


Prevalence of Intestinal Parasites and Associated Factors Among Psychiatric Patients Attending Felege Hiwot Comprehensive Specialized Referral Hospital, Northwest Ethiopia

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Background: Intestinal parasitic infections are among the major public health problems in resource-poor countries such as Ethiopia. Certain segments of the population such as psychiatric patients are believed to be at higher risk of infection because of their poor hygiene practices. However, information on the prevalence and contributing factors among psychiatric patients is limited in Ethiopia.

Methods: A facility-based cross-sectional study was conducted among 432 psychiatric patients attending Felege Hiwot Comprehensive Specialized Referral Hospital, Northwest Ethiopia from May to July 2020. Participants were selected using a systematic random sampling technique. Data on socio-demography and associated factors were collected using a pre-tested structured questionnaire. Stool sample was collected and processed for parasitological examination using direct wet mount, modified Ritchie's concentration, Kato-Katz and modified Ziehl-Neelsen staining techniques following standard protocols. Data were entered and analyzed using Statistical Package for the Social Sciences software version 20. The prevalence of intestinal parasitosis and associated factors were computed by descriptive statistics and binary logistic regression at 95% confidence interval (CI), respectively. Association between variables was considered statistically significant only if P -value < 0.05 at 95% confidence level.

Results: A total of 168 (38.9%) participants were positive for at least a single species of intestinal parasite. Hookworm, *Entamoeba histolytica/Entamoeba dispar* and *Ascaris lumbricoides* were the most frequent parasites, detected in 74 (17.1%), 47 (10.9%) and 37 (8.6%) participants, respectively. Double infection was detected in 16 (9.5%) participants where 8 (4.8%) had hookworm and *Ascaris lumbricoides* co-infections. Not washing raw fruits and vegetables before eating (adjusted odds ratio = 8.402; 95% CI: 3.055–23.109; $P < 0.001$) and having a psychiatric diagnosis other than bipolar disorder (adjusted odds ratio = 3.104; 95% CI: 1.334–7.222; $P = 0.009$) were significantly associated with intestinal parasitic infections.

Conclusion: The prevalence of intestinal parasites among psychiatric patients was significant. Therefore, improving hygiene practice and implementing regular screening for intestinal parasitic infection among psychiatric patients are recommended so as to control parasite transmission and improve the health of psychiatric patients.

Keywords: intestinal parasites, psychiatric patients, Bahir Dar

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Background

Intestinal parasitic infections (IPIs) are common public health problems globally with the majority of cases and deaths occurring in tropical countries.¹ Annually, 16 million deaths occur due to parasitic diseases worldwide.² Soil-transmitted helminths (STHs) infect 24% of the world's population.³ Among protozoan parasites, *Entamoeba histolytica* and *Giardia duodenalis* infect 500 million and 280 million people worldwide, respectively.^{4,5} In Ethiopia, intestinal parasites (IPs) are widely distributed and affect various segments of the population.⁶

Transmission of IPIs is significantly linked to poor hygiene and sanitary conditions, tropical climate and poor access to safe water. Moreover, person to person transmission is much more common in overcrowded living conditions and institutions such as schools, day care centers, orphanages and rehabilitation centers.⁷ Mentally ill individuals are considered to be vulnerable to IPIs as many people with such disabilities cannot be trained for proper health behaviors.^{8,9} As a result, they do not practice hygiene and sanitary activities and IPIs have been a major problem in rehabilitation centers for psychiatric patients.¹⁰

Intestinal parasitic infections are known to cause diarrhea, nausea, vomiting, anorexia, abdominal pain and tenesmus.^{11,12} Chronic infections can bring serious complications such as prolonged diarrhea, anemia, reduced physical and mental development and malnutrition.^{7,12} Considering the burden of intestinal parasites (IPs), the Federal ministry of health has been taking strong measures in order to control these diseases. The health extension, water sanitation and hygiene (WASH), and mass drug administration (MDA) programs for selected parasites have been implemented strategies.¹³ These programs primarily target school-age children, who are believed to be at higher risk of infection and development of complications. However, other vulnerable and high-risk segments of the population such as psychiatric patients have been forgotten and left untreated by MDA for STHs.

Some characteristics of psychiatric patients such as poor mobility, poor cooperation with hygienic measures, and frequent interaction with each other contribute to easy transmission of IPs.¹⁴ The prevalence of IPs among these patients has been reported to range from 5% to 35.2% or even more.^{15,16} In addition to their direct health impact, IPIs might complicate a psychiatric health condition as

chronic helminth infections add to the underlying cause in affecting cognitive development. Therefore, intervention of IP transmission among psychiatric patients contributes for better prognosis of such patients. This will be more important in IP endemic areas such as the Amhara region of Ethiopia where more than half of the general population harbors at least one pathogenic IP.¹⁷

Besides, factors contributing for IP transmission should also be determined. Despite this, there is a paucity of such data in Ethiopia in general and in the study area in particular. Hence, the present study aimed to assess the prevalence of intestinal parasites and associated factors among psychiatric patients attending Felege Hiwot Comprehensive Specialized Referral Hospital (FHCSRH) Psychiatry clinic.

Methods and Materials

Study Design, Area and Period

An institution-based cross-sectional study was conducted among psychiatric patients attending FHCSRH, Bahir Dar City, Northwest Ethiopia from May to July 2020. Bahir Dar City is the capital of Amhara National Regional State. The city is at an altitude of 1800 m above sea level and 560 km away in the northwest direction from Addis Ababa, the capital city of Ethiopia. The city has three governmental and three private hospitals, of which FHCSRH is the largest hospital serving around 2.4 million patients per year. The hospital has a psychiatric clinic which gives both inpatient and outpatient services. According to FHCSRH 2019/2020 report, the Psychiatry clinic serves more than 48,000 outpatients and 800 admitted patients per half year.

Sample Size Determination and Sampling Technique

The sample size (n) was calculated using a single population proportion formula. Since there are no previous data for the study area, we used a prevalence of 50% ($P = 0.5$), 95% CI ($Z_{\alpha/2} = 1.96$) and 5% margin of error ($d = 0.05$) to calculate the sample size.

$$\begin{aligned} n &= (Z_{\alpha/2})^2(P)(1-P)/d^2 \\ &= (1.96)^2(0.5)(1-0.5)/(0.05)^2 = 384 \end{aligned}$$

After adding 15% (58) for non-respondents, the final sample size was 442. Based on data from the hospital records, around 900 psychiatric patients were expected to visit the

hospital psychiatric clinic during the data collection period. Hence, systematic random sampling technique with K-value of 2 (900/442) was used to select participants. The first participant was selected on the appointment registration expected to attend on the starting day of the study through a lottery method. Then, every 2nd eligible patient was recruited in the study. All mentally disabled patients who (or whose caregivers) volunteered and could give consent/assent for participation were included in the study. Those participants who were unconscious, critically ill or unable to respond to research questions and those taking anti-parasitic drugs within the last 2 weeks before data collection were also excluded.

Data Collection

Questionnaire Data

Data on socio-demographic characteristics, clinical data and WASH related factors for IPIs were collected using a structured questionnaire. The Amharic version of the questionnaire was administered through face to face interview by trained psychiatric nurses.

Stool Collection and Processing

Study participants were consulted to collect approximately 2 g of stool sample using a wide mouth, leak proof and clean stool cup. Each sample was labeled with a unique code and transported to the Medical Microbiology and Parasitology Laboratory of College of Medicine and Health Sciences immediately after collection. A direct wet mount smear was prepared by mixing a matchstick head amount of fresh stool (2 mg) with a drop of 0.85% saline followed by a drop of iodine. Smears were examined for helminths egg or larvae and protozoan trophozoites and cysts with the low-power (10×) and high power (40×) objectives of a microscope.¹⁸

Kato-Katz smear was prepared from each stool sample by placing a small amount of stool on newspaper and a piece of nylon screen was pressed on top and some of the stool was sieved through the screen to accumulate on the top. The upper surface of the screen was scraped with a spatula to collect the sieved stool. A template with a hole capacity of 41.7 mg was placed on a microscope slide and the sieved stool was added with the spatula until the hole of the template was completely filled and excess stool was removed from the edge of the hole. The template was removed carefully and the stool remaining on the slide was covered with a pre-soaked cellophane strip with glycerol. Slides were inverted and pressed against the

cellophane strip to evenly spread the stool and then placed on a bench with cellophane upwards to enable evaporation of water while glycerol cleared the stool debris. Smears were microscopically examined within 1 h for the detection of hookworm ova and the examination was repeated after 1 h for the detection of other helminths ova.

Stool from each participant was also processed by the modified Ritchie's fecal concentration method. First, 2 mL of 10% formalin and 1 mL of ethyl acetate were added to the Ritchie's tube, respectively. Then 0.5 g of the fecal sample was added and the tube was screwed shut. After a minute, the cover was removed and the filtration concentration unit was introduced and centrifuged at 1000×g for 3 min. The supernatant was discarded and part of the sediment was examined using 10× and 40× objectives.

Modified Ziehl-Neelsen staining technique was used for the detection and identification of intestinal coccidian oocysts. Stool smear was prepared, air-dried, and fixed with absolute methanol for 3 min. Then, the preparation was stained with carbol fuchsin for 15 min and the stain was washed off with tap water. After washing, it was decolorized with 1% acid alcohol for 15 s then again washed off with tap water. Finally, the preparation was stained with 0.5% methylene blue for 30 s, washed off with tap water and dried by placing on a rack, and then the smear was examined for oocysts, using 40x and 100x objectives of a microscope.

Data Quality Control

To maintain the data quality, training was given to data collectors. The questionnaire was translated to Amharic and re-translated back to English. Standard operating procedures were strictly followed during specimen collection, transportation, processing and parasite detection. About 10% of the Kato-Katz slides were randomly selected and checked by a third technician who was blind to the initial results. All the reagents used for processing of stool were checked every week for contamination. The principal investigator checked all aspects of data collection every day.

Statistical Analysis

Data were checked for completeness, entered and analyzed using Statistical Package for Social Science software version 20. Data were summarized as frequencies, prevalence and mean using descriptive statistics. Bivariate logistic regression was used to assess associations between dependent and independent categorical variables. Multivariate

logistic regression analysis was then followed for variables with $P < 0.2$ in the bivariate analysis to determine the association between IPIs and associated factors. Association between variables was considered statistically significant only if $P < 0.05$ at 95% CI. The strength of association between exposure and outcome variables were measured through adjusted odds ratios (AOR).

Results

Socio-Demographic Characteristics of Study Participants

Among the total sample size of 442 psychiatric patients, data from 432 participants were complete for analysis. The remaining 10 participants were unable to bring a stool sample. From the total of 432 patients, 231 (53.5%) were male. The participants' age ranged from 15 to 69 years old with mean age of 34.2 (± 11.48 standard deviation) years. Three hundred (69.4%) of the psychiatric patients were urban inhabitants and 164 (38.0%) were with no formal occupation. Regarding their educational status, 198 (45.8%) participants did not attend formal education while 234 (54.2%) had attended primary school or above. Out of the 432 participants, 263 (60.9%) were single and 286 (66.2%) came from households with three or more family members (Table 1).

Clinical Data of Study Participants

Regarding the causes of mental problem, 115 (26.6%), 64 (14.8%), 57 (13.2%), and 46 (10.6%) participants had schizophrenia, epilepsy, substance disorder, and anxiety disorder, respectively. More than half (52.2%) of the participants were diagnosed within the previous one year (Table 2).

Study Participants' WASH Practice

Among the 432 study participants, 415 (96.1%) and 432 (100%) washed their hands after soil contact and before meals, respectively. Two hundred and sixty-six (61.6%) of the participants used a latrine and the majority (364; 84.3%) of them washed their hand after toilet. Two hundred and eighty-seven (66.4%) and 394 (91.2%) participants used piped water for washing and drinking, respectively. The majority of psychiatric patients (413; 95.6%) had no swimming habit and 259 (59.7%) of the participants frequently wear shoes. Three hundred and ninety (90.3%) participants got their food at home and 181 (41.9%) patients eat raw fruit/vegetables (Table 3).

Table 1 Socio-Demographic Characteristics of Psychiatric Patients Attending FHCSH, Northwest Ethiopia from May to July 2020

Characteristics	Categories	Frequency (N)	Proportion (%)
Sex	Male	231	53.5
	Female	201	46.5
Age group (in years)	15–19	27	6.3
	20–39	277	64.1
	≥ 40	128	29.6
Residence	Urban	300	69.4
	Rural	132	30.6
Educational level	No formal education	198	45.8
	Primary and above	234	54.2
Occupation	Employed	152	35.2
	No formal occupation	164	38.0
	Farmer	116	26.9
Marital status	Single	263	60.9
	Married	169	39.1
Family size	< three	146	33.8
	\geq three	286	66.2

Prevalence of Intestinal Parasitic Infections

Among 432 participants, 168 (38.9%; 95% CI: 34.3–43.5) tested positive at least for a single species of IP by one or more of the diagnostic methods. Eight parasite species, namely hookworm, *Ascaris lumbricoides*, *Trichuris trichiura*, *Schistosoma mansoni*, *E. histolytica*/*E. dispar*, *G. duodenalis*, *Cryptosporidium* spp., and *Hymenolepis nana* were detected. Among these IPIs, hookworm was the most prevalent, detected in 74 (17.1%) participants followed by *E. histolytica*/*dispar* in 47 (10.9%), *A. lumbricoides* in 37 (8.6%), and *G. duodenalis* in 13 (3.0%) (Table 4). Among 168 (38.9%) IP infected psychiatric patients, 16 (9.5%) were co-infected by two parasite species. Of these, hookworm and *A. lumbricoides* co-infections were predominantly detected in 8 (4.8%) participants (Table 5).

Factors Associated with Intestinal Parasitic Infections Among Psychiatric Patients

In the multivariate logistic regression analysis, washing raw fruits/vegetables before consumption of them raw had a statistically significant association with IPIs among

Table 2 Causes of Mental Illness and Duration Since Diagnosis of Psychiatric Patients Attending FHCSH, Northwest Ethiopia from May to July 2020

Characteristics		Frequency (N)	Proportion (%)
Cause/Type of mental problem	Schizophrenia	115	26.6
	Epilepsy	64	14.8
	Depression	31	7.2
	Substance disorder	57	13.2
	Anxiety disorder	46	10.6
	Personality disorder	36	8.3
	Bipolar disorder	40	9.3
	MDD and psychosis	36	8.3
	Panic disorder	7	1.6
Duration after diagnosis for mental problem	>one year	205	47.5
	≤one year	227	52.5

Abbreviation: MDD, major depressive disorder.

psychiatric patients (AOR = 8.402; 95% CI: 3.055–23.109; $P < 0.001$). The prevalence of IPs among participants who do not wash fruits/vegetables before consuming them raw was 55.6% (25/45) while the prevalence was only 18.4% (25/136) among participants who consumed washed fruits/vegetables. All other considered socio-demographic and WASH related factors were not significantly associated with IPs in the multivariate logistic regression analysis (Table 6).

Association Between Type of Mental Disorder and Intestinal Parasitic Infections

In bivariate logistic regression, being a psychiatric patient caused by other than bipolar disorder was significantly associated with IPs (COR = 3.286, 95% CI: 1.418–7.611, $P = 0.006$). Similarly in multivariable logistic regression analysis, participants with a mental problem caused by other than bipolar disorder had a statistically significant association with IPs (AOR = 3.104, 95% CI: 1.334–7.222, $P = 0.009$) (Table 7).

Discussion

Addressing the magnitude of IPs and their associated factors among psychiatric patients is necessary to design

Table 3 Utilization of WASH and Related Factors by Psychiatric Patients Attending FHCSH, Northwest Ethiopia from May to July 2020

Characteristics	Categories	Frequency (N)	Proportion (%)
Habit of hand washing after soil contact	Yes	415	96.1
	No	17	3.9
Habit of hand washing before meal	Yes	432	100.0
	No	0	0.0
Latrine utilization	Yes	266	61.6
	No	166	38.4
Habit of hand washing after toilet	Yes	364	84.3
	No	68	15.7
Source of water for washing	Piped water	287	66.4
	Surface water	145	33.6
Source of water for drinking	Piped water	394	91.2
	Surface water	38	8.8
Swimming habit	Yes	19	4.4
	No	413	95.6
Shoes wearing habit	Yes	258	59.7
	No	174	40.3
Raise cattle	Yes	155	35.9
	No	277	64.1
Fingernail status	Trimmed	97	22.5
	Untrimmed	335	77.5
Primary source of food	Home made	390	90.3
	Other	42	9.7
Habit of eating raw fruits/vegetables	Yes	181	41.9
	No	251	58.1
Habit of washing fruits/vegetables before eating raw	Yes	136	75.1
	No	45	24.9

appropriate intervention strategies. The high prevalence of IPs in the present study (38.9%, 95% CI: 34.3–43.5) suggested that mental illness directly influences hygiene and sanitary practices. The present finding was in line with a previous study result of 38.4% from Nigeria.¹⁹

The present prevalence was higher than findings of 12.45%, 13.5%, 29.5% and 23% from Tanzania,²⁰ Ghana,²¹ Iran²² and Italy,⁸ respectively. On the contrary, the present result was lower than study findings of 56.7% and 43.5% from Bahir Dar²³ and Egypt,²⁴ respectively. Smaller sample size in the previous studies might account for such differences. For instance, studies in Tanzania,²⁰ Ghana,²¹ Italy⁸ and Iran²² recruited only 233, 111, 125 and 173 participants, respectively. Small sample size might

Table 4 Intestinal Parasites Positivity Based on Different Diagnostic Methods in Psychiatric Patients Attending FHCSH, Northwest Ethiopia from May to July 2020

Parasitic Infection		Direct Wet Mount N (%)	Modified Richie's Concentration N (%)	Kato-Katz N (%)	Modified Ziehl Neelsen N (%)	Combined Result N (%)
Helminths	Hookworm	11 (2.5)	67 (15.5)	50 (11.6)	N/A	74 (17.1)
	<i>A. lumbricoides</i>	15 (3.5)	33 (7.6)	24 (5.6)	N/A	37 (8.6)
	<i>T. trichiura</i>	0	3 (0.7)	2 (0.5)	N/A	3 (0.7)
	<i>S. mansoni</i>	0	4 (0.9)	6 (1.4)	N/A	6 (1.4)
	<i>H. nana</i>	0	1 (0.2)	0	N/A	1 (0.2)
Protozoa	<i>E. histolytica</i> / <i>E. dispar</i>	46 (10.6)	15 (3.5)	N/A	N/A	47 (10.9)
	<i>G. duodenalis</i>	12 (2.8)	3 (0.7)	N/A	N/A	13 (3.0)
	<i>Cryptosporidium</i> spp.	0	0	N/A	3 (0.7)	3 (0.7)
Total parasites detected		84 (19.4)	126 (29.2)	82 (19.0)	3 (0.7)	184 (42.6)
Total positive participants		84 (19.4)	114 (26.4)	80 (18.5)	3 (0.7)	1. (38.9)

Table 5 Double Infection of IPs Among Psychiatric Patients Attending FHCSRH, Northwest Ethiopia from May to July 2020

Double Infection	Frequency (N)	Proportion (%)
Hookworm with <i>A. lumbricoides</i>	8	4.8
Hookworm with <i>E. histolytica</i> / <i>E. dispar</i>	4	2.4
<i>H. nana</i> with <i>A. lumbricoides</i>	1	0.6
Hookworm with <i>S. mansoni</i>	1	0.6
<i>G. duodenalis</i> with <i>Cryptosporidium</i> spp.	1	0.6
<i>A. lumbricoides</i> with <i>T. trichiura</i>	1	0.6
Total double infection	16	9.5

result in high sampling error which in turn makes the data less representative of the source population. Variation in age group of the study participants may also contribute to differences in IP prevalence. Laboratory methods used also have a significant role in the difference of IP prevalence across studies. In the present study, a combination of direct wet mount, Kato-Katz, Richie's concentration and modified Ziehl Neelsen staining were used, which increases the detection rate of microscopy.

Species level analysis revealed that hookworm (17.1%) was the most predominant parasite in the present study. This finding is higher than prevalence of 6.2% and 8.4% in

Bahir Dar²³ and Nigeria,¹⁹ respectively. However, it was lower than prevalence of 37.93% in Tanzania.²⁰ Variations in transmission level across study areas and shoe wearing habit of the population could contribute to the differences. Moreover, variations in sanitation practices and laboratory methods used are responsible factors. In the present study, the second most prevalent intestinal helminth was *A. lumbricoides* (8.6%) which is in line with the study result of 9.6% in Bahir Dar.²³ However, the present prevalence of *A. lumbricoides* was lower than previous results of 15.3% and 10.4% from Nigeria¹⁹ and Italy,⁸ respectively. The difference might be due to the variation in WASH implementation and endemicity of *A. lumbricoides*.

The prevalence of *S. mansoni* infection (1.4%) in the present study was lower than 41.38% prevalence from Tanzania.²⁰ This might be due to variation in the local transmission, frequency of water contact and number of study participants recruited. Only 4.4% of the participants had frequent swimming habit in the present study which contributes to a low prevalence of *S. mansoni*. On the other hand, the present prevalence was higher than a previous finding of 1.0% in Bahir Dar.²³ This variation might be due to difference in the diagnostic techniques, in that Kato-Katz technique was not performed in the previous study.

The prevalence of *E. histolytica*/*E. dispar* (10.9%) in the current study was in line with a previous study result of 10.34% in Tanzania.²⁰ On the contrary, the prevalence of *E. histolytica*/*E. dispar* in this study was lower

Table 6 Logistic Regression of Factors Associated with IPIs Among Psychiatric Patients Attending FHCSRH, Northwest Ethiopia from May to July 2020

Variables	Category	Number Examined	Positive N (%)	COR (95% CI)	P-value	AOR (95% CI)	P-value
Sex	Male	231	96 (41.6)	1.274 (0.863–1.881)	0.223		
	Female	201	72 (35.8)	1			
Age group (in years)	15–19	27	9 (33.3)	0.738 (0.477–1.141)	0.172	0.958 (0.375–2.446)	0.929
	20–39	277	115 (41.5)	1.048 (0.435–2.524)	0.917	6.081 (0.505–73.206)	0.155
	≥40	128	44 (34.4)	1			
Residence	Urban	300	107 (35.7)	1			
	Rural	132	61 (46.2)	1.550 (1.023–2.349)	0.039	2.171 (0.236–19.943)	0.493
Educational level	No formal education	198	89 (44.9)	1.602 (1.085–2.365)	0.018	1.407 (0.536–3.693)	0.488
	Primary school and above	234	79 (33.8)	1			
Occupation	Employed	152	50 (32.9)	1			
	No formal occupation	164	66 (40.2)	1.206 (0.746–1.952)	0.444	1.093 (0.140–8.540)	0.932
	Farmer	116	52 (44.8)	1.657 (1.007–2.728)	0.047	1.479 (0.218–10.043)	0.689
Marital status	Single	263	108 (41.1)	1.266 (0.849–1.887)	0.248		
	Married	169	60 (35.5)	1			
Number of family	<3	146	58 (39.7)	1			
	≥3	286	110 (35.8)	0.948 (0.630–1.426)	0.799		
Latrine utilization	Yes	266	73 (27.4)	1		2.099 (0.525–8.40)	0.295
	No	166	95 (57.2)	3.538 (2.351–5.324)	0.000		
Hand washing after toilet	Yes	364	130 (35.7)	1		1.058 (0.184–6.094)	0.950
	No	68	38 (55.9)	2.280 (1.349–3.852)	0.002		
Source of water for washing	Pipe water	287	98 (34.1)	1		2.564 (0.668–9.846)	0.170
	Surface water	145	70 (48.3)	1.800 (1.198–2.704)	0.005		
Source of water for drinking	Pipe water	394	148 (37.6)	1		2.071 (0.296–14.5)	0.463
	Surface water	38	20 (52.6)	1.847 (0.946–3.604)	0.072		
Food source	Home made	390	147 (37.7)	1		1.109 (0.256–4.808)	0.890
	Other	42	21 (50.0)	1.653 (0.873–3.131)	0.123		
Fingernail status	Trimmed	97	35 (36.1)	1			
	Untrimmed	335	133 (39.7)	1.166 (0.730–1.864)	0.520		
Wash raw fruit/vegetable	Yes	181	50 (27.6)	1		8.402 (3.055–23.109)	0.000
	No	251	118 (47.0)	5.550 (2.673–11.525)	0.000		

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio.

Table 7 Bivariate and Multivariate Logistic Regression of Cause of Mental Disorder with Parasitic Infections at FHCSRH, Northwest Ethiopia from May to July 2020

Variables	Category	Number Examined	Positive N (%)	COR (95% CI)	P-value	AOR (95% CI)	P-value
Schizophrenia	Yes	115	47 (40.9)	1.120 (0.724–1.730)	0.611		
	No	317	121 (38.2)				
Epilepsy	Yes	64	26 (40.6)	1.089 (0.634–1.871)	0.758		
	No	368	142 (38.6)				
Depression	Yes	31	9 (29.0)	1.606 (0.721–3.578)	0.246		
	No	401	159 (39.7)				
Substance abuse	Yes	57	28 (49.1)	1.621 (0.926–2.837)	0.091	1.466 (0.835–2.576)	0.183
	No	375	140 (37.3)				
Anxiety	Yes	46	20 (43.5)	1.237 (0.667–2.295)	0.500		
	No	386	148 (38.3)				
Personality disorder	Yes	36	14 (38.9)	1.00 (0.497–2.013)	0.607		
	No	396	154 (38.9)				
Panic disorder	Yes	7	2 (28.6)	1.602 (0.307–8.355)	0.576		
	No	425	166 (39.1)				
MDD and psychosis	Yes	36	15 (41.7)	1.134 (0.567–2.268)	0.721		
	No	396	153 (38.6)				
Bipolar	Yes	40	7 (17.5)	3.286 (1.418–7.611)	0.006	3.104 (1.334–7.222)	0.009
	No	392	161 (41.1)				
Duration after diagnosis	> 1 year	205	81 (39.5)	1.051 (0.714–1.548)	0.801		
	≤ 1 year	227	87 (38.3)				

compared with findings of 14.4% from Bahir Dar.²³ However, it was higher than results of 7.4% and 5.5% from Nigeria¹⁹ and Egypt,²⁴ respectively. The prevalence of *G. lamblia* in the present study was 3.0% which was in line with a previous finding of 3.0% in Nigeria.¹⁹ However, it was lower than prevalence of 5.8% and 4.0% from Bahir Dar²³ and Northern Iran,²² respectively. Variations in local implementation of WASH activities might be responsible for such differences. Mental health problems are associated with alteration of the immune function meaning that frequency of opportunistic infections are expected to increase. This is supported by previous studies from Ghana²¹ and Egypt²⁴ where *Cryptosporidium* spp. were the most frequent parasites found in mentally ill patients. However, examination of Ziehl Neelsen stained stool smears, in the present study, revealed that only three (0.7%) participants were infected with *Cryptosporidium* spp. It is difficult to explain this because none of the participants had diarrhea and we did not evaluate the immune status of participants.

In the present study psychiatric patients who eat unwashed raw fruits/vegetables were 8.4 times at higher risk of acquiring IP compared with those who eat washed raw fruits/vegetables. This is supported by a study done in Bahir Dar, which showed that the risks of being infected by IPs are increased by 8 times among psychiatric patients consuming unwashed raw fruits/vegetables. Infective stages of many IPs can be collected from raw fruits/vegetables which results in ingestion of parasites while eating.²⁵ Therefore, it is justifiable that psychiatric patients with a habit of consuming unwashed raw fruits/vegetables are at higher risk of parasitic infections. Psychiatric patients with bipolar disorder are known for keeping good personal hygiene and giving value for themselves. This puts them at lower risk for IPIs as confirmed in the present study, in that participants with mental problem other than bipolar disorder were 3.104 times at higher risk of infection compared with those with bipolar disorder.

Of the total infected psychiatric patients, the prevalence of IPs was higher in males than females. However, the difference was not statistically significant, which was similar to findings from Tanzania.²⁰ Contrary findings were reported in recent studies from Italy,⁸ Ghana²¹ and Nigeria¹⁹ where males were significantly at higher risk of IPIs compared with females. Occupational and socio-cultural variations, beyond the mental problem, account for these differences in the exposure level of male and

females in different geographic settings. Similar to sex, all other considered factors, as shown in Tables 6 and 7, were not significantly associated with IPIs, may be due to response bias and undetermined confounders. Because they have mental problems, we could not be sure that the patients respond to each question based on the practical truth and their day to day experiences. This demands a further cohort study in order to obtain a definitive conclusion about factors associated with IPIs among psychiatric patients.

Limitations of the Study

A single stool sample was collected and examined from all study participants due to logistic problems. This might underestimate the true prevalence of IPs among psychiatric patients in the study area.

Conclusions

The prevalence of IPIs among psychiatric patients was significant in the study area. Hookworm was one of the most predominantly identified IPs followed by *E. histolytica*/*E. dispar*. Consumption of unwashed raw fruits/vegetables and a psychiatric diagnosis other than bipolar disorder were the factors significantly associated with IPIs. Therefore, these findings should be a wakeup call for policymakers to give attention for psychiatric patients in setting a strategy to control and intervene in IP transmissions. Psychiatry health-care providers should continuously give health education in order to improve the hygiene practices of psychiatric patients. Psychiatry health-care providers should also implement regular screening and treatment for IPIs among psychiatric patients. Other health-care providers should also create awareness about the health impact and means of prevention for their clients, since other population groups will act as sources of infection for psychiatric patients.

Abbreviations

AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; FHCSRH, Felege Hiwot Comprehensive Specialized Referral Hospital; IPs, intestinal parasites; IPIs, intestinal parasite infections; MDA, mass drug administration; STHs, soil transmitted helminths; WASH, water sanitation and hygiene.

Data Sharing Statement

The original data for this study is available from the corresponding author.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the Declaration of Helsinki - Ethical principles for medical research involving human subjects. The research was carried out after obtaining ethical approval from the institutional review committee of College of Medicine and Health Sciences, Bahir Dar University. Moreover, support letter was obtained from Amhara National Regional State Health Bureau. Permission letter was also secured from FHCSRH. Informed written consent or assent was obtained from participating patients or caregivers, respectively. According to the research ethics guideline of Bahir Dar University, informed verbal consent is accepted to conduct researches where the biological sample collection doesn't include invasive procedures. Hence, the verbal consent for the present study was approved by the institutional review committee. Laboratory results were promptly communicated to the clinic for treatment of IP positive participants.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest for this work.

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