Journal of Pharmacy and Alternative Medicine www.iiste.org
ISSN 2222-4807 (online) ISSN 2222-5668 (Paper) An International Peer-reviewed Journal
Vol.15, 2017

The Prevalence of Intestinal Parasitic Infection and Associated Factors Among Primary School Children in Gurage Zone, South Ethiopia

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Abstract
Background: Intestinal parasites are either helminths or protozoan that inhabit in gastrointestinal tract. Intestinal parasites cause considerable morbidity and mortality in the world, especially in developing countries like Ethiopia. Both urban and rural inhabitants are vulnerable to infection with intestinal parasites in developing countries. The aim of this study was to determine the prevalence of intestinal parasitic infections (IPIs) and associated factors among primary school in Meskan District, Gurage Zone, Ethiopia**Result:** Of 496 selected school children, 463 participated in the study with full information for analysis. The overall prevalence of intestinal parasitosis was 195 (42.1%). Protozoa infections (59.5%) were more prevalent than soil-transmitted helminths (STHs) infections (40.5%). The predominant parasites were *Giardia lamblia* (47.7%) followed by *A. lumbricoides*(18.9%), and *E.histolytica/dispar* (11.8%). Being female with Adjusted Odds Ratio (AOR), 1.3, 95%CI, 1.02-2.26), Residence of school being rural (AOR, 0.63, 95%CI, 0.42-0.96), infrequent use of latrine (AOR ,1.31, 95%CI 0.86-2.00), not hand washing after defecation (AOR, 1.48, 95%CI, 0.37-5.88), hand washing sometimes or not at all before meal (AOR, 1.97, 95%CI, 1.25-3.09)*, infrequent wearing of shoes (AOR, 1.49, 95%CI 0.96-2.32) and finger nail not trimmed (AOR, 0.99 95%CI, 0.66-1.51) were the predictors of intestinal parasitic infection in the study population. The study revealed that the presence of Intestinal Parasitic Infections (IPIs) has shown statistically significant association with frequency of hand washing before meal, sex and school location ($p < 0.05$).**Conclusion:**Intestinal parasititic infections (IPIs) are major public health problem in primary school children in the study area. Being female, attending urban and infrequent handwashing before meals increase the risk of parasitic infections. Health education to school children is recommended to improve hand washing practice before meals.
Keywords: intestinal parasitic infection, school children, risk factors, Meskane district

Background

Intestinal parasites are parasites that populate in gastrointestinal tract (GIT) and some of them prefer the intestinal wall of humans. In humans, intestinal parasites may live in the small and large intestines. Three types of intestinal parasites that live in the small and large intestines are tapeworms, roundworms or nematodes and protozoa. Most tapeworms and roundworms develop in the human body and lay their eggs there. The eggs then pass out of the body through feces and can infest others (1). Parasitic infections, caused by intestinal helminths and protozoan parasites, are among the most prevalent infections in humans in developing countries. In developed countries, protozoan parasites more commonly cause gastrointestinal infections compared to helminthes. Intestinal parasites cause a significant morbidity and mortality in endemic countries (2). Intestinal helminths are intestinal parasites that inhabit the human gastrointestinal tracts and are one of the most prevalent forms of parasitic disease causing organisms. The soil transmitted helminths [*Ascaris lumbricoides(A. lumbricoides),* hookworm and *Trichuris trichiura (T. trichiura*)] are parasitic nematode worms causing human infection through contact with parasite eggs or larvae that thrive in the warm and moist soil of the world's tropical and subtropical countries (3). They are one of the world's most important causes of physical and intellectual growth retardation. Intestinal parasitic infections are among the most communicable diseases worldwide, particularly in developing countries. Worldwide, about 3.5 billion people are affected, and 450 million are ill as a result of these infections, the majority being children (4). In Ethiopia, like in other developing countries, intestinal parasitic infections are widely spread. Several studies indicated that the prevalence of helminthic infections was high in the lower altitudes (5) and *A. lumbricoides* the most prevalent intestinal parasites in different communities usually occurring together with *Trichuris* and *hook worm* (6, 7). The present study is aimed at determining the prevalence of IPIs and associated factors in Gurage zone, Ethiopia

Methods

Study area and period

The study was conducted in Meskane District. Meskane is one of the woredas in Gurage zone in the Southern

Nations, Nationalities, and Peoples' Region of Ethiopia. Part of the Gurage Zone, Meskane is bordered on the south by the Silt'e Zone, on the west by Muhor Na Aklil, on the northwest by Kokir Gedebano, on the north by the Oromia Region, on the northeast by Sodo, and on the southeast by Mareko. The town of Butajira is surrounded by Meskane. Near Butajira are the Tufta Swamps at 8°8′N 38°24′E, located in the Western highlands near the headwaters of the Meki River. Mesqane Community is a member of the Gurages who are settled in south west of Ethiopia in the Southern Nations, Nationalities and Peoples Region. The Mesqan Community is settled in Mesqan Woreda and Buttajira Town Administration. The city of Butajira is one of the administrative centers of the Gurage Zone. It is located about 120 kilometers South-Southwest of Addis Ababa and can be reached in about 3 hours on a bus. Butajira is located about 7,000 ft. above sea level near the edge of the Great Rift Valley. The combined current population of Mesqan Woreda and Buttajira Town is 225,931, of which the Mesqan ethnic group constitutes the majority. Based on the 2007 Census conducted by the CSA, this woreda has a total population of 155,782, of whom 76,396 are men and 79,386 women; 11,388 or 7.31% of its population are urban dwellers. The majority of the inhabitants were reported as Muslim, with 60.19% of the population reporting that belief, while 34.55% practice Ethiopian Orthodox Christianity, and 4.7% were Protestants

Study design and sampling

Cross-sectional survey was conducted to determine the prevalence of intestinal parasitic infection and associated factors among primary school children in Meskan District. Butajira town and Meskan rural woreda (the town and district administrative, respectively, in Gurage zone) were selected as study areas by simple random sampling method based on zonal health bureau report on prevalence of intestinal parasitic infection. The study primary schools were selected from the Meskan district (6 schools from Meskan rural woreda and 2 from Butajira town), Gurage zone, Ethiopia. The sample size was estimated using the single population proportion formula ^{Z2}p (1-p)/d2. Where p= proportion of intestinal parasites from previous study, d= the margin of error and Z=standard score corresponds to 1.96. Design effect of 2 was used since multi-stage sampling technique was used. The proportion (p) of intestinal parasites from previous study was 81% (34). For calculation, a 95% confidence interval and a 5% margin of error were used. To minimize errors arising from the likelihood of noncompliance, 5% was added to the normal sample giving a final sample size of 496. Number of students allocated in each class was based on the total number of students in each school divided by total number of students in the primary school. The results were multiplied by the calculated sample size. Then, students were allocated for each grade and each class room according to their educational level (Grade 1 to grade 8). Finally, the sample children were selected using systematic random sampling techniques by using class rosters as the sample frame.

Data collection procedure and specimen examination

Interviewers were trained to conduct the survey using a pre-tested standardized questionnaire about factors such as socio demographic, environmental and behavioral factors. To ensure reliable information, the household head were interviewed in their local language.

After checking the completion of the questionnaires, a dry, clean, leak proof container labeled with the name and applicator stick were given by the technician. Proper stool samples were taken from all selected students at their school. As soon as the stool samples were presented, all specimens were checked for their label, quantity, time, procedure of collection by a field worker (staff trained in proper hygienic and bio-safety measures) and then performed for gross microscopic stool examinations. The slides were prepared directly for wet mount in saline and microscopically examined initially under low power (10×) bright field then under high power (40×) bright field. Simultaneously, samples were emulsified in a 10% formalin solution and transported to Butajira Hospital Medical laboratory department. From the emulsified sample 1 g (pea size) of feces was taken in about 4 ml of 10% formal water and then mixed and sieved in another tube. Then 3-4 ml of ether was added and centrifuged immediately at 750-1000 g (~ 3000 rpm) for 1 min. Finally, the supernatant was discarded, and then small portion of the sediment was transferred to a slide and covered with cover slip and examined first with 10X and then 40 X objectives and again the iodine stained slides were prepared and examined microscopically.

Data management and analysis

The data were analyzed using SPSS version 21.0. During data collection, completeness of questionnaires was checked regularly to rectify any discrepancy, logical errors or missing values. In all cases, *P*-values less than 0.05 were considered statistically significant. Initially the association between each exposure and the presence of infection was assessed using the Chi-squared test. Odds ratios and 95% confidence interval (CI) were computed to measure the strength of association. To determine independent risk factors for infection, logistic regression analysis was employed.

Quality control

Questionnaires were evaluated by collecting data from households to keep its standard in small numbers. The data consistency was checked at the site. All laboratory materials such as quality of reagents, sampling equipments, transporting system and microscope were checked in Butajira hospital by experienced laboratory professionals. The specimens were also checked for serial number, quality and procedures of collection. Concentration method was performed in Butajira hospital, Medical laboratory department. To eliminate observer

bias, each stool sample was examined by two laboratory technicians in hospital and similar samples concentration method was performed by the college laboratory technician. In presence of inconsistent results, the results were checked by the senior and it was taken as the final result of the examination.

Ethical consideration

Prior to the commencement of the study approval letter was obtained from Wolkite University, Research director. Permission was also obtained from Butajira Town and Meskan Woreda education bureaus, and authority of the schools to conduct the study. Informed verbal consent was obtained from students and school directors. The students' privacy during the interview and stool collection was maintained and the data obtained from them were strictly kept confidential. Finally, the study participants who were found positive for intestinal parasites were treated with the standard regimen for free by local health professionals.

Result

Socio-demographic characteristics

Of total 496 samples planned, about 463 successfully collected and included into final analysis, which gave response rate of 93.3%. About 51% of the respondents were male students and the left were females. Eight primary schools (1-8 grades) were participated, two of them were from urban and others were from rural area. About 37.6% of the respondents were from students attending urban school and the rest were from students attending rural school. All students were within age range of 5-15 years old. About 208(44.8%) of the children were in age range of 5-10 years old and 255(55.1%) of them are within age range of 11-15 years old. About 231(49.9%) were attending 1-4 grades and the rest were attending 5-8 grades.

Prevalence of intestinal parasites

About 195(42.1%) of the students were found to have parasite in their stool. Seven different parasite species were identified. Most common parasite species were Giardia *lamblia*, *Ascaris lumbricoides,* and *Entamoeba histolytica*. The rest are hookworm, Tenia species, *H.nana* and *Trichuria trichuris.*

Table 1: Distribution of intestinal parasitic infections among Meskan District primary schools, southern Ethiopia, 2016

Variable		Frequency (%)
Parasite species(N=195)	Ascaris lumbricoides	37(19.0)
	Hookworm	13(6.7)
	Giardia lamblia	93(47.7)
	Tinae species	8(4.1)
	Hymenolepsis nana	13(6.7)
	Entamoeba histolytica	23(11.8)
	Trichuris trichuria	8(4.1)

Sanitary practice and facilities

Major of the respondents (357(77.1%)) get water for drinking from pipe. About 69(14.9%) and 37(8.0%) respondents get water from well, and spring and river respectively. Almost all (99.6) respondents said they would not boil water before drinking. Almost all (99.1%) respondents have latrine availability at their home. But smaller respondents 34(7.3) don't wash their hands after defecation.

Table 2: Sanitary practice of the students among Meskan District primary schools, southern Ethiopia, 2016

Variables	Category	Frequency (%)
Habit of swimming river(N=463)	Yes	148(32.0)
	No	315(68.0)
Washing cloth or taking bath in river(N=463)	Yes	280(60.5)
	No	183(39.5)
Eating raw vegetables(N=463)	Yes	382(82.5)
	No	81(17.5)
Availability of latrine	Ye	459(99.1)
	No	4(0.9)
Frequency of latrine use (N=463)	Always	219(47.7)
	Sometimes	240(51.8)
	Not at all	4(0.9)
Hand washing after defecation	Yes	429(92.7)
	No	34(7.3)
Frequency of hand washing after defecation(N=463)	Always	124(26.8)
	Sometimes	314(67.8)
	Not at all	25(5.4)
Frequency of hand washing before meal(N=463)	Always	186(40.2)
	Sometimes	276(59.6)
	Not at all	1(0.2)
Presence foot wear during data collection(N=463)	Yes	447(96.5)
	No	16(3.5)
Frequency of shoe wearing(N=463)	Always	319(68.9)
	Sometimes	144(31.1)
Trimmed finger nail during data collection(N=463)	Yes	262(56.6)
	No	201(43.4)
Raw meat eating habit(N=463)	Yes	341(73.7)
	No	122(26.3)

Factors associated with intestinal parasitic infections

Gender, school location and hand washing before meals are factors that have statistically significant association with intestinal parasite infection ($p<0.05$).

Table 3: Factors associated with intestinal parasitic infections (IPIs) in Meskan District primary school, Southern Ethiopia, 2016

Variable	**Category**	**Parasite in the stool**		**Crude odds ratio(95%CI)**	**Adjusted odds ratio(95% CI)**	**p-value**
		Yes (%)	**No (%)**			
Sex	Male	92(39.0)	144(61.0)	1	1	
	Female	103(45.4)	124(54.6)	1.3(0.90,1.88)	1.52(1.02,2.26)*	0.039
Age of child	5-10	93(44.7)	115(55.3)	1	NA	
	11-15	102(40.0)	153(60.0)	0.82(0.57,1.19)	NA	
School	Urban	84	90	1	1	
	Rural	111	178	0.67(0.46,0.98)	0.63(0.42,0.96)*	0.030
Grade	Primary cycle	97	134	1	NA	
	Secondary cycle	98	134	1.01(0.70, 1.46)	NA	
Source of drinking water	Well	32	37	1.24(0.74,2.07)	NA	
	Spring and river	16	21	1.09(0.55,2.16)	NA	
	Pipe	147	210	1	NA	
Habit of swimming in river	Yes	64	84	1	NA	
	No	131	184	0.93(0.63,1.39)	NA	
Habit of washing in the river or taking bath	Yes	118	162	1	NA	
	No	77	106	1.00(0.68,1.45)	NA	
Eat raw vegetable	Yes	161	221	1	NA	
	No	34	47	0.99(0.61,1.61)	NA	

NA=factors not applicable to multivariable analysis, *= statistically significant at 95% confidence level.

Table 4: factors associated with intestinal parasitic infections (IPIs) in Meskan District primary school, Southern Ethiopia, 2016(continued from previous page)

Variable	Category	Parasite in the stool		Crude odds ratio(95%CI)	Adjusted odds ratio(95%CI)	p-value
		Yes	No			
Consuming street food	Yes	158	227	1	NA	
	No	37	41	1.30(0.79,2.11)	NA	
Frequency of latrine use	Always	76	143	1	1	
	Sometimes or not at all	119	125	1.79(1.23,2.61)	1.31(0.86,2.00)	0.211
Hand washing after defecation	Yes	170	259	1	1	
	No	25	9	4.23(1.93,9.29)	1.48(0.37,5.88)	0.575
Frequency of hand washing after defecation	Always	35	89	1	1	
	Sometimes	140	174	2.05(1.30,3.20)	1.38(0.81,2.36)	0.238
	Not at all	20	5	10.17(3.54,29.21)	4.45(0.78,25.51)	0.093
Frequency of hand washing before meal	Always	54	132	1	1	
	Sometimes or not at all	141	136	2.53(1.71,3.76)	1.97(1.25,3.09)*	0.003
Presence of footwear during data collection	Yes	188	259	1	NA	
	No	7	9	1.07(0.39,2.93)	NA	
Frequency of shoe wearing	Always	118	201	1	1	
	Sometimes	77	67	1.96(1.31,2.92)	1.49(0.96,2.32)	0.075
Whether finger nail trimmed or not	Yes	102	160	1	1	
	No	93	108	1.35(0.93,1.96)	0.99(0.66,1.51)	0.997
Eating raw meat	Yes	142	199	1	NA	
	No	53	69	1.08(0.71,1.63)	NA	

NA=factors not applicable to multivariable analysis, *= statistically significant at 95% confidence level.

Discussion

In this study about 42.1% of the students had been infected at least with one parasite. This finding is similar with study done at Aksum town and northwest Ethiopia showed corresponding figure of 44.6% (36). The finding showed much lower prevalence reported among different regions in Southern Ethiopia(i.e Chencha woreda (34) and Dega ocholo (29),) north western Ethiopia, Gondar zone (28) and Dagi primay school, Amhara national Regional state (30) that showed prevalence of 81.0%, 56.8%, 66.7% and 77.9% respectively. This may be due to difference in existing sanitation facilities and practices as well as extent of health education to the community on risk factors of intestinal parasitic infection and improvement of personal hygiene. But study done at Arbaminch town and Gondar showed lower prevalence of intestinal parasites, which is 27.7% (27, 31).

It is known that the transmission of intestinal parasites depends on the presence of infected individuals, poor sanitation and principally, the socioeconomic and behavioral factors in the population. This study attempted to show the potential risk factors for the prevalence of intestinal parasitic infection in primary school children.

In this study, there was no statistically significant association between intestinal parasitosis and grade level as well as age of the participants, $P > 0.05$. However, there was significant association between intestinal parasitic infection and sex, school type and frequency of hand washing before meal. Female students, students attending urban and students who washed their hands before meal only sometimes or not at all were more likely to have intestinal parasitic infection. Female students were 1.52 times more likely to be infected with intestinal parasites as compared male students. But study done in Arbaminch and Axum did not find any association between sex and intestinal parasites. Students attending rural school are less likely (AOR: 0.63:95%CI:0.42,0.96) to have intestinal parasite infection as compared to their urban counter part. But study done in Gondar report statistically no significant association between area of residence and infections with intestinal parasites. Students who wash their hands sometimes or not at all before meal were 1.97 times more likely to be infected with intestinal parasitic infection as compared to students who wash their hands always before meal. Similar findings were reported from different studies done in Ethiopia (7, 28, 34). But study done in Nepal did not report any association with hand washing practices (37).

Conclusion

The result of this study indicated that intestinal parasitic infections were major public health problem among primary school children. This study has shown that sex, school type and frequency of hand washing before meal

are closely associated with the prevalence of intestinal infections. There is a need for intensive and habitual health education for behavioural changes related to personal hygiene and mass treatment for the effective control of intestinal parasitic infections in the concerned area. The prevention and control of parasitic diseases depend upon economic development as well consequent improvements in personal hygiene and sanitation, water supplies, health education and socio-economic status. In order to obtain maximum benefits, further epidemiological studies focusing on control of parasitic diseases require to be undertaken in a coordinated manner. Female students, students attending urban school and students washing their hands less frequently were more likely to have intestinal parasite infection.

Recommendations

Based on the result of the study following are recommended

- Provision of health education on hand washing before meals
- Focusing Water sanitation and Hygiene (WaSH) initiatives mostly on urban school and female students.

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ANNEX I: QUESTIONNAIRE
WOLKITE UNIVERSITY
FORMAT SHEET FOR PARASITIC SURVEY QUESTIONNAIRE

Date of data collection_____

I.GENERAL INFORMATION

Name of data collector _____

Study code _____

Name of the school _____ Age in year's _____ Sex _____ Grade_____

II. Assessment of risk factors of intestinal parasites

1. Source of drinking water A. Well_____ B. Spring_____ C. pipe_____ D. River_____ E. other (specify)
2. Do you boil drinking water? Yes_____ No_____
3. Do you swim in the river? A. Ye s_____ B. No_____
4. Do you wash clothes or take bath in the river? A. Yes_____ B. No_____
5. Do you eat raw vegetables? A. Yes_____ B. No_____
6. Do you consume street foods? A. Yes_____ B. No_____
7. Do you have latrine at home? A. Yes_____ B. No_____
8. If yes to Q7, do you use it A. Always ____B. Sometimes _____C .Not at all_____
9. Do you wash your hands after defecation? A. Yes_____ B. No_____
10. If yes to Q9, how often do you wash A. Always ____B. sometimes C. not at all____
11. How often do you wash your hands before meal? A. Always __B. Sometimes_ C not at all
12. Observing shoe wearing during interview A. Yes_____ B. No_____
13. How often do you wear shoes? A. Always ____B. Sometimes _____C .Not at all_____
14. Observing finger nail status A. trimmed____ B. Untrimmed ___

15. Raw meat eating habit A Yes…… B No …….

III. LABORATORY FINDINGS

1. Consistency of the stool, hard/formed_____ soft _____ loose _____watery/diarrhea _____
2. Result of microscopic examination

- No ova or parasite seen _____
- Ova or parasite seen(specify species) _____
- Eggs per gram of
  - *A. lumbricoides*_____
  - Hook worms_____
  - *T. trichiura*_____
  - *S. mansoni*_____
  - Others (cyst/trophozoite)of protoan parasite

STANDARD OPERATING PROCEDURES (SOP) FOR STOOL EXAMINATION

A.DIRECT WET MOUNT METHOD

1. A drop of fresh normal saline will be placed on the slide and mixed with small amount of stool specimen using a piece of stick.
2. The smooth preparation will be covered with cover glass.
3. The entire saline preparation will be examined systematically using 10x and 40x objective

B. Standard operational procedure for the Formal-Ether concentration technique, Gurage zone, South Ethiopia, 2015.

1. using a stick, emulsify about 1g (pea size) of feces in about 4ml of 10% formal water. Add more 3-4ml formal water
2. Mix well by shaking and sieve into another tube made of glass or polypropylene
3. Add 3-4ml of ether (anesthetic). Stopper tube and mix for 1 min
4. Loosen the stopper (there is pressure inside tube)
5. Centrifuge immediately at 750-1000g (~ 3000rpm) for 1 min
6. using a stick loosen the layer of fecal debris from the side of the tube and discard the supernatant, the sediment remain
7. Allow the fluid from the side of the tube to drain to the bottom. Tap the bottom tube to re suspend and mix sediment
8. Transfer a small portion of the sediment to a slide and cover it
9. Examine the preparation first with 10X and then 40X objective

Flow chart for data collection and laboratory processing