

Prevalence of Intestinal and Soil Transmitted Helminths Among Primary School Children of Badessa District, West Hararghe Zone, Oromia Region, Eastern Ethiopia

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Abstract

Background

Helminthes are known as parasitic worms [1]. Helminthes of medically important are belonging to two phyla: the Platy helminths as flat worms and Nematy helminths or round worms. Platy helminths are further subdivided into Cestodes and Trematodes [2]. According to some literatures, parasitic worms are categorized into three groups: Cestodes, nematodes, and Trematodes [1]. In this study, the prevalence of intestinal and soil transmitted helminths among primary school children were assessed by two stool examination methods namely: wet mount and Kato-Katz thick smear techniques. for the diagnosis of intestinal helminths were compared to detect human intestinal helminths.

Objective

To assess the prevalence of intestinal and soil transmitted helminths among primary school children in Badessa woreda, west Hararghe zone, Oromia region, eastern Ethiopia.

Methodology

A cross-sectional study design was conducted for the study then four primary schools were selected by lottery method from 11 primary schools. Finally, 200 primary school children had given a stool specimen for wet mount and Kato-Katz methods so that two types of stool specimens were collected from school children aged 6 to 16 from four primary schools randomly selected in Badessa woreda, West Hararghe Zone, Eastern Ethiopia. Each specimen was smeared on one slide for every technique with normal saline for wet mount and a cellophane cover for Kato-Katz technique. The overall prevalence of the parasites in each school of the woreda was determined.

Result

The prevalence of *Ascaris lumbricoides* (19.5%), *Eterobius vermicularis* (13%) and Hookworm (49%) was high in schools 1, 2 and 4. The prevalence of *Schistosoma mansoni* (38%) high in school 3 (Table 3). Finally, Kato-Katz technique had played more role and was more effective and sensitive than the stool wet mount technique in order to find the result.

Conclusion

Intestinal and soil transmitted helminths were significantly detected especially from carriers and non-symptomatic children. Kato-Katz technique was more selective and sensitive than wet mount method.

Keywords: Prevalence, Intestinal helminths, Soil-transmitted helminths

Introduction

Background

Helminthes are known as parasitic worms [1]. Helminthes of medically important are belonging to two phyla: The Platy helminths as flat worms and Nematy helminths or round worms. Platy helminths are further subdivided into Cestodes and Trem-

atodes [2]. According to some literatures, parasitic worms are categorized into three groups: Cestodes, nematodes, and Trematodes [1]. Intestinal protozoa include amoebae, flagellates, and some coccidia. There are two diagnostic stages: vegetative or trophozoite stage and dormant or cyst stage. Both stages may be found in the same specimen [2]. They are distributed all over the

world. In developing countries such as Africa, their distribution is higher. In Ethiopia, almost all areas of the country helminths are highly distributed. Majority of them are diagnosed microscopically at egg and larva stage according to their species. Microscopic examination of helminths is the easiest and simplest technique in stool examination. There are different laboratory techniques to detect helminths and intestinal protozoa; these include: Buffered Methylene Blue (BMB) wet mount, Eosin wet mount, Concentration methods, permanent staining techniques, and Cellophane (Adhesive Tape) preparation. There are also different microscopic examinations (wet mounts) which include saline mount and iodine mount [2], or wet mount or thick smear technique or sometimes direct smear and Kato-Katz technique called Kakuru technique (also called the Kakuru-Katz technique) are laboratory methods for preparing human stool samples prior to searching for parasite eggs [1, 3].

In 1954, Kato and Miura were the first to introduce a new method, the “cellophane thick smear technique” which involved the principle of direct fecal sampling. It is different from the standard direct smear procedure in that a larger amount of fecal sample is employed and cellophane strips are used as cover slips instead of glass [3]. According to some authors, direct smear is qualitative and Kato-Katz is a quantitative examination method [4].

Effective and efficient technique for the diagnosis of helminths is essential. Therefore, comparison and evaluation of the diagnosing techniques is a crucial procedure prior to helminths' egg findings.

Statement of the problem

Helminths and intestinal protozoa infection are one of the health burdens in the world. One of the causes of prevalence and distribution of helminths and intestinal protozoa are inappropriate use and inefficient application of the testing techniques. In developing countries, the problem is aggravated. In Ethiopia, the application of an appropriate and evaluated testing techniques is not understood. Therefore, the prevention and control of helminths and intestinal protozoa in the country is less effective due to the shortage, quality problem, and lack of evaluated techniques.

The accuracy of one technique in identifying individuals with soil-transmitted helminths (STH) and intestinal protozoa infections is limited by day-to-day variation in helminths egg excretion, confusion with other parasites and laboratory technicians' experience [5].

The accuracy of other techniques is limited by immeasurable sample volume, time-consuming procedures, and unaffordable reagents, unequal sensitivity of the techniques to different parasites, and specificity of the technique to only certain parasite. As a result, the quality of diagnosing and treating of helminths infection is low.

Intestinal protozoa and soil-transmitted helminthiasis (STH) are still to be major problems in health worldwide, especially in the tropical and subtropical regions. Although frequent, these infections are not always trivial. They can be the cause of a wide clinical spectrum ranging from apparently symptomless infec-

tions to life-threatening conditions such as intestinal obstruction in *Ascaris* infection. Therefore, this study is a help to promote and protect the highest attainable standard of health and to facilitate for the diagnosis and treatment of helminths and intestinal protozoa.

There is no any study conducted on the efficiency and sensitivity of soil-transmitted helminths and intestinal protozoa diagnosing techniques in Ethiopia. Thus, there is a need to generate further sensitivity evaluation of the Wet mount and Kato-Katz techniques for the diagnosis of soil-transmitted helminths and intestinal protozoa parasites in faecal samples.

Objective

To assess the prevalence of intestinal and soil transmitted helminths among primary school children of Badessa woreda, west Hararghe zone, Oromia region, eastern Ethiopia with wet mount and Kato-Katz techniques

Materials and methods

Study design

A Cross-Sectional study design was conducted to assess the prevalence of intestinal and soil transmitted helminths among primary school children with wet mount and Kato-Katz techniques.

Study area

The study was conducted in Badessa woreda area of four schools. Badessa is a town and separate woreda in eastern Ethiopia. Located in the West Hararghe Zone of the Oromia Region, at the base of a spur of the Chercher Mountains 40 km south of the Addis Ababa - Djibouti Railway and 65 km east of Awash, this town has a latitude and longitude of 8°54'N 40°47'E Coordinates: 8°54'N 40°47'E with an elevation of 1761m above sea level. The climate is mostly warm with a dry and rainy season. Badessa, as the rest of the country, has experienced economic and social changes during the past one decade. As a result, there has been a marked improvement in the life style and in the health status of the inhabitants. Other crops in the area are vegetables, greens, cereals, and fruits. Health care is delivered by government primary health care clinics, health centers, and private clinics of different levels started by physicians, public health officers, nurses, medical laboratory sciences personnel, and druggists. About 200 students had given a stool specimen for both saline wet mount preparation and Kato-Katz preparation per each working day from Monday to Friday at selected schools.

Study period

The study was conducted from February 20, 2019 to July 10, 2019. This includes the entire period of the study, including selection of the title and approval, preparation of the proposal, submission and approved training, pretesting, data collection, data analysis, report preparation, and dissemination of the results etc.

Data collection method

A Questionnaire was administered by the principal investigator to the children and it covered the following selected areas (Taking into account that these are the main characteristics common-

ly related to intestinal parasitic infection): Age, Gender, Family Education, Finger nail status, Toilet use, Source of drinking water, Shoes wearing habits, residence with domestic animal(s) and anti-helminthic Treatment status before the study was conducted. All students who have no the habit of toilet use, no student was living with animal and no anti-helminthic treatment before 15 days prior to submit stool sample.

Specimen collection method

Prior to specimen collection Badessa woreda health office has reviewed and approved that a questionnaire and the study protocol has not any ethical and health effect on the students since there was no human tissue was used. Students were informed to submit faecal specimen in to a plastic cup with a tight-fitting lid labeled with code. They were also informed to submit a faecal specimen of sized about thumb finger

Laboratory testing method

Principle and procedure of both Kato-Katz and wet mount methods were followed the centers for disease control and prevention (CDC), world health organization (WHO) as well as international standards guidelines and protocols of stool sample collection and testing methods [13]. Badessa woreda health office has reviewed and approved that the principles and procedures were based on the WHO guidelines and protocols on human intestinal and soil transmitted parasites control and elimination

Population

Source population

All primary schools in Badessa woreda, west Hararghe zone, Oromia region, Eastern Ethiopia

Study population

All primary school students submitted faecal samples for intestinal and soil transmitted helminths examination.

Sampling procedure and sample size

Random sampling techniques were applied to select four schools from 11 primary schools found in Badessa Woreda of West Hararghe Zone. Using a convenient sampling method, 50 students from four schools, and a total of 200 students were involved in the study.

Quality assurance

Data and specimen quality assurance

Wet mount and Kato-Katz techniques were carried out by a trained one medical laboratory technologist and the principal investigator. Pilot study checking was done at Olinchity primary school before the actual laboratory testing to check the quality of materials, reagents, and all entire procedures. Diarrheic samples and anthelmintic medicated participants in the last 15 days before the stool examination were excluded.

Statistical analysis

All data derived from microscopic examinations were compared for the two techniques. Statistical analysis was done using Statistical Package for Social Science (SPSS) statistical software version 20.

Results

Study subjects

This study was based on two hundred stool samples collected from school children aged 6-16 years. The study was conducted in four primary public schools; fifty students were participated from each school. At a mean age of 11 years, 67% (134 Females) and 33% (66) Males were tested for the study. The Female-to-Male ratio of the study was about 2:1.

The Socio-demographic characteristics of the study subjects were shown according to Table 1 below.

Table 1: Socio-demographic characteristics of the study subjects of Badessa Woreda, West Haraghe, in February, 2019

Variable	Group	Investigated Students	Percentage (%)
Gender	Female	134	67
	Male	66	33
Total		200	100
Age Group	6-9 Years	76	38
	10-13 Years	74	37
	≥14 Years	50	25
School Name	School 1	50	25
	School 2	50	25
	School 3	50	25
	School 4	50	25
Total		200	100
Family Education level	Grade 1-4	199	99.5
	Grade 5-8	1	0.5
Total		200	100
Finger nail status	Trimmed	129	64.5
	Not trimmed	71	35.5
Total		200	100

Drinking water Source	River	139	69.5
	Well	61	30.5
Total		200	100
Shoes Wearing Habits	Occasional	90	45
	Not at all	110	55
Total		200	100

The study showed that 76 (38%) of the study subjects were from the age group of 6-9 years, 74 (37%) from the age group of 10-13 years, and 50 of the study subjects (25%) were from ≥ 14 years of age group. About 99.5% (199) of the study subjects were from the family educational level of grades 1-4. All study subjects had no habits of toilet use (100%) and none of them treated with anthelmintic drug (100%) before the study was

conducted (Table 1).

Other variables such as; drinking water source, finger trimming status, and bare footing habits were directly related to the prevalence of intestinal helminths in the study subjects.

The following table (Table 2) showed the result concordance with different variables and p- value of the significant variations.

Table 2: Socio-Demographic Characteristics and Personal hygienic habits in Relation to intestinal Helminth infection in the study population

Variables	Group	Positive (%)	Negative (%)	Total (%)	P value
Gender	Female	90 (67.2)	44 (32.8)	134 (67.0)	P=0.015(0.021) OR 2.04[1.12-3.73] F=0.781 (0.626-0.9) M=1.19[1.08-2.35] P=0.000
	Male	33 (50.0)	33 (50.0)	66 (33.0)	
Total		123 (61.8)	77 (38.5)	200 (100)	
Age Group	6-9 Years	72 (94.7)	4 (5.3)	76 (38.0)	P=0.000
	10-13 Years	40 (54.1)	34 (45.9)	74 (37.0)	
	≥ 14 Years	11 (22.0)	39 (78.0)	50 (25.0)	
Total		123 (61.5)	77 (38.5)	200(100)	
Drinking Water Source	River Water	36 (25.9)	103 (74.1)	139 (69.5)	P=0.000 OR=0.048Neg=.753[.679-.851] Pos.=15.79[2.21-2.616] P=0.000 OR=0.110(.019-.249)
	Well Water	1 (1.6)	60 (98.4)	61 (30.5)	
Total		37 (18.5)	163 (81.5)	200 (100)	
Finger nail Status	Trimmed	60 (46.5)	69 (53.5)	129 (64.5)	P=0.000 OR=6.9[2.588-18.79] Neg.=1.33[1.17-1.516] Pos.=.191[0.078-0.47] P=0.385 OR=1.4=0.987[.962-1]
	Not Trimmed	63 (88.7)	8 (11.5)	71 (35.5)	
Total		123 (61.5)	77 (38.5)	200 (100)	
Shoes Wearing habits	Occasional	5 (5.6)	85 (94.0)	90 (45.0)	P=0.000 OR=6.9[2.588-18.79] Neg.=1.33[1.17-1.516] Pos.=.191[0.078-0.47] P=0.385 OR=1.4=0.987[.962-1]
	Not at all	32 (29.1)	78 (70.9)	110 (55.0)	
Total		37 (18.5)	163 (81.5)	200 (100)	
Family Education	Grade 1-4	123 (61.8)	76 (38.2)	199 (99.5)	P=0.385 OR=1.4=0.987[.962-1]
	Grade 5-8	0 (0.0)	1 (0.5)	1 (0.5)	
School Names	School 1	31(62.0)	19 (38.0)	50 (25.0)	F= female M= male P= p value OR= odds ratio
	School 2	9 (18.0)	41(82.0)	50 (25.0)	
	School 3**	62 (124)	5 (10.0)	67 (33.5)	
	School 4*	45 (90.0)	5 (10.0)	50 (25.0)	
Total		147 (73.5)	70 (35.0)	217 (108.5)	

*Multiple Infections of: Hook Worm + *Enterobius vermicularis* 7 (3.5%)

**Hook Worm + *Schistosoma mansoni* 17 (8.5%)

Total 24 (16.3%)

High parasitic prevalence was observed among the age group of 6-9 years (P=0.000). Therefore, among all ages, this age group was the highest (accounted for about 38% followed by the age group of 10-13 Years, 37% and ≥ 14 Years was 25%) (Refer Table 2).

There were significant Variations of the parasites between the above variables (Table 2): gender (P=0.15 (0.021), OR= 2.04 [1.12-3.73], Female (0.781[0.626-0.9)) and Male (1.19 [1.1.08-

2.35]); Drinking Water source (P=0.000) OR=0.048 (.006-.8); Finger nail status (P=0.000) or= 0.110 [.049-.249]; Shoe wearing Habits (P=0.000) OR= 6.9 ([2.588-18.791] (Refer Table 2).

Toilet use, treatment status with anthelmintic drugs before the study, and residence with domestic animal(s) were excluded from the relations due to the following data: All study subjects had no habits of toilet using (Open-air defecations were practiced (100%); none of them treated with anthelmintic drugs be-

fore the study was conducted (100%); all study subjects were not live with domestic animal (s).

Prevalence of intestinal helminths detected in faecal samples of all study subjects was summarized for the four schools participated in the study in Table 3.

Table 3: Prevalence of Intestinal Helminths detected from 200 faecal samples from four Public Primary Schools in Badessa Woreda, West Hararghe Zone.

Helminthic Parasites (Ova / Eggs)

Schools	No of Students Examined	<i>Ascaris lumbricoides</i>	<i>Enterobius vermicularis</i>	Hook Worm	<i>Schistosoma mansoni</i>	Total
School 1	50	10 (20%)	7 (14%)	12 (24%)	2 (4%)	31(62%)
School 2	50	4 (8%)	2 (4%)	3 (6%)	0 (0.0)	9 (18%)
School 3	50	0 (0.0)	0 (0.0)	17 (34%)	45 (90%)	62 (124%)*
School 4	50	10 (20%)	7 (14%) **	28 (56%)	0 (0.0)	45 (90%)
Total	200	24 (19.5%)	16 (13%)	60 (48.8%)	47 (38.2%)	147 (73.5%)

* Multiple Infections of: Hook Worm and *Schistosoma mansoni*

** Multiple Infections of Hook Worm and *Enterobius vermicularis*

Discussion

The current study demonstrated that the prevalence of intestinal helminths was very high in the area when we compared with the previous studies. There were significant variations of all species in all schools (refer Table 3). This study demonstrated that the variations of intestinal helminth distribution in the woreda areas/schools required further study. School 3 primary school is the largest in *Schistosoma mansoni* due to highly intensified irrigations are developing whereas; School 4 primary school is the largest in Hook Worm infection. All samples were examined by Wet mount and Kato-Katz techniques, according to the standardized procedure described elsewhere [2, 6]. One slide was prepared per person for each technique (Wet mount and Kato-Katz techniques), and egg findings from Kato-Katz preparation were conducted 30 minutes after its preparation.

This study has an agreement in Kato-Katz technique Sensitivity with some of the previous studies [1, 3, 5, 7, 6, 8, 9, and 10]. However, the study conducted in other areas [4, 6, 11 and 12] revealed that Kato-Katz technique was less sensitive for soil transmitted Helminths including Hook Worm infection. The present study found that Kato-Katz technique is more sensitive than Wet mount technique for all intestinal helminth's infections. In contrast to the previous study [4], the present study examined a single slide per person and concluded that the Kato- Katz technique, when used with the wet mount, is sensitive, appropriate and efficient for the examination of intestinal helminthiasis.

As to the relationship between prevalence sexes, the study demonstrated that the infection rate was higher in females in comparison to males. The study also demonstrated that the prevalence of intestinal Helminths was related with drinking river water, bare footing, and not trimming the finger nails. However, within the limited scope of this study, the relationships between using toilets, family education, anti-helminthic treatment, and residence with domestic animals and prevalence of intestinal helminths were given less attention according to the following data. All study participants used no toilet (100%), 199 (99.5%) families had grade 1-4 educational level, all participants were not treated with any anti-helminthic drug before the study was conducted (100%), and all participants were not living with any

domestic animal(s).

The overall prevalence of Intestinal Helminths in the woreda was 73.5%. This may be due to poor personal and environmental hygiene like other areas of the country.

The most serious consequence of Hook Worm infection is chronic blood loss from the small intestine, which leads to iron deficiency anemia, particularly in children and women of child-bearing age, whose physiological needs for iron are greater. In areas where Hook Worm anemia is present, 50% or more of the population may have hemoglobin values below the normal range and some of these may have severed degrees of anemia [13].

The overall prevalence of intestinal Helminths among the study subjects were led by Hook Worm infection with 48.8% followed by *Schistosoma mansoni* with 38.2%, *Ascaris lumbricoides* with 19.5% and 13% with *Enterobius vermicularis*. There were significant variations of the parasites among schools. School 3 public primary school was the highest prevalence with 214% including multiple infections of Hook Worm and *Schistosoma mansoni*. School 4 was 48.8% in Hook Worm infection and Hook Worm and *Enterobius vermicularis* double infection was observed.

This is the first report on the sensitivity of Kato-Katz technique, after the examination of Hook Worm infection on 30 minutes after preparation [14-18].

Conclusion

This study concluded that intestinal and soil transmitted helminths were significantly detected especially from carriers and non-symptomatic children. Kato-Katz technique was more selective and sensitive than wet mount method in order to achieve the result. It also a selective technique for field surveys to investigate the prevalence and drug resistance of the parasites.

Recommendations

High magnitude of Hook worm in school 3 and *Schistosoma mansoni* in school 4 areas calls for immediate intervention. School 1 and school 2 areas also need nonspecific control measures.

The study wants to indicate that a comprehensive control strategy for helminths infection should include:

Ensuring the wide availability of anti-helminthics for *schistosomiasis* and soil-transmitted helminth infections in all health services in endemic areas;

Regular treatment of all children at risk, including adolescent girls; through school- and community-based initiatives;

Ensuring a safe water supply and adequate sanitation facilities in all schools;

Ensuring provision of potable water and sanitation facilities at house or community level;

Promoting good hygiene and sanitation practices among school children and caregivers (hand washing, finger nail trimming, using of latrines, and use of footwear) through community development activities and in school curricula.

Declarations

Ethics approval and consent to participate

The study was reviewed and approved by Ambo University Woliso Campus ethics and research review committee. Written and verbal informed consent for participation was obtained from students, teachers, and schools principals as the study poses no risk to them. All those who harbored pathogenic intestinal Helminthic infections were given an anthelmintic drug (Praziquantel) to be treated appropriately. In this study there was no human tissue is collected and not used as one of the study materials.

Consent for publication

Not applicable (N/A)

Availability of data and materials

The full data for this study is available from the corresponding author when there is a reasonable need.

Competing interests

The author declares that he has no competing interests.

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The author's contributions

I, Amsalu Mekonnen Wolde, the author of the manuscript was fully participated in gap finding, proposal writing, involved in the study design, data collection, data analysis, report writing, writing the manuscript, and edition of the revised manuscript.

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Limitations of the study

Unlike other studies conducted in many areas of the world, the current study did not consider the parasitic count per person. The smallness of the sample size (200 school children) was also another drawback of the current study. Within the limited scope of the current study, there was incapability to determine the specific

reason of variations of distribution of the intestinal helminths in the woreda except that in school 3 areas in which irrigations are highly extended.

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