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Status of individual, household and environmental sanitary practices in relation to intestinal parasitic infections among patients visiting Hara health center, Tehuledere District, northeast Ethiopia

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ABSTRACT: Intestinal parasitic infections (IPIs) are among the most common diseases-of-poverty. Current information on the magnitude of the problem in relation to individual, household and environmental sanitary practices in a locality is vital to devise fitting control strategies. The objective of this study was, therefore, to assess the occurrence of IPIs and associated sanitary practices among patients visiting Hara health center, Tehuledere District, northeast Ethiopia. A cross-sectional study was conducted from November 2015 to April 2016 involving participants recruited through the convenience sampling method. A structured questionnaire was used to capture environmental, socio-demographic and behavioral factors related to IPIs. Stool specimens were collected and examined for the existence of IPIs using the direct-saline wet mount technique. Bivariate and multiple logistic regression analyses were done with p-value less than 0.05 considered statistically significant. Fecal samples from 430 individuals were analyzed in the study. Among these participants, 251(58.4%) were males and 179(41.6%) females with 213 (49.5%) in the age group ≥15 years, 190(44.2%) 6-14 years and 27(6.3%) 1-5 years old (range 67-1, median (IQR):14(9.0-27.7) and mean ± SD: 20.13±14.35). The overall prevalence of intestinal parasites was 42.3% (182/430). Seven intestinal parasite species were detected. The predominant parasite was *Entamoeba histolytica/dispar/moshkovskii* (42(33.0%)), followed by *Giardia intestinalis* (26(6.1%)), *Enterobius vermicularis* (5(1.2%)), taeniid species (5(1.2%)), *Trichuris trichiura* (2(0.5%)), *Hymenolepis nana* (1(0.2%)) and *Ascaris lumbricoides* (1(0.2%)). The study showed that river/stream drinking water source (adjusted odds ratio (AOR)) 2.954, 95% confidence interval (CI) 1.140-6.192, p<0.0001)), rare pre-meal hand washing (AOR 2.647, 95% CI 1.194-5.871, p 0.017), no post-toilet hand washing (AOR 3.396, 95% CI 1.454-7.931, p 0.005), untreated drinking water (AOR 2.745, 95% CI 1.137-6.626, p 0.025), open-field defecation (AOR 2.517, 95% CI 1.037-6.109, p 0.014), rural residence (AOR 2.157, 95% CI 1.178-3.950, p 0.013) and 5-14 years age (AOR 7.984, 95% CI 4.346-14.667, p<0.0001) were significant predictors of IPIs-positivity . IPIs were a common health problem in the study area. Health education on personal and environmental hygiene coupled with improved accessibility to safe drinking water is needed.

Keywords/phrases: diseases-of-poverty, intestinal parasites, adjusted odds ratio

INTRODUCTION

Diseases-of-poverty (DOP) include a wide array of diseases in low-income countries particularly affecting the poorest and most deprived communities. Diseases due to intestinal parasitic infections (IPIs) are among the most common such diseases worldwide and are among neglected tropical diseases. The most predominant intestinal helminths and protozoa are *Ascaris lumbricoides,* the hookworms, *Trichuris trichiura, Giardia intestinalis* and *Entamoeba histolytica* which, respectively, accounting for 800-1000, 700-900, 500, 200 and 500 million cases globally (WHO, 2016). Nowadays, the above helminths are recognized as soil-transmitted helminths (STH) and school-age children represent the most important risk group for them (Legese Chelkeba *et al*., 2020). High worm loads and repeated infections with intestinal protozoa have influence on the nutritional status of children and can cause severe anemia and chronic diarrhea. This has negative impacts on growth, fitness and learning ability of children and then societal long- or short-term impact is huge. According to the World Health Organization

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(WHO), the burden of STH in 2015 was 3,394,211 disease-adjusted life years (http://www.who.int /healthinfo/global_burden_disease/ estimates/en /index2.html).

IPIs are widely distributed in tropical areas, particularly sub-Saharan Africa primarily for economic reasons. Poverty and its manifestations such as shortage of health facilities, poor toilet coverage, scarcity of safe drinking water, overcrowded living, illiteracy and thus poor personal and environmental hygiene are the reasons. Depending on the relative spatial and temporal distribution of these and other risk factors, the prevalence of IPIs and infectious diseases in particular varies from setting to setting (Tatem *et al*., 2012).

For instance, of 294 Turkish schoolchildren screened for IPIs, 91(31.0%) were found to be infected with at least one parasite with *G. intestinalis* the most common (Östan *et al*., 2007). The authors incriminated uneducated and unemployed mother, lower father social status, crowded houses with insufficient indoor spaces, using the tap water as drinking water, and living at shanty areas were significant risk factors for the infection demonstrating the link between lower socio-economic conditions and incidence of IPIs.

Ethiopia, like any other low-income country in the tropics, is heavily affected by IPIs due to poor water quality and toilet coverage, and low community awareness and thus very poor personal and environmental hygienic practices. Various authors reported IPIs from different parts and localities of Ethiopia on different occasions. Tigray in the north (Megbaru Alemu *et al*., 2015), Gondar (Aschalew Gelaw *et al*., 2013) and Gojam (Baye Sitotaw *et al*., 2019) in the northeast, in Butajira in south-central (Teha Shumbej *et al*., 2015), Jimma in the southwest (Alemeshet Yami *et al*., 2011) and Babile in the East (Ephrem Tefera *et al*., 2015) are just a few examples.

The link between overall sanitation and health in general is well-known (Mara *et al*., 2010). Specifically, individual variables such as hand washing and household factors like drinking water source have also been shown to be associated with IPIs (Lewin *et al*., 2000, Mahmud *et al.,* 2015).

Over the last decade, however, some efforts are underway to reduce the burden of these infections (https://www.unicef.org/ethiopia/ 2014-12-15-Red_HEALth-hep.pdf).

Different governmental (through health extension workers) and non-governmental (development agents) programs and strategies have been in place. For instance, the Water, Sanitation and Hygiene (WASH) (Ross *et al*., 2011 and SAFE (Surgery, Antibiotic distribution, Facial cleanliness and Environmental improvements) strategies (Grimes *et al.,* 2016) are being practiced in Ethiopia for some time to tackle DOP in the country via promotion of sanitation including construction and proper use of household and/or public latrine.

In some districts in Amhara Region like Kewet district, unpublished district health office documents showed that latrine coverage was 97% in 2010 as cited in Ross *et al*. (2011). But, the accuracy of local reports is usually questioned. The United Nations Children's Fund (UNICEF) is supporting the WASH component of the Ethiopian National Growth and Transformation Plan-II in advancing sanitation and hygiene promotion, intensifying urban sanitation and pro-poor water service delivery (https://www.unicef.org/ ethiopia/wash.html.). Accordingly, this the same UNICEF source shows that water supply and sanitation is the top priority of Ethiopian water management policy and strategy and Ethiopia in its growth and transformation plan II (GTP-II) (2015-2020) planned to reach safe water coverage of 85% from current 59% in rural areas and 75% from current 58% in urban areas by 2020. Similarly, the number of people (particularly mothers) practicing improved hygiene behaviors such as hand-washing, face-washing, food hygiene and living in healthy environments is planned to be increased to 70%, by 2020, from the current 17%.

Furthermore, the Ethiopian Federal Ministry of Health in collaboration with UNICEF, is working towards stopping practicing open defecation and promotes rural sanitation in Ethiopia. Between 2012 and 2016, the country achieved substantial rise in latrine coverage (Grimes *et al*. 2016). In general, there are reports witnessing that Ethiopia has been implementing a community health extension program (HEP) since 2003 and a systematic review shows that via this program the country achieved significant improvements in maternal and child health, infectious diseases, hygiene and sanitation, knowledge and healthcare seeking although the program has its own challenges (Yibeltal Assefa *et al*., 2019).

On the other hand, some original reports argue to the contrary. However, a study that assessed latrine coverage and associated factors among rural communities around Bahir Dar, northwest Ethiopia (Worku Awoke and Semahegn Muche 2013) found that out of 608 households, 355(58.4%) had pit latrines with only 220(62.0%) functional at the time of the study where functional latrine availability was significantly associated with household income, among other factors. Ethiopia set an ambitious plan 'Universal Access Plan' for water and sanitation in 2005 whereby basic water and sanitation services for virtually all Ethiopians by 2015 (FMoH 2005). Another similar study from the Amhara Region (Aiemjoy *et al.*, 2017) showed that latrine coverage was 71%, which varied greatly across communities but not associated with household income level. These studies indicated that the observed latrine coverage was far below the national target, which is 100%.

To this end, current information on the status of individual, household and environmental factors for IPIs is vital to evaluate the implementation and effectiveness of the ongoing preventive strategies and scale-up or modify in a locality-specific manner. This study was designed to detect IPIs and evaluate the status of individual, household and environmental sanitary practices among patients visiting Hara health center (HHC), Tehuledere District, northeast Ethiopia.

METHODS

Study area

Tehuledere is one of several Districts in the Amhara Region of Ethiopia, which is located at the northeastern edge of the Ethiopian highlands in the south Wollo Zone (Fig 1). The District is bordered on the south by Dessie Zuria, southwest by Kutaber, northwest and north by the Mille River, northeast by Wore Babo and on the southeast by Kalu. The District has a total population of 117,877 (http://www.csa.gov.et.). This the same source indicates that the majority of the inhabitants (90.4%) are Muslims and 9.4% Orthodox Christians.

The altitude of Tehuledere ranges from 500 meters above sea level along the boundary with South Wollo Zone to 2700 meters along its southwest border. Its hydrology includes two lakes: Hayk, which is entirely within it, and Ardibo which lies to the south of Hayk, defining part of border with Kalu. The present study was conducted at HHC, belonging to Hara village, which is found around Ardibo Lake.

Study design, population and fecal samples

The study was health facility based cross-sectional survey. Patients from Hara town and its surroundings visiting HHC between November 2015 and April 2016 and suspected of IPIs were invited to participate in the study and consenting/assenting ones were recruited. Thus, the sampling technique was convenience sampling. The study was time and space bound. Its objective was to examine all IPIs suspects who were attending HHC within a specific period (November 2015 and April 2016), there was no necessity for sample size determination and special design. Children below 1 year and patients treated for STH in the past 10 weeks were excluded. Data on socio-demography; individual (e.g. pre-meal and post-toile hand washing, consuming raw and less clean food, open field defecation, etc.), household (possession of latrine, drinking water source, etc.) and environmental (garbage disposal mechanism, etc.) sanitary practices of the participants were captured using a structured questionnaire. Direct observations were made by the first-author and his assistants to verify verifiable information. Participants were given a specimen cup and requested to provide a stool sample. Patients who could not provide sufficient samples (approximately below 0.5g) were excluded. The samples were examined by the direct saline (0.85% sodium chloride) wet-mount technique following a standard method (WHO, 1992). Ova, cysts, or trophozoites were detected and identified by professional microscopists.

Data quality

To ensure data quality, before the data collection period, the questionnaire and laboratory materials were checked. All samples were clearly labeled with the respective names of participants to avoid confusion of results. Each of the questionnaires was checked whether the necessary information was properly filled. Standard operating procedures were used for specimen collection and processing. Before starting the work, laboratory technicians checked microscopes. Two laboratory technicians examined each stool sample. A third senior reader settled discordant readings among the technicians.

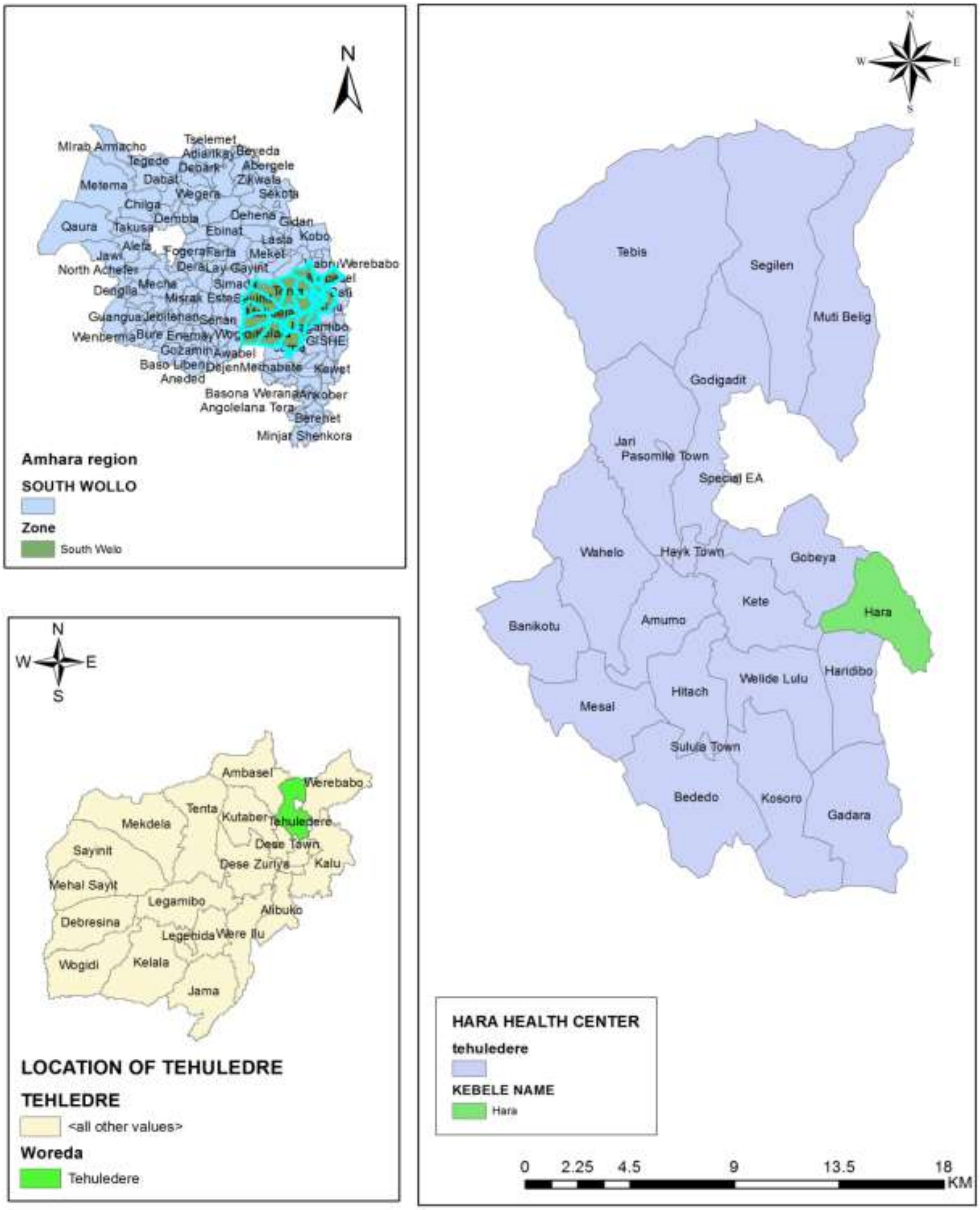

Figure 1. Location map of Tehuledre showing the study area

Data analysis

Data were recorded in Microsoft excel spreadsheet. For analysis SPSS version 16 (SPSS Inc., IL, Chicago) was used. The prevalence of IPIs was determined with frequency counts and percentage. To assess the association of different variables with IPIs, univariate logistic regression analysis was done and to identify the independent risk factors the multivariate model was used. P-value of less than 0.05% was considered statistically significant.

Ethics and consent

The study was approved by the College of Natural and Computational Sciences Institutional Review Board, Addis Ababa University. Study participants gave their written informed consent and for minors parental consents were obtained. Individual patient identity was maintained confidential. Individuals found infected with intestinal parasites were referred to the health personnel in the health center for appropriate treatment.

RESULTS

Socio-demographic and clinical characteristics

Totally, 430 individuals participated in the study. Among these, 251(58.4%) were males and 179(41.6%) females. Two-hundred-thirteen (49.5%) individuals were in the age group ≥15 years, 190(44.2%) 6-14 years and 27(6.3%) 1-5 years old with range 67-1, median (IQR):14(9.0-27.7) and mean ± SD: 20.13±14.35. Regarding occupation, 193(44.9%) were students, 162(37.7%) farmers, 44(10.2%) unemployed, 16(3.7%) government employees and 15(3.5%) were daily workers. Most participants (209(48.6%) had primary school education, 84(19.3%) able to read/write, 56(13.0%) in preschool stage for instance kindergarten and satellite schools, 17(3.9.0%) high school and 17(3.9%) above high school. There were 47(10.9%) self-reported illiterates.

All of the participants were suspects for IPIs, 100% symptomatic. The participants had complained of at least one of the following clinical symptoms/signs typical of IPIs (abdominal pain, diarrhea, nausea or vomiting, and gas or bloating, dysentery (loose stools containing blood and mucus)).

Distribution of IPIs and associated factors

Hundred-eighty-two (42.3%) individuals were positive for IPIs. Seven different intestinal parasites (2 protozoa, 5 helminths) were identified, all single infections (no polyparasitism). *E. histolytica/dispar/ moshkovskii* was the most common (142 (33.0%) followed by *G. intestinalis* 26(6.0%), *E. vermicularis* 5(1.2%), *Taenia spp* 5(1.2%), *T. trichiura* 2(0.5%), *H. nana* 1(0.2%) and *A. lumbricoides* 1(0.2%) (table 1).

Table 1. Distribution of intestinal parasite species among patients in HHC, northwest Ethiopia (N=430).

Parasite species	no.(%)
Protozoa (single)	
E. histolytica/dispar/moshkovskii	142(33.0)
G. intestinalis	26(6.0)
Helminths (single)	
A. lumbericoides	1(0.2)
E. vermicularis	5(1.2)
H. nana	1(0.2)
T. trichiura	2(0.5)
Taenia species	5(1.2)
Overall	182(42.3)

Positive males for IPIs were 117(46.6%) and females 65(36.3%). Individuals in 6-14 age group were predominantly affected by IPIs (129(67.9%)) followed by ≥15 years (43(20.2%)) and 1-5 years old (10(37.0%)). The proportion of IPIs among farmers, governmental employee, students, the unemployed and 'others' were 30.3, 12.5, 60.1, 18.2 and 46.6% respectively. On the other hand, the number (proportion) of IPIs-positives among the illiterate was 11(23.4%, able to read/write 21(25.0%), primary school 123(58.9%), high school 1(5.9%), above high school 3(17.6%) and 'others' 23(41.1%). Sex, age, garbage disposal mechanism, untreated water, residence, toilet type, pre-meal and post-toilet hand wash, consumption of raw/lessclean food and drinking water source were significantly associated with IPIs-positivity in the bivariate analysis (Table 2). However, only age, residence, toilet, hand wash and drinking water source showed significant association with IPIS after adjustment for compounding factors in the multivariate analysis (Table 3).

Age is a significant predicator of IPIs with children aged 6-14 years having the highest burden (129(67.9%)) compared to other age groups (adjusted odds ratio (AOR) 7.984, 95% confidence interval (CI) 4.346-14.667, p<0.0001). Similarly, the odds of being IPIS-positive were 2.157 times higher for patients from rural area than urban dwellers (95% CI, 1.178-3.950, p 0.013). Individuals who used river/stream water for drinking purpose had significantly higher prevalence of IPIs than those who used tap water (AOR 2.954, 95% CI 1.140-6.192, p< 0.0001). Patients who responded as using water directly without treatment were at significantly increased risk of IPIs than those who used other alternatives like boiling (AOR 2.745, 95% CI, 1.137-6.626, p 0.025).

Individuals who replied as they rarely washed their hands before meal had significantly higher risk of IPIs than those who claimed to practice that habit always (AOR 2.647, 95% CI, 1.194-5.871, p 0.017). Likewise, patients who responded to never wash their hands after using toilet, had significantly higher risk of IPIs than those who consistently washed their hands after toilet (AOR 3.396, 95% CI 1.454-7.931, p 0.005). The odds of IPIs in patients who defecated outside or in the field were more than twice at higher risk of infection by intestinal parasites than those who used proper latrine (AOR 2.517, 95% CI, 1.037-6.109, p 0.041).

Table 2. Univariate logistic regression analysis of socio-demographic factors in relation to intestinal parasite positivity of patients visiting HHC

Variables	Options	n	Positive, n(%)	COR	95% CI	p-value
Sex	Male	251	117(46.6)	1.531	1.034-2.268	0.033*
	Female	179	65(36.3)	-	-	-
Age (year)	1-5	27	10(37.0)	2.326	0.994-5.440	0.052
	6-14	190	129(67.9)	8.361	5.318-13.144	<0.000l*
	≥15	213	43(20.2)	-	-	-
Garbage disposal	Burn	50	20(40.0)	-	-	-
	open ground	175	85(48.6)	0.417	0.748-2.683	0.285
	river/ravine	85	41(48.2)	1.398	0.689-2.837	0.049*
	Bury	58	22(37.9)	0.917	0.422-1.991	0.826
	bury/burn	62	14(22.6)	0.438	0.192-0.995	0.354
Way of using water	boiled	101	35(34.7)	-	-	-
	Filtered	67	23(34.3)	0.986	0.515-1.888	0.965
	Untreated	101	70(69.3)	4.258	2.363-7.673	<0.0001*
	Other	83	22(26.5)	0.680	0.360-1.286	0.235
	no idea	78	32(41.0)	1.312	0.713-2.413	0.383
Residence	Urban	184	49(26.6)	-	-	-
	Rural	246	133(54.1)	3.243	2.148-4.896	<0.0001*
Toilet type	indoor toilet	69	17(24.6)	-	-	-
	Field	183	103(56.3)	3.938	2.117-7.325	<0.0001
	public/shared	109	34(31.2)	1.387	0.702-2.740	0.347
	private outdoor	69	28(40.6)	2.089	1.008-4.328	0.47
Pre-meal hand wash	Never	127	56(44.1)	1.858	1.041-3.317	0.036*
	Rare	101	45(44.6)	1.504	0.904-2.502	0.116
	Occasional	77	38(49.4)	1.532	0.894-2.626	0.120
	Always	125	43(34.4)	-	-	-
Post-toilet hand wash	Never	119	73(61.3)	3.862	2.199-6.780	<0.0001*
	Rarely	91	35(38.5)	1.521	0.835-2.769	0.170
	occasional	117	44(37.6)	1.467	0.833-2.584	0.185
	Always	103	30(29.1)	-	-	-
Eat raw, less clean food	Yes	315	152(48.3)	2.642	1.649-4.233	<0.0001*
	No	115	30(26.1)	-	-	-
Shoes-wearing	Never	48	19(39.6)	0.810	0.434-1.512	0.508
	Rare	45	18(40.0)	0.824	0.434-1.564	0.554
	Sometimes	53	18(33.9)	0.636	0.344-1.176	0.149
	Always	284	127(44.7)	-	-	-
Drinking water	tap water	113	26(23.0)	-	-	-
	community well	71	23(32.39)	1.606	0.827-3.110	0.163
	Lake	58	22(37.90)	2.045	1.028-4.068	0.042*
	river/stream	188	111(59.04)	4.824	2.851-8.160	<0.0001*

*CI: confidence interval, COR: crude odds ratio, n: number of people, %: percentage, *statistically significant*

Table 3. Multivariate logistic regression analysis for factors significantly associated with IPIs in the univariate model in patients visiting HHC

Variables	Options	n	Positives, n(%)	AOR	95% CI	P-value
Age (year)	1-5	27	10(37.0)	2.191	0.713-6.735	0.171
	6-14	190	129(67.9)	7.984	4.346-14.667	<0.0001*
	≥15	213	43(20.2)	-	-	-
Sex	Male	251	117(46.6)	1.050	0.573-1.922	0.875
	Female	129	65(36.3)	-	-	-
Residence	Urban	184	49(26.6)	-	-	-
	Rural	246	133(54.1)	2.157	1.178-3.950	0.013*
Drinking water	tap water	113	26(23.0)	-	-	-
	community well	71	23(32.4)	1.495	0.594-3.767	0.393
	Lake	58	22(37.9)	0.790	0.278-2.248	0.658
	river/stream	188	111(59.0)	2.954	1.410-6.192	<0.0001*
Way of using water	Boiled	101	35(34.7)	-	-	-
	Filtered	67	23(34.3)	0.798	0.311-2.046	0.639
	Untreated	101	70(69.3)	2.745	1.137-6.626	0.025*
	other**	83	22(26.5)	0.377	0.140-1.019	0.055
	no idea	78	32(41.0)	0.737	0.294-1.845	0.514
Toilet	indoor toilet	69	17(24.6)	-	-	-
	field	183	103(56.3)	2.517	1.037-6.109	0.041*
	public/shared	109	34(31.2)	1.767	0.691-4.517	0.235
	private outdoor	69	28(40.6)	1.342	0.437-4.119	0.607
Eat raw, less clean food	Yes	315	152(48.3)	0.536	0.271-1.062	0.074
	No	115	30(26.1)	-	-	-
Pre-meal hand wash	Never	127	56(44.1)	1.732	0.803-3.738	0.161
	Rarely	101	45(44.6)	2.647	1.194-5.871	0.017*
	Occasional	77	38(49.4)	2.155	0.898-5.171	0.085
	Always	125	43(34.4)	-	-	-
Post-toilet hand wash	Never	119	73(61.3)	3.396	1.454-7.931	0.005*
	Rarely	91	35(38.5)	1.159	0.476-2.826	0.745
	Sometimes	117	44(37.6)	0.737	0.737-0.316	0.481
	Always	103	30(29.1)	-	-	-

CI: Confidence interval, AOR: adjusted odds ratio: *statistically significant, HHC: Hara health center. **: no single method is consistently used

DISCUSSION

The 42.3% IPIs prevalence is within the WHO category of 'moderate' level (WHO, 2006). It is comparable with a finding (42.2%) from west Ethiopia (Addisu Adera Gebru *et al*., 2015). However, it is lower than the prevalence reported by Amare Mengistu *et al*. (2007) among urban dwellers in southwest Ethiopia (83.0%), Abraraw Abate *et al*., 2013 (62.3%) and Mengistu Endris *et al.* (2010) (72.9%) from northwest Ethiopia. On the other hand, it is higher than the prevalence reported by Desta Haftu *et al.* (2014) from Arbaminch (12.9%) from south Ethiopia and Gashaw Andargie *et al.* (2008) from Gondar town (8.7%). The observed apparent variations might be due to differences in environmental sanitation, personal hygienic status, socio-demographic status, geographical location and climatic conditions. Furthermore, some of these previous studies in different settings of Ethiopia are community-based or school-based and largely on asymptomatic individuals. On the other hand, the current study is facility-based. Thus, the observed differences may be attributed to the differences in the study population. Besides, although sanitary status, living conditions and customs are more or less similar in various parts of Ethiopia and sub-Saharan Africa at large, still there are local differences, which may account for some differences in the prevalence of IPIs.

Since 92.3% of the total positives were due to protozoa, waterborne transmission is suspected. Nevertheless, the 33% entamoeba case, which appears very high, might not necessarily be invasive amoeba (clinical amoebiasis). It could be any of the three morphologically indistinguishable intestinal amoebae: *E. histolyica/dispar/moshkovskii*. The latter two are common intestinal commensals.

Although previous baseline (reference) study is lacking from the study area, the current observation demonstrates a dramatic decrease in prevalence of STH compared to intestinal protozoa. This may evidence the success of health education and improved sanitary practices, as stated in the background section, with respect to STH notwithstanding a methodological limitation in this study. The soil-type as well as climate of the area might be affecting the embryonation of some helminth eggs. Indeed, it is an established fact that STHs require moist, shady soil conditions for embryonation of their eggs.

The Ethiopia National Deworming Programme June 2015 to June 2020 has a plan of delivering 100 million treatments to school-age children living in endemic areas. The activity is partnered between the Federal Ministries of Health and Education to train teachers and Health Extension Workers (https://ciff.org/grant-portfolio/ethiopia-national - deworming-programme/).

Unfortunately, the specific site of this study was not covered by the campaign during the study period. In addition, our study was on mixed age groups who visited a health center. But, nowadays it is becoming a common practice that people take traditional or modern drugs, without prescription, when they feel intestinal discomfort. So, such a practice might have its own contribution to the lower STH result in this study.

On the other hand, the increased prevalence of the protozoa implies poor drinking water quality in the study area. A considerable number of the study participants (101(23.5%)) were using water for drinking without treatment. Moreover, 317(73.7%) of the study population were utilizing totally unprotected water (well, lake, river) for drinking. The study showed that the common practice of defecation was open ground and that further increases the risk of IPIs around HHC. At least 183(42.6%) people reported that they release their excreta outside latrine and these could frequently contaminate various water bodies the community uses. Therefore, this practice might have played a significant role in drinking water contamination by protozoa cysts. Similarly, from 1990 to 2011, 38.1 million Ethiopians reported to practice open defecation in rural areas (https://www.unicef.org/ethiopia/Ethiopia_Fact_ Sheet_Jan_ 2014._final.pdf). A community-based study (Ross *et al.*, 2011) in one district in north-central Ethiopia estimated household latrine coverage of overall 56.2% and in rural areas, the coverage was 67.7%.

Individual variables such as hand washing practices (post-toilet, pre-meal) may contribute more to protozoan than helminthic infections. For instances, except the self-reported 103(23.9%) and 125(29.1%) patients who practiced post-toilet or pre-meal hand wash, respectively, the majority lacked those behaviors. This is a main risk behavior for autoinfection by amoeba and giardia whose cysts are mature and infective immediately after defecation. On the contrary, helminths necessarily require environmental phases to be infective.

Other similar facility-based studies, both retrospective and prospective, from different parts of Ethiopia corroborate the two important findings of this study - more intestinal protozoa than STHs and age-based overall distribution. A retrospective study that analyzed previous 5-year data from Bale-Robe health center, southeast Ethiopia, recorded prevalence ranged 0.3-36.0% (Bayissa Chala 2013). *Entamoeba* and *G. intestinalis* found to be the most prevalent during 2005-2009 compared to STH. The study revealed that the 15 and over were significantly more affected than 0-4 and 5–14 years. A similar 5-year retrospective study in Poly Health Center, north Ethiopia (Meseret Ayelgn *et al.*, 2019), documented similar finding that *E. histolytica/dispa/moshkovskii* more predominant followed by *G. intestinalis* than STH and significantly more IPIs among the younger age group. Another retrospective analysis of 10-year data from Hawassa University students' clinic, Southern Ethiopia (Tadesse Menjetta *et al.*, 2019) reported higher overall prevalence of intestinal protozoa (27.6%) than intestinal helminth (20.3%).

A facility-based study on 310 symptomatic under-five children attending Woreta Health Center in northwest Ethiopia (Habtamu Sewunet Mekonnen and Daniale Tekelia Ekubagewargies 2019) found the overall prevalence of intestinal parasites 18.7%. Children and their families who practice field defecating were more significantly affected by IPIs with *G. intestinalis* and *E. histolytica/ dispar/moshkovskii* more frequent than other intestinal parasites. In another similar study, a prevalence of 56.9% IPIs was found among patients attending Shahura Health Center, Northwest Ethiopia (Abiye Tigabu *et al.*, 2019). The most prevalent parasite was *E. histolytica/dispar/*

moshkovskii and 1-20 years age group was significantly associated with IPIs.

Five cases of Taeniid cestode species were detected. Likely, it was *Taenia saginata* as raw meat (locally called *qurt)* is habitually consumed in the study area. Out of the 430 people, only 115(26.7%) reported that they had no habit of eating uncooked food. The rest 315(73.3%) reported that they enjoy raw food and beef is definitely included. Although the overall helminth infection was low, the total absence of hookworm infection could be explained by the fact that most participants (284(66.0%)) were practicing shoes-wearing. Although the number of patients who were not always shoes-protected was sizeable, (146(34.0%)), the study did not detect hookworms perhaps for a number of other reasons. Only a single stool sample was analyzed from each participant and that might have underestimated the result. Further, light hookworm infections might have been undiagnosed as the Kato-Katz thick smear method, formalin-ethyl acetate sedimentation or flotation methods were not used for logistic and financial reasons.

On the other hand, the recovery of five pinworm cases is interesting. Pinworm eggs are often sparse in the feces and stool sample examination is not recommended to detect this nematode. Fecal samples may be contaminated, to a certain degree depending upon the worm burden, by pinworm eggs from the perianal skin. Occasionally, pinworms may introduce themselves into even female genitourinary tract and their eggs can be seen in vaginal smear as a result of contamination (Shetty *et al*., 2012).

More than half of the study participants (246(57.2%)) were living in rural communities. There was a statistically significant association between residence and IPIs. It is clear that urban dwellers are better protected because of relatively better facilities and increased awareness, and environmental, household and personal hygienic practices.

The prevalence of IPIs was not significantly, in the multivariate model, different between males and females although relatively more males (251(58.4%)) than females (179(41.6%)) were suspected or examined. This is expected as there is no clearly identified biological factor predisposing more males than females or vice-versa to IPIs based on sex *per se* as long as the two genders share common environment and practices. However, observing a significantly more number of IPIs-positives among children aged 6-14 years than the under-6 might have been affected by the very lower size (27) of the latter category. It was unclear why the number of suspects among the under-6 was very low. Perhaps it may be associated with limited mobility of the under-5/6 children.

In general, the study witnessed high prevalence of individual, household and environmental factors that are suitable for easy perpetuation and dissemination of IPIs, both protozoa and helminths. The results support this statement: waste disposed on open ground (n=175), unprotected water used (n=262), no latrine (n≥183), no hand washing (n=374), feeding raw food was rampant (n=315), and no access to at least tap water (n=317).

Therefore, the actual prevalence of intestinal parasites in the present study might have been affected by climatic conditions and seasonal fluctuations and the study design and laboratory method used. If concentration methods were used, possibly extra parasites would have been identified. This last methodological aspect is the major limitation of the study. Although overall lower prevalence was obtained in light of the prevailing risk factors and fewer STH than protozoa because only the direct-smear method and single fecal sample used, the results are still useful. Although it may not enable one to conclude plausibly about the reduction of IPIs vis-à-vis control interventions, it is helpful to know the problem even using a less sensitive method.

CONCLUSION

The result showed the high public health burden of IPIs in Hara and its surroundings with higher magnitude of protozoan than helminthic infections suggesting more of waterborne transmission. This calls for concerned bodies to respond appropriately to reduce the impact of these parasites in the area. Improved accessibility to safe drinking water coupled with health education on personal and environmental hygiene is recommended.

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