated risk factors among school children in Merhabete District, Central Ethiopia.*Journal of Parasitology Research*, 2021.

Damtie, D., &Liyih, M. (2021).Prevalence and associated risk factors of intestinal parasitic infections among pregnant women attending antenatal care in Yifag Health Center, Northwest Ethiopia.*Canadian Journal of Infectious Diseases and Medical Microbiology*, 2021, 1–10.

Daniel, W. W. (1999). *Biostatistics: A foundation for analysis in the health sciences* (7th ed.). John Wiley & Sons.

Ethiopia Demographic and Health Survey. (2011). *Ethiopia demographic and health survey 2011*. Central Statistical Agency.

Eyayu, T., Kiros, T., Workineh, L., Sema, M., Damtie, S., Hailemichael, W.,Dejen, E., &Tiruneh, T. (2021). Prevalence of intestinal parasitic infections and associated factors among patients attending at Sanja Primary Hospital, Northwest Ethiopia: An institutional-based cross-sectional study. *PLoS ONE*, 16(2).

Gelaw, A., Anagaw, B., Nigussie, B., Silesh, B., Yirga, A., Alem, M., Endris, M., &Gelaw, B. (2013). Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. *BMC Public Health*, 13, 304.

Geleto, G. E., Kassa, T., &Erko, B. (2022).Epidemiology of soil-transmitted helminthiasis and associated malnutrition among under-fives in conflict-affected areas in southern Ethiopia.*Tropical Medicine & Health*, 50.

Gizachew, Y., Zewde, H., Mekene, T., Manilal, A., Lakew, S., &Teshome, A. (2020). Prevalence and associated risk factors of intestinal parasites among schoolchildren from two primary schools in Rama Town, Northern Ethiopia.*Canadian Journal of Infectious Diseases and Medical Microbiology*, 2020, 1–8.

Hailegebriel, T., Nibret, E., &Munshea, A. (2020). Prevalence of soil-transmitted helminth infection among school-aged children of Ethiopia: A systematic review and meta-analysis. *Infectious Diseases: Research and Treatment*, 13.

Hailu, T. (2014).Current prevalence of intestinal parasites emphasis on hookworm and *Schistosoma mansoni* infections among patients at Workemeda Health Center, Northwest Ethiopia.*Clinical Microbiology*, 2014, 3–4.

Hajare, S. T., Gobena, R. K., Chauhan, N. M., &Eriso, F. (2021). Prevalence of intestinal parasite infections and their associated factors among food handlers working in selected catering establishments from Bule Hora, Ethiopia. *BioMed Research International*, 2021.

Liyih, M., Damtie, D., &Tegen, D. (2022). Prevalence and associated risk factors of human intestinal helminth parasitic infections in Ethiopia: A systematic review and meta-analysis. *The Scientific World Journal*, 2022.

Menjetta, T., Simion, T., Anjulo, W., Ayele, K., Haile, M., Tafesse, T., &Asnake, S. (2019). Prevalence of intestinal parasitic infections in Hawassa University students' clinic, Southern Ethiopia: A 10-year retrospective study. *BMC Research Notes*, 12, 702.

Mohammed, J., Shiferaw, A., Zeleke, A., Eshetu, Y., Gebeyehu, Z., Ayehu, A., &Adem, Y. (2022). Prevalence and associated risk factors of intestinal parasites among diarrheic under-five children attending Bahir Dar and Han Health Centers, Northwest Ethiopia: A cross-sectional study. *Journal of Parasitology Research*, 2022, 1–10.

MulusewAndualem. (2014). Knowledge and experience sharing practices among health professionals in hospitals under the Addis Ababa Health Bureau, Ethiopia.*BMC Health Services Research*, 14(1), 1–10.

Nsagha, D. S., Njunda, L. A., Assob, N. J. C., Ayima, C. W., Tanue, E. A., Kibu, O. D., &Kwenti, T. E. (2017). Prevalence and predisposing factors to intestinal parasitic infections in HIV/AIDS patients in Fako Division of Cameroon.*American Journal of Epidemiology and Infectious Disease*, 5(3), 42–49.

NuruEndris,&HassenMamo. (2020). Status of individual, household and environmental sanitary practices in relation to intestinal parasitic infections among patients visiting Hara Health Center, Tehuledere District, northeast Ethiopia. *SINET: Ethiopian Journal of Science*, 43(2), 114–124.

Omar, M., &Abdelal, H. O. (2022).Current status of intestinal parasitosis among patients attending teaching hospitals in Zagazig district, Northeastern Egypt.*Parasitology Research*, 121(6), 1651–1662.

Ramos, J. M., Rodríguez-Valero, N., Tisiano, G., Fano, H., Yohannes, T., Gosa, A., Fruttero, E., Reyes, F., &Górgolas, M. (2014).Different profile of intestinal protozoa and helminthic infections among patients with diarrhoea according to age attending a rural hospital in southern Ethiopia.*Tropical Biomedicine*, 31(2), 392–397.

Rega, S., Melese, Y., Geteneh, A., Kasew, D., Eshetu, T., &Biset, S. (2022). Intestinal parasitic infections among patients who visited Woldia Comprehensive Specialized Hospital's emergency department over a six-year period, Woldia, Ethiopia: A retrospective study. *Infection and Drug Resistance*, 15, 3239–3248.F

Saki, J., Khademvatan, S., Foroutan-Rad, M., &Gharibzadeh, M. (2017).Prevalence of intestinal parasitic infections in Haftkel County, southwest of Iran.*International Journal of Infection*, 4(4).

Sangwan, J., Mane, P., &Lathwal, S. (2017). Burden of intestinal parasitic infection in patients attending tertiary care hospital in rural Haryana: A three-year retrospective study. *Perspectives in Medical Research*, 5, 3–7.

Sanprasert, V., Srichaipon, N., Bunkasem, U., Srirungruang, S., &Nuchprayoon, S. (2016). Prevalence of intestinal protozoan infections among children in Thailand: A large-scale screening and comparative study of three standard detection methods. *Southeast Asian Journal of Tropical Medicine and Public Health*, 47(6), 1123–1133.

Shiferaw, K., Tesfay, T., Kalayu, G., &Kiros, G. (2021). Human intestinal parasites: Prevalence and associated risk factors among grade school children in Maksegnit, Northwest Ethiopia. *Journal of Tropical Medicine*, 2021, 1–6.

Signaboubo, D., VKh, P., Cedric, Y., Moussa, I. M., Nfor, E. K., & Romeo, N. G. (2019). Prevalence of gastro-intestinal parasitic infections among patients in Bafia Health District, Center Region Cameroon: A retrospective study. *South Asian Journal of Parasitology*, 3(1), 1–9.

Sitotaw, B., &Shiferaw, W. (2020).Prevalence of intestinal parasitic infections and associated risk factors among first-cycle primary schoolchildren in Sasiga District, Southwest Ethiopia.*Journal of Parasitology Research*, 2020, 8681247.

Sylla, K., Tine, R. K., Sow, D., Lelo, S., Ndiaye, L. A., Faye, B. T., Ndiaye, M., Dieng, T., Faye, B., & Gaye, O. (2018). Epidemiological profile of intestinal parasitic infection among

preschool and school children living in a rural community in Senegal: A cross-sectional survey. *Journal of Bacteriology and Parasitology*, 9(4), 1–2.

Teimouri, A., Alimi, R., Farsi, S., &Mikaeili, F. (2022). Intestinal parasitic infections among patients referred to hospitals affiliated to Shiraz University of Medical Sciences, southern Iran: A retrospective study in pre- and post-COVID-pandemic. *Environmental Science and Pollution Research*, 29(24), 36911–36919.

Tigabu, A., Taye, S., Aynalem, M., &Adane, K. (2019).Prevalence and associated factors of intestinal parasitic infections among patients attending Shahura Health Center, Northwest Ethiopia.*BMC Research Notes*, 12(1), 1–8.

World Health Organization. (1987). *Prevention and control of intestinal parasitic infections: Report of a WHO Expert Committee*. https://iris.who.int/handle/10665/41298

Yemata, G., Azanaw, M., Bilal, L., &Mekonnen, B. (2020).Prevalence of intestinal parasitic infections and associated factors among diarrheal outpatients in South Gondar Zone, Northwest Ethiopia.https://doi.org/10.21203/rs.3.rs-109505/v1

.

.