2022-03-26

Prevalence of Intestinal Parasites and Schistosoma Mansoni and Associated Factors Among Fishermen At Lake Tana, Northwest Ethiopi

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BAHIR DAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

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DEPARTMENT OF MEDICAL LABORATORY SCIENCE

PREVALENCE OF INTESTINAL PARASITES AND *SCHISTOSOMA MANSONI* AND ASSOCIATED FACTORS AMONG FISHERMEN AT LAKE TANA, NORTHWEST ETHIOPIA

BY: ABEBAW FENTAHUN (MSC CANDIDATE)

JULY 2021

BAHIR DAR, ETHIOPIA

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PREVALENCE OF INTESTINAL PARASITES AND *SCHISTOSOMA MANSONI* AND ASSOCIATED FACTORS AMONG FISHERMEN AT LAKE TANA, NORTHWEST ETHIOPIA

A THESIS SUBMITTED TO DEPARTMENT OF MEDICAL LABORATORY SCIENCE, SCHOOL OF HEALTH SCIENCES, COLLEGE OF MEDICINE AND HEALTH SCIENCES, BAHIR DAR UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICAL PARASITOLOGY AND VECTOR CONTROL

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Advisors: Mr. Tadesse Hailu (MSc, Associate Professor, PhD fellow)

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DEPARTMENT OF MEDICAL LABORATORY SCIENCE

Advisors' Approval of Thesis for Defense

I hereby certify that I have supervised, read, and evaluated this thesis titled "Prevalence of intestinal parasites and *Schistosoma mansoni* and associated factors among fishermen at Lake Tana, Northwest Ethiopia" by Abebaw Fentahun, prepared under my guidance. I recommend the thesis be submitted for oral defense (mock-viva and viva voce).

Advisors' name	Signature	Date
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Examiners' Approval of Thesis for Defense Result

We hereby certify that we have examined this thesis entitled "**Prevalence of intestinal parasites and *Schistosoma mansoni* and associated factors among fishermen at Lake Tana, Northwest Ethiopia**" by Abebaw Fentahun. We recommend that the thesis is approved for the MSc degree in "Medical Parasitology and Vector control".

Board of Examiners

External examiner's name	Signature	Date
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Internal examiner's name	Signature	Date
Mr. Megbaru Alemu (MSc, Associate Professor)	______________	___________
Chair person's name	Signature	Date
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DECLARATION

This thesis entitled 'Prevalence of intestinal parasites and *Schistosoma mansoni* and associated factors among fishermen at Lake Tana, Northwest Ethiopia' was carried out by me under the supervision of Mr. Tadesse Hailu and Mr. Getaneh Alemu from Bahir Dar University, College of Medicine and Health Sciences, for the award of MSc Degree in Medical Parasitology and Vector control. I declare that this thesis is original and has not been presented or published in this University or other institution.

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Place: Bahir Dar

Date of submission: ________________________________

ACKNOWLEDGEMENTS

First, I would like to express my deepest gratitude to my advisors Mr. Tadesse Hailu and Mr. Getaneh Alemu for their valuable advice, support and constructive comments in the development of this thesis. I sincerely thank Amhara regional health bureau for providing me financial support. I also thank fishermen at Bahir Dar zuria and Dera district, who were volunteered to participate in this study. Finally, I would like to extend my gratitude to Bahir Dar University, College of Medicine and Health sciences, Department of Medical Laboratory Science for giving a chance to develop this research paper.

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ACRONYMS

AOR - Adjusted Odds Ratio

COR - Crude Odds Ratio

EPG - Eggs Per Gram

KK - Kato-Katz

SPSS - Statistical Package for the Social Sciences

STH - Soil Transmitted Helminths

STS - Spontaneous Tube Sedimentation

WHO - World Health Organization

ABSTRACT

Background: Intestinal parasites and *Schistosoma mansoni* infections adversely affect the health of humans in many parts of the world especially in sub-Saharan Africa countries including Ethiopia. Water, sanitation and hygiene and water based activities like swimming and fishing believed to increase the risk of intestinal parasites and *Schistosoma mansoni* infection. Fishermen who spend most of their time in the water bodies are supposed to be at high risk of intestinal parasite infection and schistosomiasis. However, the magnitude of these parasites infections and their determinant factors are not well addressed.

Objective: This study aimed to assess the prevalence of intestinal parasites and *Schistosoma mansoni* and associated factors among fishermen at Lake Tana, Northwest Ethiopia their

Methods: A cross-sectional study was conducted among 388 fishermen selected by systematic random sampling technique from Dera and Bahir Dar zuria districts around Lake Tana from March to May 2021. Data on socio-demographic information and risk factors were collected using a structured questionnaire. A fresh stool sample was collected from each and processed using Kato-Katz and spontaneous tube sedimentation techniques. The data were entered and analyzed using SPSS version 26. Descriptive statistics was used to compute the prevalence and intensity of parasitic infections. Logistic regression was used to determine factors associated with intestinal parasitic and *Schistosoma mansoni* infections. Variables with $P<0.05$ was considered as statistically significant.

Result: From the total 388 fishermen, the prevalence of intestinal parasites and *Schistosoma mansoni* were 164 (42.3%) and 88 (22.7%), respectively. The most prevalent parasite include hookworm species 76 (19.6%), *A. lumbricoides* 46 (11.9%) and *E. histolytica/dispar* 29 (7.5%). The distribution of STHs and intestinal protozoa's among fishermen were 122 (31.4%) and 42 (10.8%), respectively. Participant who attended primary school (AOR=2.02; 95%CI: 1.16-3.55; P=0.014) and illiterates (AOR=2.54; 95%CI: 1.35-4.77; P=0.004) and not washing hands before meal (AOR=2.23; 95%CI: 1.25-3.96; P=0.007) were significantly associated with intestinal parasite infection. Illiterate educational status (AOR=2.37; 95%CI: 1.13-4.95; P=0.022), fishing by bargee (AOR=2.43; 95% CI: 1.30-4.53; P=0.005), fishing ≥4 days per week (AOR=2.27; 95%CI: 1.09-4.75; P=0.029), swimming (AOR=3.03; 95%CI: 1.11-8.25; P=0.030) and participation in irrigation (AOR=3.09; 95% CI: 1.805-5.314; P<0.001) were statistically significant predictors of *S. mansoni* infection.

Conclusion: The prevalence of hookworm species, *A. lumbricoides* and *S. mansoni* are high among fishermen at Lake Tana. Being primary and illiterate educational status and absence of hand washing before meal were predisposing factors for intestinal parasite infection. Fishing ≥4 days per week, swimming and participation in irrigation were also risk factors for *S. mansoni* infection among the fishermen. Therefore, health education to improve sanitation and personal hygiene and regular deworming should be adopted to reduce intestinal parasite and *S. mansoni* infections.

Key words: Associated factors, Fishermen, Intestinal parasite, Lake Tana, *S. mansoni*

1. INTRODUCTION

1.1. Background

Intestinal parasitic (IP) infections are major public health problems in developing countries (Wegayehu *et al.*, 2013; Regassa *et al.*, 2021). It is estimated that about 3.5 billion people are infected and approximately 450 million people are ill as a result of intestinal parasitic infections worldwide (Amogne, 2020; Regassa *et al.*, 2021). As in many developing countries, parasitic infection is among the most common causes of morbidity in Ethiopia. Among the IP burden, ascariasis is the second-highest followed by Ancylostomiasis and Trichuriasis in Sub-Saharan Africa (Mengistu *et al.*, 2007; Deribe *et al.*, 2012).

Lack of proper sanitation and hygiene, the habit of eating raw vegetables and not washing hands before meal are some of the factors associated with intestinal parasitic infections (Alemu *et al.*, 2019; Amogne, 2020). Socio-economic variables associated with poverty such as no provision of safe water, unsafe human waste disposal systems, open field defecations and unavailability of sufficient health care are also risk factors for the high prevalence of IP infection (Mengistu *et al.*, 2007; Regassa *et al.*, 2021).

Schistosomiasis is also a chronic helminthic infection caused by trematodes of the genus *Schistosoma*. It is one of the neglected tropical parasitic diseases in the tropics and subtropics. The species of *Shistosoma* that cause human infection include *Shistosoma mansoni, Shistosoma heamatobium, Shistosoma japonicum, Shistosoma intercalatum, Shistosoma mekongi and Shistosoma guenensis* (Colley *et al.*, 2014; WHO, 2017), of which, *S. mansoni* and *S. heamatobium* are medically important species in Ethiopia (Negussu *et al.*, 2017; Hussen *et al.*, 2019). Schistosomiasis affects over 250 million people and 780 million people are at risk of infection worldwide (Colley *et al.*, 2014; WHO, 2017). More than 90 % of the infections occur in Africa notably in sub-Saharan Africa (Colley *et al.*, 2014; Lai *et al.*, 2015). The disease results in a considerable human morbidity with a global burden of an estimated 3.5 million Disability-Adjusted Life Years (DALY) (Mitra and Mawson, 2017; WHO, 2017). In Ethiopia, about 5.01 million peoples are infected and 37.5 million people are at risk of the disease schistosomiasis (Steinmann *et al.*, 2006; Negussu *et al.*, 2017).

Schistosoma infection is more wide spread in poor rural communities particularly in places where fishing and water irrigation activities are commonly practiced (Steinmann *et al.*, 2006; Colley *et al.*, 2014). Construction of dams for irrigation and other purposes is a suitable snail habitat (Usman *et al.*, 2019). Domestic activities such as washing clothes and fetching water in infested water expose people to schistosomiasis (WHO, 2017). Open defecation practice and water based activities like swimming and fishing also increase the risk of *Schistosoma* infection. People like fishermen spend most of their time in water bodies and they are at a high risk of schistosomiasis (WHO, 2002; Menjetta *et al.*, 2019).

Fisheries are one of the livelihood strategies to many people in developing countries. It is an important source of diet for over one billion people and provides employment for about 38 million people around the world (Gebremedhin *et al.*, 2013; Amare *et al.*, 2018). In Ethiopia fishing is mostly practiced in lakes and rivers. Lake Tana is one of the largest fishing sites in Amhara region and it is almost dominated by artisanal fishermen. According to a survey conducted in 2015/16 about 4380 fishermen have been engaged in fishing in a seasonal and full time basis (Amare *et al.*, 2018).

The laboratory diagnostic techniques for intestinal parasites include parasitological diagnosis (direct wet mount microscopy, Kato-Katz, formol-ether concentration and spontaneous tube sedimentation techniques), immunodiagnostic and molecular techniques. These methods vary in sensitivity, specificity, cost, simplicity, and applicability. The KK technique is recommended by the World Health Organization (WHO) as a means of detection method for epidemiologic surveys and for the quantitative assessment of intensity to soil-transmitted helminths (STHs) and *S. mansoni* infection (Utzinger *et al.*, 2012; Weerakoon *et al.*, 2015). The spontaneous tube sedimentation techniques can be applied in poor health care settings and under field-work condition due to its ability to detect majority of intestinal parasites eggs, larvae, cysts, and trophozoites, and *S. mansoni* ova with a reasonable cost (Tello *et al.*, 2012).

1.2. Literature Review

Intestinal parasites and *S. mansoni* are a major public health challenge in developing countries. Their prevalence is different in different countries of the world due to personal, parasitic, snails, environmental and other factors (Elbaz and Esmat, 2013; Gebreyohanns *et al.*, 2018; Menjetta *et al.*, 2019).

A study conducted in Brazil in a community of fishermen from the endemic area of Alagoas showed that the prevalence of *S. mansoni* by using Kato-Katz technique is 13.9% with an infection intensity of light (24-100/eggs per gram of faeces [epg]) 78.8 %, Moderate (101 to 400/epg) among 21.2 % of individuals. Adults (29 to 49 years) and elderly (more than 60 years) were the most affected segments of the population (Melo *et al.*, 2019).

Another study conducted in East Africa, North Western Tanzania in a fishing village on the southern shores of the Lake Victoria showed that, the overall prevalence of *S. mansoni* using the Kato-Katz technique is 47.85% (854/1785), with a mean intensity of 183.21 epg. Prevalence of *S. mansoni* infection is also higher among males 56.19% than females 40.59% and younger age group than older age with an infection intensity of 41.21% light, 27.16% moderate and 31.61% heavy intensity of *S. mansoni* infection (Mazigo *et al.*, 2014).

A similar study conducted in East Africa, South East Uganda along Lake Victoria, Mayuge district also showed that prevalence of *S. mansoni* by Kato-Katz technique was 88.6% with a mean intensity of 236.2 epg of faeces and heavily, moderately and lightly infection intensity are 39.0%, 22.2% and 27.4% respectively. In this study, males have significantly higher intensity of *S. mansoni* (370.2 epg) than females (132.6 epg) and the levels of water contact activities significantly influenced intensity of infection (Tukahebwa *et al.*, 2013) and the highest intensity of infection was found among people involved in fishing. In this study, the prevalence of hookworm species was 43.3% which increases with age group up to the age group 20–24 years while differences between this age group and those older were not significant (Tukahebwa *et al.*, 2013).

A household survey conducted in fishing villages in Koome Islands, Lake Victoria, Mukono district, Uganda show that 57.2% (719/1257) peoples has *S. mansoni* infection by Kato-Katz technique. Male has 2.6 fold greater odds of *S. mansoni* infection than female, while increasing age showed an inverse association (Sanya *et al.,* 2015). Another similar study conducted in Egypt in the Lake Manzala region, show that the overall prevalence of *S. mansoni* by Kato-Katz technique and formalin ether sedimentation technique is 26.6% with an intensity of (42.7+/-7.2) ova/g of stool. The intensity of infection is relatively low as a result of repeated courses of chemotherapy (Taman *et al.*, 2014).

In Ethiopia, limited studies have been conducted among fishermen around the Lakes. For instant, a study conducted in southern Ethiopia, at Lake Hawassa showed that, the overall prevalence of intestinal helminths, including *S. mansoni* by Kato–Katz technique, is 69.54%. The prevalences of *A. lumbricoides* are 40.74%, *T. trichiura* 35.80% and hookworm species 5.76%. The mean infection intensities of *A. lumbricoides, T. trichiura* and hookworm species are 1349.04 EPG, 246.24 EPG and 99.36 EPG, respectively. A light infection intensity of *A. lumbricoides* 81.82% and *T. trichiura* 91.95% is recorded. Only light infection intensity is recorded in hookworm species infected fishermen (Menjetta *et al.*, 2019). The prevalence of *S. mansoni* is 29.21% with a mean infection intensity of 158.88 epg. The level of infection intensities for *S. mansoni* was 52.11% light, 43.66% moderate and 4.23% heavy. Prevalence of *S. mansoni* based on age groups were 31.82%, 31.75%, 31.94% in age groups of 15-19, 20-24 and 25-29 years respectively (Menjetta *et al.*, 2019).

A study conducted in Abaye Deneba village community, living in the shore of Lake Ziway, Ethiopia among the 491 stool samples examined, using the formol ether concentration technique, 50.2% of study participants show infection with at least one intestinal parasite. *Schistosoma mansoni* is the most prevalent (41.3%) followed by *T. trichiura* (9.4%), *A. lumbricoides* (8.4%), *T. saginata* (2.4%), *E. vermicularis* (2.0%) and hookworm species (0.4%). Prevalence of schistosomiasis was highest in men aged 15-24 years (Nyantekyi *et al.*, 2014).

Another study conducted in Addiremets town, Western Tigray, the overall intestinal parasite prevalence by direct microscopy, formol-ether concentration and Kato-Katz techniques is 51.3% (2111/411). The most prevalent parasite is *S. mansoni* 26.3% followed by hookworm species 23.1%. The prevalence of intestinal parasites among males 54.1% is higher than females 47.3%. The highest proportion of parasite infection is reported among the age group of 5–9 year old participants, at 70.6%. The mean *S .mansoni* infection intensity is 218 eggs per gram (Gebreyohanns *et al.*, 2018).

Poor personal hygiene like poor practice of hand washing before, regular hand washing after visiting toilets, was significantly associated with intestinal parasitic infection (Tefera and Mebrie, 2014; Alemu *et al.*, 2019). Intestinal parasitic infection increased by 4.77 times in those who didn't wash hands before meal than who washed their hands before meal (Alemu *et al.*, 2019). Peoples who are eating raw vegetables, lack of proper use of latrine (AOR: 2.89 (95%1.18-7.08)) and poor environmental sanitation has the highest probability to be infected by intestinal parasites infection (Derso *et al.*, 2016; Mengist *et al.*, 2017). The prevalence of intestinal parasitic infection was higher among who live in rural than urban settings. This might be due to a lack of awareness on the transmission of intestinal parasites and open defecation problem in rural areas (Tesfaye, 2015; Hailu *et al.*, 2020).

Several factors including water contact activities like washing clothes or utensils, fetching water, swimming and bathing are the risk for schistosomiasis prevalence and infection intensity among fishermen (Tukahebwa *et al.*, 2013; Taman *et al.*, 2014; Menjetta *et al.*, 2019). Considering the frequency of exposure, frequency of visiting the water bodies or frequency of contact with water has a relative higher risk of getting infected with the parasite and being associated with higher intensity of infection (Tukahebwa *et al.*, 2013; Sanya *et al.*, 2015; Melo *et al.*, 2019). Fishermen who are swimming always are 2.92 times more likely to acquire *S. mansoni* than those who swim some times (Menjetta *et al.*, 2019).

Schistosoma mansoni infection increased with declining education level or in those who cannot read or write (illiterates). The instruction level is an important factor in the control of the disease, because the access to information promotes the empowerment of the population, adherence to health care, behavioral change and consequent reduction of the prevalence rates. On the other hand, individuals with less education were less prone to orientations for prevention of the disease and health promotion (Ssetaala *et al.*, 2015; Melo *et al.*, 2019).

Generally, the above information indicates that IPs and *S. mansoni* infection is frequently occurs among fishermen and there are several aggravating factors for the existence of IPs and *S. mansoni* infections.

1.3. Statement of the Problem

Intestinal parasites and *Schistosoma* infections adversely affect the health of humans in many parts of the world especially in sub-Saharan Africa countries including Ethiopia (Wegayehu *et al.*, 2013; WHO, 2017). In developing countries a habit of open defecation, eating raw meat, no provision of safe water, washing clothes in water bodies, irrigation and fishing which increase the intestinal parasites and *S. mansoni* infection. People like fishermen who are performing their day to day activities in the water bodies are believed to be at a high risk of *S. mansoni* infection. They usually contact with water in one or another way and their bargee also do not prevent them from water contact during fishing (Nyantekyi *et al.*, 2014; WHO, 2017; Menjetta *et al.*, 2019). People working around Lakes are at a higher risk schistosomiasis since snail intermediate hosts are highly populated around the lake due to existence of water throughout the year. Factors including the stability of water in regard to flow rate, availability of water throughout the year and pollution of the water body by organic matter are suitable for water plants which in turn serve as substrates for feeding and oviposition of snails as well as providing protection from high water velocities and predators such as fish and birds. The existences of snails create more suitable conditions to complete the life cycle and transmission of *S. mansoni*.

In our country many studies have been done on intestinal parasites prevalence and associated factors among schoolchildren. However, there is a scarcity of information about intestinal parasites and *S. mansoni* prevalence and associated factors among high risk segments of the population like fishermen. In our study area, there are many people who are living by fishing in Lake Tana which is a potential infectious area for schistosomiasis. In addition, open defecation is a common problem around the Lake where fishermen are performing their daily activities due to the absence of community latrine. As a result, fishermen are believed to be at a high risk of intestinal and S. *mansoni* infections around Lake Tana. However, the parasitic status of fishermen around Lake Tana is not yet known and needs investigation. Therefore, the aim of this study was to assess the prevalence and associated factors of intestinal parasites and *Schistosoma mansoni* infections among fishermen in Lake Tana basin.

1.4. Significance of the Study

This study helps to give information about the magnitude and associated factors of intestinal parasites and *S. mansoni* among fishermen to health professionals and other health sectors. In addition, it helps to draw the attention of policy makers and stake holders to focus on prevention and control strategies to high risk population groups like fishermen. This, in turn, will benefit fishermen and other community in the study area as fishermen will get attention to be targeted for interventions. As well, the result of this study can be used as a baseline data to scholars for further study.

2. OBJECTIVES

2.1. General Objective

To assess the prevalence and associated factors of intestinal parasites and *S. mansoni* infections among fishermen at Lake Tana, Northwest Ethiopia

2.2. Specific Objectives

- To determine the prevalence of intestinal parasites among fishermen at Lake Tana
- To determine the prevalence of *S. mansoni* among fishermen at Lake Tana
- To determine the intensity of STHs and *S. mansoni* infection among fishermen at Lake Tana
- To identify factors associated with intestinal parasites among fishermen at Lake Tana
- To identify factors associated with *S. mansoni* among fishermen at Lake Tana

3. MATERIALS AND METHODS

3.1. Study Design, Area and Period

A cross-sectional study was conducted in Bahir Dar zuria and Dera districts *kebeles* around the Lake Tana basin from March to May 2021. Bahir Dar zuria district is located around Bahir Dar town, the capital city of Amhara region, 565 km North West of Addis Ababa. The mean altitude of the district is 1,800 m above sea level and the temperature of the district ranges from 10 to 32°C with annual rainfall of 800-1250 mm (Bazezew and Bisewer, 2018; Fentahun *et al.*, 2020). Dera district is located in South Gondar administrative zone, 602 km from Addis Ababa. The mean altitude of the district is 2077 m above sea level. The areas mean annual rain fall and mean annual temperature was 1300 mm and 26°C, respectively (Shiferaw and Mengistu, 2015). Peoples living around Lake Tana uses the Lake for different purposes like fishing, irrigation, washing clothes and bathing.

3.2. Population

3.2.1. Source Population

All people who were engaged in fishing activities at Lake Tana

3.2.2. Study Population

All fishermen in Dera and Bahir Dar zuria district who were actively engaged in fishing activities during the study period

3.3. Sample Size and Sampling Technique

3.3.1. Sample Size Determination

The sample size was calculated using n=Z2x P(1-P)/d2 by taking a proportion of 50% because of the absence of data on prevalence of intestinal parasites among fishermen, 95% confidence interval with 5% marginal error.

$$n = \frac{Z\hat{}2\alpha/2\ P\ (1-P)}{d2} = \frac{(1.96)>2(0.5)(0.5)}{(0.05)} = 384$$

Where n= sample size, Z = critical value at 95% certainty (1.96 at 95% CI)

P = prevalence (p = 0.5)   d = precision (if 5%, d= 0.05)

By including 10% non-respondent rate, the total sample size was 422.

3.3.2. Sampling Technique

Among the nine districts bordering Lake Tana two districts (Bahir Dar zuria and Dera district) were selected by simple random sampling technique. The study participants in each district were proportionally allocated by considering the total number of fishermen in each district. So, 308 fishermen from a total of 598 fishermen from Bahir Dar zuria district and 114 fishermen from a total of 220 fishermen from Dera district were included. Study participants were selected by systematic random sampling technique from the sample frame of the lists of fishermen in the fishermen association registration book (Table 1).

Table 1: Number of fishermen and allocated study participants in each fishing sites/*kebeles* of Bahir Dar zuria and Dera district, Northwest Ethiopia, 2021

Study sites		**Number of fishermen**	**Study participants**
Bahir Dar Zuria district *kebeles*	**Chicha**	50	26
	Debranta	80	41
	Dek	107	55
	Lijomi	68	35
	Weramit	111	57
	Wonjeta	60	31
	Robit	68	35
	Sekelet	54	28
	Subtotal	598	308
Dera district *kebeles*	**Tana Dnbiso**	96	50
	Mirafe Mariam	53	27
	Qorata	71	37
	Subtotal	220	114
Total		818	422

3.4. Study Variables

3.4.1. Dependent Variable

·Intestinal parasites infection

· *Schistosoma mansoni* infection

3.4.2. Independent Variable

Socio-demographic variables

· Age

· Residence

·Level of education

·Marital status

·Monthly income

·Family size

Independent factors for intestinal parasites

· Washing vegetables/fruits

· Water source for drinking

· Hand washing habit before meal

· Latrine availability

· Latrine utilization

· Hand washing after toilet

· Shoe wearing habit

Independent factors for *S. mansoni* infection

· Frequency of fishing

· Fishing instrument

· Washing cloth in Lake Tana

· Bathing in Lake Tana

· Swimming habit

· Swimming frequency

· Participate in irrigation

· Distance from border for fishing

3.5. Operational Definition

Fishermen: People who had been actively engaged in fishing activities by boat and bargee.

3.6. Eligibility Criteria

3.6.1. Inclusion Criteria

Fishermen who were actively engaged in fishing activities during the study period, those who had been continuously engaged in fishing atleast for the last six weeks and volunteer to participate were included in the study.

3.6.2 Exclusion Criteria

Those who had taken treatment for intestinal parasites and *S. mansoni* infection two months prior to or during the data collection time were excluded from the study.

3.7. Data Collection and Processing

A structured questionnaire was used to obtain socio-demographic information and risk factors by trained data collectors. The study participants were oriented about the aim of the study and how to collect and provide sufficient stool specimen by data collectors. Approximately, 5 gram fresh stool sample was collected using labeled, clean, dry and leak-proof container in a nearby toilet. The stool specimen was transported to Bahir Dar University, College of Medicine and Health Sciences, Department of medical laboratory teaching laboratory following specimen transport guideline for parasitological examination. The stool specimen was processed using Kato-Katz and spontaneous tube sedimentation techniques to detect ova and Kato-Katz is also used to determine the intensity of STHs and *S. mansoni* infection.

Kato-Katz: A stool sample was pressed through a sieve to remove large particles. About 41.7 milligrams of sieved stool was transferred to the template which was put on a slide until the template hole was filled. Then, the template was removed and the stool sample was covered with cellophane (previously immersed with glycerol-malachite green for 24 hrs) and pressed with a new slide. The glycerol clears the faecal debris, enabling the ova to be seen. The Kato thick smears were examined within 30 minutes for hookworm species and after one hour up to 24 hours for other intestinal parasites. From each study participant two KK slides were prepared. For STHs and *S. mansoni* positive samples the infection intensity was estimated based on the eggs per gram of stool. The number of eggs counted multiplied by 24 to calculate intensity in eggs per gram. The intensity of STHs was categorized as light (1–4999 EPG), moderate (5000–49999 EPG) and heavy (≥50,000) for *A. lumbricoides*); light (1–1999 EPG), moderate (2000–3999 EPG), heavy (≥4000 EPG) for hookworms; light (1–999 EPG), moderate (1000–9999 EPG), heavy (≥10,000) for *T. trichiura*. The intensity of *S. mansoni* was categorized as light (1–99 EPG), moderate (100–399 EPG), and heavy (>400 EPG) (WHO, 2002; Fenta *et al.*, 2020). (See Annex V)

Spontaneous tube sedimentation: In the STS technique, approximately three grams of fresh stool sample was weighed and homogenized in 10 ml of normal saline solution. The mixture was filtered through surgical gauze into a 50 ml plastic tube which was then filled with more saline solution up to 50 milliliters; Close cap tightly and Shake for 30 s. The tube was left to stand for 45 minutes, and then, the supernatant was discarded. A sample was taken using a plastic pipette from the bottom and put on a microscopic slide and observed for the ova of intestinal parasites by light microscope (Fenta *et al.*, 2020). (See Annex V)

3.8. Quality Control

Before data collection, training was given to data collectors by principal investigator about data and sample collection protocols. At the end of each data collection date, the questionnaire was crosschecked for completeness. Standard operating procedures were followed during stool specimen collection, transportation, processing, examination and result recording. Ten percent of total slides for Kato-Katz were randomly selected and read by experienced laboratory technologist who is blind to the primary result and it was taken as a final result.

3.9. Data Analysis

The data were entered and analyzed using SPSS version 26. Prevalence of intestinal parasites and *S. mansoni* was analyzed with descriptive statistics and reported in percentages. Intensity of STHs and *S. mansoni* was reported in mean eggs per gram of stool. The associated risk factors for intestinal parasites and *S. mansoni* were first analyzed by univariate logistic regression. Then, to control the possible confounding factors, variables with *P-value* less than 0.2 were adjusted by multivariate logistic regression. Finally, variables considered statistically significant if the *P-value* is less than 0.05.

3.10. Ethical Considerations

Ethical clearance was obtained from Bahir Dar University College of Medicine and Health Sciences institutional review board (IRB) and approved prior to the start of data collection (Protocol number: 151/2021). Permission letter was obtained from Amhara Public Health Institute and letter of support from West Gojjam and south Gondar zonal health dep't, Dera and Bahir Dar zuria district health office. The objective of the study was explained and informed verbal consent was obtained from the fishermen. A verbal assent was also obtained from their parents for those whose age was less than 18. Confidentiality of the information was kept and maintained during the study. A result of participants was kept confidential and fishermen infected by any intestinal parasites were linked to the nearby health institution for treatment.

3.11. Dissemination of the Results

The final result of this study will be submitted and presented to Bahir Dar University, College of Medicine and Health Sciences, Department of Medical Laboratory Science staff and will be submitted in hard copy to Amhara Public Health Institute. Furthermore, it will be presented on conferences and the manuscript will be submitted to peer reviewed journals for publication.

4. RESULTS

4.1. Socio-demographic Characteristics

From the total 422 fishermen, 388 (92%) individuals were participated in this study with 34 (8%) non-respondent rate. From the non-respondent 29 (6.8%) didn't exist during data collection, and 5 (1.2%) didn't give stool samples after checked three times. The mean age of study participants was 29.52 years ranged from 14 to 50 years with a standard deviation of 8.725 years. All participants were males and orthodox religion followers. The majority of study participants 306 (78.9%) lived in rural settings, 194 (50.0%) attended primary school and 272 (70.1%) had average monthly income of ≤1000 birr. Married participants and participants who had <5 family size accounted 222 (57.2%) and 223 (57.5%), respectively (Table 2).

Table 2: Socio-demographic characteristics of fishermen at Lake Tana, Northwest Ethiopia, 2021 (N=388)

Demographics		**Number**	**Percent**
Age group	**<18**	11	2.8
	18-40	316	81.4
	≥41	61	15.7
Residence	**Urban**	82	21.1
	Rural	306	78.9
Educational status	**Illiterate**	107	27.6
	Primary	194	50.0
	High school &above	87	22.4
Marital status	**Single**	166	42.8
	Married	222	57.2
Family size	**<5**	223	57.5
	≥5	165	42.5
Monthly income (in birr)	**≤1000**	272	70.1
	>1000	116	29.9

4.2. Prevalence of Intestinal Parasites among Fishermen

The overall prevalence of intestinal parasites (IPs) among fishermen by Combining KK and STS techniques was 42.3% (164/388) (17.5% (68/388) by KK and 36.3% (141/388) by STS techniques). The overall prevalence of STHs and intestinal protozoans was 31.4% (122/388) and 10.8% (42/388), respectively. Intestinal parasites identified in this study were hookworm species (19.6%), *A. lumbricoides (*11.9%), *E. histolytica/dispar* (7.5%), *G. lamblia* (3.6%), *H. nana* (2.3%), *Taenia spp.* (1.3%), *T. trichiura* (1.3%), *S. stercoralis* (0.8%) and *E. vermicularis* (0.5%). Among 164 IP infected participants, 14.6% (24/164) were co-infected by two parasite species. Of these, hookworm species and *A. lumbricoides* co-infections were predominantly detected in 5.5% (9/164) participants. The prevalence of triple infections among fishermen was 0.6% (1/168) which is *E. histolytica/dispar*, hookworm and *H. nana* (Table 3).

Table 3: The prevalence of intestinal parasites among fishermen at Lake Tana, Northwest Ethiopia, 2021 (N=388)

Parasite species		**Prevalence [n (%)]**			**Prevalence at 95 % C.I for combined**
		KK	**STS**	**Combined**	
Intestinal helminths	**Hookworm species**	31 (7.9)	69 (17.8)	76 (19.6)	15.95-23.83
	A. *lumbricoides*	28 (7.2)	35 (9.0)	46 (11.9)	9.01-15.46
	E. vermicularis	1 (0.3)	1 (0.3)	2 (0.5)	0.14-1.87
	S. stercoralis	N/A	3 (0.8)	3 (0.8)	0.26-2.24
	T. trichiura	4 (1)	2 (0.5)	5 (1.3)	0.55-2.98
	Taenia spp.	3 (0.8)	4 (1.0)	5 (1.3)	0.55-2.98
	H. nana	4 (1)	6 (1.5)	9 (2.3)	1.23-4.35
Intestinal protozoans	***G. lamblia***	N/A	14 (3.6)	14 (3.6)	2.16-5.97
	E. histolytica/dispar	N/A	29 (7.5)	29 (7.5)	5.14-10.67
Total positive participants		68 (17.5)	141 (36.3)	164 (42.3)	37.33-47.37

N=total examined, n= number of positive, N/A= not applicable

The prevalence of IPs among rural and urban participants was 132 (43.1%) and 32 (39.0%), respectively. The highest prevalence of IPs 5 (45.5%) was recorded among the age group of <18, illiterates 57 (53.3%), participants who had monthly income of ≤1000 birr 116 (42.6%). Married participants and participants who had ≥5 family size had a prevalence of intestinal parasites 99 (44.6%) and 72 (43.6%), respectively (Table 4).

Table 4: The distribution of intestinal parasites across socio-demographic variables among fishermen at Lake Tana, Northwest Ethiopia, 2021

Socio-demographic variables		**IP infection [n (%)]**		χ^2, ***P- value***
		Positive	**Negative**	
Age group	**<18**	5 (45.5)	6 (54.5)	0.053, 0.974
	18-40	133 (42.1)	183 (57.9)	
	≥41	26 (42.6)	35 (57.4)	
Residence	**Urban**	32 (39.0)	50 (61.0)	0.448, 0.503
	Rural	132 (43.1)	174 (56.9)	
Educational status	**Illiterate**	57 (53.3)	50 (46.7)	14.32, 0.001
	Primary	84 (43.3)	110 (56.7)	
	High school & above	23 (26.4)	64 (73.6)	
Marital status	**Single**	65 (39.2)	101 (60.8)	1.15, 0.283
	Married	99 (44.6)	123 (55.4)	
Family size	**<5**	92 (41.3)	131 (58.7)	0.220, 0.639
	≥5	72 (43.6)	93 (56.4)	
Monthly income (birr)	**≤1000**	116 (42.6)	156 (57.4)	0.054, 0.817
	>1000	48 (41.4)	68 (58.6)	
Total		164 (42.3)	224 (57.7)	

The highest prevalence of IPs was recorded among fishermen in Qorata 18 (58.0%) followed by Dek 26 (49.1%) *kebeles*. However, the lowest prevalence of intestinal parasites was obtained among fishermen in Debranta 13 (33.3%), Mirafe Mariam 6 (25.0%) and Lijomi 10 (32.7%) *kebeles* (Table 5).

Table 5: Prevalence of intestinal parasites among fishermen across study sites bordering the Lake Tana, Northwest Ethiopia, 2021

Data collection site		**Total examined**	**IP infection [n (%)]**		**χ^2, *P- value***
			Positive	**Negative**	
Bahir Dar Zuria district *kebeles*	**Chicha**	24	11 (45.8)	13 (54.2)	11.123, 0.348
	Debranta	39	13 (33.3)	26 (66.7)	
	Dek	53	26 (49.1)	27 (50.9)	
	Lijomi	31	10 (32.7)	21 (67.7)	
	Weramit	55	26 (47.3)	29 (52.7)	
	Wonjeta	28	11 (39.3)	17 (60.7)	
	Robit	31	14 (45.2)	17 (54.8)	
	Sekelet	24	11 (45.8)	13 (54.2)	
Dera district *kebeles*	**Tana Dnbiso**	48	18 (37.5)	30 (62.5)	
	Mirafe Mariam	24	6 (25.0)	18 (75.0)	
	Qorata	31	18 (58.0)	13 (42.0)	
Total		388	164 (42.3)	224 (57.7)	

4.3. Prevalence of *Schistosoma mansoni* among Fishermen

The overall prevalence of *S. mansoni* among fishermen at Lake Tana was 22.7% (88/388). The highest prevalence of *S. mansoni* 3 (27.3 %) was recorded among <18 age groups, those who live in rural settings 75 (24.5%) and participants who were illiterates 34 (31.8%). Married participants and participants who had ≥5 family size had a prevalence of *S. mansoni* 57 (25.7%) and 41 (24.8%), respectively (Table 6).

Table 6: The distribution of *S. mansoni* among fishermen at Lake Tana across socio-demographic variables at Lake Tana, Northwest Ethiopia, 2021

Demographic factors		***S. mansoni* [n (%)]**		**χ^2, *P- value***
		Positive	**Negative**	
Age group	**<18**	3 (27.3)	8 (72.7)	0.479, 0.787
	18-40	73 (23.1)	243 (76.9)	
	≥41	12 (19.7)	49 (80.3)	
Residence	**Urban**	13 (15.9)	69 (84.1)	2.763, 0.096
	Rural	75 (24.5)	231 (75.5)	
Educational status	**Illiterate**	34 (31.8)	73 (68.2)	7.250, 0.027
	Primary	39 (20.1)	155 (79.9)	
	High school & above	15 (17.2)	72 (82.8)	
Marital status	**Single**	31 (18.7)	135 (81.3)	2.655, 0.103
	Married	57 (25.7)	165 (74.3)	
Family size	**<5**	47 (21.1)	176 (78.9)	0.770, 0.380
	≥5	41 (24.8)	124 (75.2)	
Monthly income	**≤1000**	58 (21.3)	214 (78.7)	0 .955, 0.328
	>1000	30 (25.9)	86 (74.1)	
Total		88 (22.7)	300 (77.3)	

The highest prevalence of *S. mansoni* infection was recorded among fishermen in Lijomi 10 (32.3%) followed by Dek 17 (32.0%) *kebeles*. However, the lowest prevalence of *S. mansoni* infection was obtained among fishermen in Mirafe Mariam 4 (16.7%) and Chicha 3 (12.5%) *kebeles* (Table 7).

Table 7: Prevalence of *S. mansoni* among fishermen across study sites bordering the Lake Tana, Northwest Ethiopia, 2021

Data collection site		**Total examined**	***S. mansoni* [n (%)]**		**χ^2, *P- value***
			Positive	**Negative**	
Bahir Dar Zuria district *kebeles*	**Chicha**	24	3 (12.5)	21 (87.5)	7.262, 0.700
	Debranta	39	9 (23.0)	30 (77.0)	
	Dek	53	17 (32.0)	36 (68.0)	
	Lijomi	31	10 (32.3)	21 (67.7)	
	Weramit	55	10 (18.2)	45 (81.8)	
	Wonjeta	28	7 (25.0)	21 (75.0)	
	Robit	31	6 (19.3)	25 (80.7)	
	Sekelet	24	5 (20.8)	19 (79.2)	
Dera district *kebeles*	**Tana Dnbiso**	48	10 (20.8)	38 (79.2)	
	Mirafe Mariam	24	4 (16.7)	20 (83.3)	
	Qorata	31	7 (22.6)	24 (77.4)	
Total		388	88 (22.7)	300 (77.3)	

4.4. Infection Intensity of STHs and *S. mansoni* among Fishermen

The prevalence of STHs and *S. mansoni* among fishermen using KK technique was 56 (14.4%) and 46 (11.9%), respectively. Among *S. mansoni* positives, the majority 23 (50.0%) had light infection intensity followed by 16 (34.8%) moderate and 7 (15.2%) high infection intensity with a mean egg per gram of 171.91. The mean infection intensity of *A. lumbricoides*, hookworm species and *T. trichiura* were 1352.15, 116.13 and 40 epg, respectively. *Ascaris lumbricoides* had 25 (89.3%) light and 3 (10.7%) moderate infection intensities, but hookworm species and *T. trichiura* had only light infection intensity (Table 8).

Table 8: Infection intensity of STHs and *S. mansoni* among fishermen at Lake Tana, Northwest Ethiopia, 2021

Parasite species	**Infection intensity**			
	Mean EPG	**Light [n (%)]**	**Moderate [n (%)]**	**High [n (%)]**
S. mansoni	171.91	23 (50.0)	16 (34.8)	7 (15.2)
A. lumbricoides	1352.15	25 (89.3)	3 (10.7)	0
Hookworm spp	116.13	31 (100)	0	0
T. trichiura	40	4 (100)	0	0

4.5. Factors Associated with Intestinal Parasites among Fishermen

In the univariate logistic regression, primary and illiterate educational status, absence of hand washing before meal and absence of latrine availability had *P*-value <*0.2* (Table 9).

In the multivariate logistic regression, the odds of intestinal parasitic infection among fishermen who were primary school were 2.02 folds (AOR= 2.02; 95% CI: 1.16-3.55) higher than from those who were high school and above. The odds of intestinal parasitic infection among fishermen who were illiterates were 2.54 times (AOR= 2.54; 95% CI: 1.35-4.77) higher than who were college and above. Intestinal parasitic infection increased by 2.23 times (AOR=2.23; 95% CI: 1.25-3.96) in those who didn’t washed hands before meal than who washed their hands before meal (Table 9).

Table 9: Univariate and multivariate analysis of factors associated with intestinal parasites among fishermen at Lake Tana, Northwest Ethiopia, 2021

Associated factors		IP infection		COR (95% C.I.)	*P-value*	AOR (95% C.I.)	*P-value*
		Pos.	Neg.				
Age group	**<18**	5	6	1.12 (0.31-4.08)	0.861		
	18-40	133	183	0.98 (0.56-1.70)	0.938		
	≥41	26	35	1			
Residence	**Urban**	32	50	1			
	Rural	32	174	1.19 (0.72-1.95)	0.503		
Educational status	**Illiterate**	57	50	3.17 (1.73-5.83)	0.000	2.54 (1.35-4.77)	0.004
	Primary	84	110	2.13 (1.22-3.70)	0.008	2.02 (1.16-3.55)	0.014
	High school &above	23	64	1		1	
Marital status	**Single**	65	101	1			
	Married	99	123	1.25 (0.83-1.88)	0.283		
Family size	**<5**	92	131	1			
	≥5	72	93	1.10 (0.73-1.66)	0.639		
Monthly income	**≤1000 birr**	116	156	1.05 (0.68-1.64)	0.817		
	>1000 birr	48	68	1			
Latrine available	**Yes**	127	190	1		1	
	No	37	34	1.55 (0.92-2.59)	0.099	1.35 (0.78-2.34)	0.224
Latrine utilization	**Yes**	104	147	1			
	No	23	43	0.72 (0.41-1.26)	0.243		
Hand washing after toilet	**Yes**	91	130	1			
	No	13	17	1.09 (0.51-2.36)	0.822		
Water source for drinking	**Tap**	40	62	1			
	Untreated	124	162	1.19 (0.75-1.89)	0.468		
Hand washing before meal	**Yes**	125	200	1		1	
	No	39	24	2.60 (1.49-4.53)	0.001	2.23 (1.25-3.96)	0.007
Wash vegetables before eating	**Yes**	71	96	1			
	No	93	128	0.98 (0.65-1.48)	0.932		

4.6. Factors Associated with *S. mansoni* among Fishermen

In the univariate logistic regression, rural dwellers, being illiterate, bargee fishing instrument users, fishing ≥4 days per week, wash clothes in Lake Tana, bathing in Lake Tana, swimming habit in Lake Tana and participate in irrigation activities had *P*-value <*0*.2 (Table 10).

In the multivariate regression, the odds of *S. mansoni* infection among illiterate fishermen were 2.37 folds (AOR=2.37; 95%CI: 1.13-4.95) higher than those who were high school and above. Fishing by bargee increases the odds of *S. mansoni* infection 2.08 folds (AOR=2.43; 95% CI: 1.30-4.53) higher than fishing by boat. The odds of *S. mansoni* infection among fishermen who catch fish ≥4 days per week were 2.27 times (AOR=2.27; 95%CI: 1.09-4.75) higher than those who catch fish 2-3 days per week. The odds of *S. mansoni* infection among fishermen who had swimming habit in Lake Tana were 3.03 folds (AOR=3.03; 95%CI: 1.11-8.25) higher than who didn't swim. The odds of *S. mansoni* infection among fishermen who participated in irrigation were 3.09 times (AOR=3.09; 95% CI: 1.80-5.31) higher than those who didn't participate in irrigation (Table 10).

Table 10: Univariate and multivariate analysis of factors associated with *S. mansoni* infection among fishermen at Lake Tana, Northwest Ethiopia, 2021

Associated factors		***S. mansoni***		**COR (95% C.I.)**	***P-value***	**AOR (95% C.I.)**	***P-value***
		Pos.	**Neg.**				
Residence	**Urban**	13	69	1		1	
	Rural	75	231	1.72 (0.90-3.90)	0.099	0.77 (0.37-1.61)	0.492
Educational status	**Illiterate**	34	73	2.24 (1.12-4.45)	0.022	2.37 (1.13-4.95)	0.022
	Primary	39	155	1.21 (0.63-2.33)	0.574	1.42 (0.70-2.86)	0.329
	High school & above	15	72	1		1	
Fishing frequency per week	**<4 days**	11	74	1		1	
	≥4 days	77	226	2.29 (1.16-4.54)	0.017	2.27 (1.09-4.75)	0.029
Fishing instrument	**Boat**	19	114			1	
	Bargee	69	186	2.23 (1.27-3.89)	0.005	2.43 (1.30-4.53)	0.005
Swimming habit	**No**	5	47	1		1	
	Yes	83	253	3.08 (1.19-8.01)	0.021	3.03 (1.11-8.25)	0.030
Swimming frequency	**Sometimes**	53	70	1			
	Always	30	83	1.14 (0.68-1.93)	0.619		
Wash clothes in Lake Tana	**No**	2	9	1		1	
	Yes	86	281	2.92 (0.66-12.73)	0.157	1.87 (0.38-9.14)	0.439
Bathing in Lake Tana	**No**	2	18	1		1	
	Yes	2	282	2.75 (0.62-12.06)	0.181	1.97 (0.28-13.89)	0.495
Work in irrigation	**No**	26	184	1		1	
	Yes	62	116	3.78 (2.26-6.32)	<0.001	3.09 (1.80-5.31)	<0.001
Distance from border	≥1km	53	161	1			
	<1km	10	36	0.84 (0.39-1.82)	0.664		

5. DISCUSSION

The overall prevalence of intestinal parasites among fishermen at Lake Tana was 42.3% [95% C.I: 37.33-47.37] in the present study. It is higher than a study finding from west Africa, Burkina Faso (4.1%) (Zongo *et al.*, 2008). However, it is also lower than previous reports (68.7%) in Jimma town (Mengistu, 2008), (51.3%) in Addiremets town (Gebreyohanns *et al.*, 2018) and (50.2%) Abaye Deneba (Nyantekyi *et al.*, 2014). The difference in prevalence report might be due to differences in age of study participants and sample size where 54.7% and 48% of Jimma and Abaye Deneba study participants were children. However, in our study only 14.7% of study participants were children. Children are more exposed to intestinal parasites than adults because they usually play on soil and eat food without washing their hands. Regarding to sample size; in the present study only 388 study participants were included, but 517 in Jimma and 491 in Abaye Deneba and 49 in Burkina Faso.

The prevalence of *E. histolytica/dispar* was 7.5% (95 % C.I: 5.14-10.67) which is higher than a study finding in Addiremets town (1.2%) (Gebreyohanns *et al.*, 2018). The prevalence of *G. lamblia* was 3.6% (95 % C.I: 2.16-5.97) which is higher than a study finding in Addiremets town (1.9%) (Gebreyohanns *et al.*, 2018). This might be due to differences in lab techniques in which they used direct microscopy but, in the present study we used STS technique which is more sensitive for detection of motile trophozoites of *E. histolytica/dispar* and *G. lamblia*.

In the present study, the prevalence of STHs was 31.4% (95 % C.I: 27.02-36.22) which is higher than a study report from Addiremets town (26.5%) (Gebreyohanns *et al.*, 2018) but, lower than reports from Bushulo village, southern Ethiopia (67.3%) (Terefe *et al.*, 2011). The difference might be due to the variation in hygiene and sanitation, habit of soil contact and shoes wearing. The prevalence of hookworm species was 19.6% (95 % C.I: 15.95-23.83) which is in agreement with a study report from Addiremets town (23.1%) (Gebreyohanns *et al.*, 2018). It is higher than a report from Hawassa (5.76%) (Menjetta *et al.*, 2019) and abaye Deneba (0.4%) (Nyantekyi *et al.*, 2014) but, lower than a report from Uganda along Lake Victoria, Mayuge district 43.3% (Tukahebwa *et al.*, 2013). The difference might be due to differences in number of stool samples examined in which we used only one random sample but reports from Uganda used three early morning stool specimens on consecutive days from each participant. The prevalence of *A. lumbricoides* was 11.9% (95 % C.I: 9.01-15.46) which is higher than study findings from abaye

Deneba 8.3% (Nyantekyi *et al.*, 2014) and Addiremets town (3.4%) (Gebreyohanns *et al.*, 2018) but lower than a report from Hawassa (40.74%) (Menjetta *et al.*, 2019). This difference might be due to variation in hygiene and sanitation of study participants and local prevalence.

The overall prevalence of *S. mansoni* in the present study was 22.7% [95% C.I: 18.67- 27.24] this result is comparable with a study findings in Addiremets town (26.3%) (Gebreyohanns *et al.*, 2018), Jimma (26.3%) (Mengistu, 2008) and Egypt in the Lake Manzala region (26.6%) (Taman *et al.*, 2014). It is higher than a reports obtained from Brazil (13.9%) (Melo *et al.*, 2019) and Burkina Faso (16.35%) (Zongo *et al.*, 2008). Our result is also lower than the prevalence reported from Hawassa (29.21%) (Menjetta *et al.*, 2019) and Abaye Deneba (41.3%) (Nyantekyi *et al.*, 2014), Tanzania (47.85%) (Mazigo *et al.*, 2014), Uganda Mayuge district (88.6%) (Tukahebwa *et al.*, 2013), Mukono district of Uganda (57.2%) (Sanya *et al.*, 2015). This might be due to the differences in laboratory techniques used. In the present study for instance, we used both Kato-Katz and STS techniques; however, studies in Brazil and Burkina Faso used only Kato-Katz technique. The other difference might be due to variations in parasite and snail distribution. The low prevalence of *S. mansoni* in the present study might also be due to fish catching place of fishermen. The majority fishermen catch fish from the center which is away from border of the Lake where infection of cercaria mainly takes place.

In the present study, the mean *S. mansoni* infection intensity was 171.91 eggs per gram of faeces. This result is higher than a previous study conducted in Hawassa where the mean egg per gram was 158.88 (Menjetta *et al.*, 2019). However, the current infection intensity is lower 218 epg in Addiremets town, Western Tigray (Gebreyohanns *et al.*, 2018), 236.2 epg in Uganda (Tukahebwa *et al.*, 2013), 183.21 epg in Tanzania (Mazigo *et al.*, 2014). This difference might be due to difference in the endemicity, mass drug administration, treatment seeking behavior and frequency of water contact.

In the present study, the mean egg per gram of *A. lumbricoides* among fishermen was 1352.15 which is comparable 1349.04 epg in Hawassa (Menjetta *et al.*, 2019), but lower than 5292 epg in Addiremets town (Gebreyohanns *et al.*, 2018). The difference might be due to the variation in mass drug administration, hygiene and sanitation and local prevalence. The mean egg per gram of hookworm species in the present study was 116.13 which is higher than Hawassa 99.36 epg (Menjetta *et al.*, 2019) and lower than Addiremets town 563 epg (Gebreyohanns *et al.*, 2018).

The mean infection intensity of *T. trichiura* was 40 epg which is lower than Hawassa 246.24 epg. This difference might be due to difference in treatment seeking behavior of study participants, mass drug administration, habit of soil contact and shoes wearing.

In this study, being illiterates (*P=0.004*) and primary school (*P=0.014*) was significantly associated with the prevalence of IPs infection among fishermen. This report is in agreement with a previous findings conducted in Nahavand, Western Iran (Kiani *et al.*, 2016). This might be due to a lack of awareness on the transmission of intestinal parasites and low personal hygiene. The odd of intestinal parasitosis among fishermen who didn't wash their hands before meal was higher than those who wash hands before meal. This finding is consistent with previous studies done in Chagni Town, Northwest Ethiopia (Alemu *et al.*, 2019) and Yebu town, Southwest Ethiopia (Tefera and Mebrie, 2014). This can be justified as hand washing before meal reduces intestinal parasite infection by preventing ingesting of the infective stage of the parasite.

In the present study *S. mansoni* infection among illiterate fishermen were higher than those who had high school and above educational status. This finding is supported by a previous study reports in Uganda which shows *S. mansoni* infection increased with declining education level (Ssetaala *et al.*, 2015). This might be due to a low level of knowledge or awareness on the transmission of *S. mansoni* among illiterates.

Fishing by bargee increases the odds of *S. mansoni* infection 2.08 folds higher than fishing by boat. This might be due to the possibility of contacting of the fishermen to water body when fishing by bargee which allow water to squeeze to inside part of the bargee. Fishing ≥4 days per week and swimming habit in Lake Tana were significantly associated with *S. mansoni* infection. This is similar to the previous findings reported from Hawassa, southern Ethiopia (Menjetta *et al.*, 2019). In the present study, the odds of *S. mansoni* infection among fishermen who participated in irrigation were 3.09 times (AOR=3.09; 95% CI: 1.80-5.31) higher than those who didn't participate in irrigation. This finding is consistent with a study done in Hintallo-Wejerat, North Ethiopia (Dejene, 2008). This is because manipulating the irrigation activity exposes to the cercarial stage of *S. mansoni* to penetrate the skin.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The prevalence of intestinal parasitic and *S. mansoni* infection was high among fishermen at Lake Tana and hookworm species was the most prevalent intestinal parasite identified. Most of the infections of *S. mansoni*, *A. lumbricoides*, *T. trichiura* and hookworm species were light. Being illiterate and primary educational status and absence of hand washing before meal were significantly associated with IPs infection among fishermen. Being illiterate, fishing by bargee, fishing ≥4 days per week, swimming and participate in irrigation activities were found to be predictors for *S. mansoni* infection among the fishermen.

6.2. Recommendations

Intervention measures like improving sanitation and personal hygiene through continuous health education should be given by health extension workers and district health office to reduce intestinal parasitic infection. Deworming of fishermen infected with *S. mansoni* should be done. Regular checking of fishermen to IPs infection and schistosomiasis should be done to break the transmission cycle. The Federal ministry of health should take the responsibility to undergo the deworming program the high risk segments of the population.

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8. ANNEXES

Annex I: English version of participant information sheet and consent

I. Participant information sheet

Bahir Dar University, College of medicine and Health Sciences, Department of Medical Laboratory Science, Bahir Dar, Ethiopia

Title of the Thesis: Prevalence of intestinal parasites and *S. mansoni* infections and their associated factors among fishermen at Lake Tana, Northwest Ethiopia

First of all I would like to thank you in advance for your cooperation and consent in participation in this study. Please read or listen when it is read for you about the general information of the study. If you have any question regarding the study please ask freely.

Background information

Background: Intestinal parasitic infections are major public health problems in developing countries where there is a habit of open defecation and eating raw meat, no provision of safe water for drinking and other purposes, fetching and washing clothes in the water bodies, irrigation system for agriculture and fishing increases the burden of the intestinal parasites and *S. mansoni* infection. It is estimated that about 3.5 billion people are infected by intestinal parasites worldwide. Schistosomiasis is a common helminthiasis affecting more than 250 million people globally. In Ethiopia, 37.3 million people are living in schistosomiasis endemic areas, comprising 3.4 million pre-school children, 12.3 million school-aged children, and 21.6 million adults.

Aim of the study: The purpose of this study is to assess the prevalence and risk factors of intestinal parasites and *S. mansoni* infections among fishermen at Lake Tana, Northwest Ethiopia.

Benefits for participants: Study participants did not have any financial incentives or other inducements from participating on this study. However, based on the diagnosis result you will be treated accordingly by linking to nearby health institution. Most importantly, the result of the study will be beneficial to design effective prevention and control measures for intestinal parasites.

Risks and complication

There are no anticipated risks to your participation. As routine laboratory procedure stool sample will be taken. There is no any discomfort you may feel during sample collection.

Confidentiality

There is no sensitive issue that you will be asked related with your social desirability but any information that is obtained in connection with this study and that can be identified with you will remain confidential. Participants will not be prohibited to stop or withdraw at any time from the study. Only interested participants will retrieve their own lab result using their code number. The information collected about you will be coded using numbers. No personal information will be disclosed to third party or will not appear in any report from this study.

Assurance of Principal Investigator:

I put my signature below to confirm you that I take over the responsibility for the scientific ethical and technical conduct of the research project and for provision of progress reports for all stakeholders of the research project.

Abebaw Fentahun (student of MSC in Medical Parasitology)

Signature: __________________ Date: __________________

Note: If you have any questions about this study, you should feel free to ask now or anytime throughout the study by contacting

Address: Bahir Dar University, College of medicine and Health Sciences, Department of Medical Laboratory Science, Bahir Dar, Ethiopia

E-mail: yosephpara@gmail.com Mobile:0931754905

II. Informed consent

I am doing this research to find out more about intestinal parasites and *S. mansoni* infections and the choice that you have to take part in it is up to you. I would still take good care of you no matter what you decide. You can ask me any questions that you have any time. If you decide to be in the research, you may need a stool cap so I could test some of your stool. I would ask you to read questions on a piece of paper. Then you would mark your answers on the paper. A person on the research team would ask you questions. Then you would say your answers out loud. You can say no to what I ask you to do for the research at any time and I will stop. This research did not have any incentive and you would not be paid. But, it helps you to check if you have been exposed by intestinal parasites. It is also ok to say yes and change your mind later. You can stop being in the research at any time. If you want to stop, please tell the data collectors. Take the time you need to make your choice. If you want to be in the research after I talk, please tell me without shame.

Annex II: Questionnaire in English version

Bahir Dar University College of Medicine and Health Sciences Department of Medical Laboratory Sciences

Thesis title: Prevalence of intestinal parasites and *S. mansoni* infections and their associated factors among fishermen at Lake Tana, Northwest Ethiopia

Questionnaire

The main aim of this thesis is for the partial fulfillment of master of degree sciences in medical Parasitology and vector control. So you are kindly requested to give your response. Your concise and clear responses would facilitate smooth data analysis. All information provided will be treated as confidential.

Data collection site ________________________ Date________________

Name of data collector _______________________Signature_____________

Participant's Code (questionnaire code) ________

Questionnaire in English version

No	**Part I: Socio-demographic information**	**Responses of the client**
1	Age (in years)	
2	Sex	M F
3	Residence	Urban Rural
4	Religion	Orthodox Muslim Protestant other
5	Educational status	illiterate, primary, Junior, high school, college and above
6	Marital status	Married unmarried divorce widowed
7	Monthly income (in Birr)	<500 500-1000 >1000
8	Family size	
Part II: Environmental factors		
1	Do you have latrine?	Yes No
2	If yes in Q1, do you properly utilize the latrine?	Yes No

3	Do you wear shoe?	Yes No
4	Frequency of wearing shoe	Always Sometimes Occasionally
5	Where do get water for drinking?	Tap water Lake Tana River Others
6	Where do engage in fishing?	Lake Tana River Abay Others
7	How often do you engage in fishing activity per week?	
8	Do you eat raw fish?	Yes No
9	What is your fishing instrument?	Boat Bargee
10	Do you swim in Lake Tana?	Yes No
11	If yes to Q 10, how often you swim?	Always Sometimes
12	Do you wash cloth in Lake Tana?	Yes No
13	Do you bath in Lake Tana?	Yes No
14	Do you participate in irrigation?	Yes No
15	Do you wash hands before meal?	Yes No
16	Do you wash hands after latrine?	Yes No
17	Do you work with bare foot?	Yes No
18	Do you wash vegetables before eating?	Yes No
19	The main soil type found in your living area?	Black Red clay Sandy
20	How much distance do you far from the border during fishing?	Mostly not far ________k.m.

Annex III: Amharic version of participant information sheet and consent

1. የተሳታፊዎች መረጃ ቅፅ

ባህርዳር ዩኒቨርሲቲ የህክምናና ጤና ሳይንስ ኮሌጅ የህክምና ላቦራቶሪ ሳይንስ ት/ት ክፍል

አርዕስት፡- በጣና ሓይቅ አሳ አስጋሪዎች ላይ የሆድ ዉስጥ ጥገኛ ትላትልና የብልሃርዚያ በሽታ አምጭ ተዉሳክ ስርጭትና የበሽታው አጋላጭ ሁኔታዎች

አጠቃላይመረጃ፡- ጥናቱ በመሳተፍዎ ከልብ እያመሰገንኩ ከመወሰንዎ በፊት ይህን ቅፅ በትክክል ያንብቡ ወይም ሲነበብልዎ በትክክል ያዳምጡ ፤እንዲሁም ግልጽ ያልሆነልዎትን ነገር በሙሉ በነፃነት ይጠይቁ

ስለጥናቱ መረጃ፡- የሆድ ዉስጥ ጥገኛ ትላትል በታዳጊ ሀገራት ከፍተኛ የህብረተሰብ ጤና ችግሮች ናቸዉ። ሜዳ ላይ መጸዳዳት፣ንጹህ ዉሃ አለመኖር፣ ከተበከለ ዉሃ መቅዳትና ልብስ ማጠብ፣ ጥሬ ስጋ መመገብ፣ አትክልትና ፍራፍሬ ሳያጥቡ መመገብ ለበሽታዉ የሚያጋልጡ ነገሮች ናቸዉ። በአለም ዉስጥ 3.5 ቢሊዮን ህዝብ በበሽታዉ ተጠቅተል። የብልሃርዚያ በሽታ በአለም አቀፍ ደረጃ ከ250 ሚሊዮን በላይ ህዝቦችን እያጠቃ ያለ የትላትል በሽታ ነው። በሃገራችን ኢትዮጵያም 37.3 ሚሊዮን ህዝብ የበሽታው ተጋላጭ ሲሆን ከእነዚህ ዉስጥ 3.4 ሚሊዮኖቹ ጨቅላ ህጻናት፣ 12.3 ሚሊዮኖቹ ደግሞ ለትምህርት የደረሱ እና 21 ሚሊዮኖቹ ወጣቶች ናቸው።

የጥናቱ አላማ፡- በጣና ሓይቅ አሳ አስጋሪዎች ላይ የሆድ ዉስጥ ጥገኛ ትላትልና የብልሃርዚያ በሽታ አምጭ ተዉሳክ ስርጭትና የበሽታውን አጋላጭ ሁኔታዎችን ስለማጥናት

ጥናቱ ለተሳታፊዎች ያለው ጥቅም፡- በጥናቱ የሚሳተፉ ተሳታፊዎች ምንም አይነት የገንዘብ ክፍያ የለም፣ነገር ግን በምርመራው ውጤት መሰረት ወደ ሚቀርብዎ ጤና ተቋም በመላክ ይታከማሉ። በተጨማሪም የጥናቱ ውጤት በጣና ሓይቅ አሳ አስጋሪዎች ና ሌሎች ሰዎች ላይ ሚከሰተውን የጥገኛ ትላትል በሽታን ለመቆጣጠር ና ለመከላከል ስለሚጠቅም በተዘዋዋሪ መንገድ ህብረተሰቡን ይጠቀማል።

በጥናቱ ተሳታፊዎች ላይ ያለው ጉዳትና ተዛማጅ ችግር: በዚህ ጥናት በመሳተፍ ሊደርስብዎ የሚችል አንድም ጉዳት አይኖርም:: ለዚህ ጥናት የሚያገለግል የሰገራ ናሙና የሚወሰድ ሲሆን ምንም አይነት የህመም ስሜት ና በጤናዎ ላይ ምንም ጉዳት አያደርስም።

የመረጃ ሚስጥራዊ አጠባበቅ: መረጃ በሚሰጡበት ወቅትም ሆነ ከዛ በኋላ ባሉት ጊዜያት ሙሉ በሙሉ ሚስጥራዊነቱ የሚጠበቅ ና መረጃውም የሚያዘው በስም ሳይሆን በመለያ ቁጥር ይሆናል።በጥናቱ ላይ እያሉ በፈለጉት ጊዜ የማቆም ወይም የማቋረጥ መብት አለዎት። የላቦራቶሪ ውጤትዎን ማወቅ ከፈለጉ የመለያ ቁጥርዎን በመጠቀም በሚሰጥዎ የቀጠሮ ጊዜ መውሰድ ይችላሉ።

ጥናቱን የሚያካሂደው ሰው ማረጋገጫ: ለዚህ ጥናት ሃላፊነቱን ለመውሰድና ማንኛውንም ጥናቱ የሚመለከቱ ጉዳይ ክትትል ለማድረግ ና ለሚመለከተው አካል መግለጫ ለመስጠት በፊርማዬ አረጋግጣለሁ።

ስም፡ አበባዉ ፈንታሁን (በባህርዳር ዩኒቨርሲቲ ፣ ህክምና ና ጤና ሳይንስ ኮሌጅ፣የሜዲካል ፓራሳይቶልጂ ማስተርስ ተማሪ)

ፊርማ ------------------------------ ቀን --------------------------

ማንኛውንም ጥያቄ መጠየቅ የሚሹ የሚቀጥለውን አድራሻዬን መጠቀም ይችላሉ።

ኢሜል: yosephpara@gmail.com ተንቀሳቃሽ ስልክ: 0931754905

2. **የፍቃደኝነት መጠየቂያ**

ይህ ጥናት በጣና ሀይቅ የሚሰሩ አሳ አስጋሪዎች ላይ የሆድ ዉስጥ ጥገኛ ትላትልና የብልሃርዚያ በሽታ አምጭ ተዉሳክ ስርጭትና የበሽታውን አጋላጭ ሁኔታዎችን ስለማጥናት ሲሆን መሳተፍ ከፈለጉ ምርጫው በርስዎ የሚወሰን ነው።ምንም አይነት ውሳኔ ቢዎስኑ ከዚህ በፊት የሚደረግልዎ እንክብካቤ አይቀንስም።በማንኛውም ሰአት ማንኛውንም ጥያቄ መጠየቅ ይችላሉ።በጥናቱ ለመሳተፍ ከወሰኑ ለምርመራ ጥቂት የሰገራ ናሙና ይወሰዳል።ወረቀቱ ላይ ለሰፈሩት ጥያቄዎች አንብበው ተገቢውን ምላሽ ወረቀቱ ላይ ይሙሉ።በጥናት ቡድን አባል ለሚጠይቁዎ ድምፅዎትን ከፍ አድርገው መልስ ይስጡ። በማንኛውም ሰአት በጥናቱ አልሳተፍም የማለት መብት አለዎት። በዚህ ጥናት ምንም አይነት የገንዘብ ክፍያ አያገኙም ።ሆኖም ግን በዚህ ጥናት የሆድ ትላትሎችን ምርመራ ያደርጋሉ።በማንኛውም ሰአት ጥናቱን ማቆም ይችላሉ።ምርጫዎትን ለማሳወቅ ጊዜ ወስደው ያስቡበት። ወደ ጥናቱ መመለስ ከፈለጉ ያለምንም መሳቀቅ ይንገሩን።

Annex IV: Questionnaire in Amharic version

ባህርዳር ዩኒቨርሲቲ የህክምናና ጤና ሳይንስ ኮሌጅ የሕክምና ላቦራቶሪ ት/ት ክፍል

የጥናቱ ርዕስ፡ በጣና ሓይቅ አሳ አስጋሪዎች ላይ የሆድ ዉስጥ ጥገኛ ትላትልና የብልሃርዚያ በሽታ አምጭ ተዉሳክ ስርጭትና የበሽታው አጋላጭ ሁኔታዎች

እባክዎን ለጥናቱ መሳካት ያግዘን ዘንድ ጥያቄዎችን በጥንቃቄ እንዲመልሱልን በትህትና እንጠይቃለን።

ሁሉም የሚሰጧቸዉ መረጃዎች ሚስጥራዊነት የተጠበቀ ነዉ።

የጥናቱ ተሳታፊ መለያ ቁጥር ________________ መረጃ የተሰበሰበበት ቦታ________________________

ቀን ______________መረጃ የሰበሰበዉ ባለሙያ ስም ________________ፊርማ

ቁጥር	**ማህበራዊ-ስነህዝብ መረጃ**	**የደንበኛዉ ምላሽ**
1	ዕድሜ	
2	ጾታ	ወንድ ሴት
3	የመኖሪያ ቦታ	ከተማ ገጠር
4	ሀይማኖት	ኦርቶዶክስ ሙስሊም ፕሮቴስታንት ሌላ
5	የትምህርት ደረጃ	ያልተማረ 1-4ኛ 5-8ኛ 2ኛ ደረጃ ኮሌጅና በላይ
6	የጋብቻ ሁኔታ	ያገባ ያላገባ የፈታ ባለቤት የሞተበት
7	ወርሀዊ ገቢ (በብር)	ከ500 በታች 500-1000 ከ1000 በላይ
8	የቤተሰብ ብዛት	
	አካባቢያዊ ምክንያቶች	
1	ሽንት ቤት አለዎት?	አዎ የለም
2	ተራ ቁ. 1 ላይ አዎ ካሉ በአግባቡ ይጠቀማሉ?	አዎ የለም
3	ጫማ ይለብሳሉ?	አዎ የለም
4	ተራ ቁ. 3 ላይ አዎ ካሉ መቼ መቼ?	ሁልጊዜ አልፎ አልፎ አንዳንዴ

5	የመጠጥ ዉሃ ከየት ይጠቀማሉ?	ቧንቧ ጣና ሓይቅ ሌላ
6	አሳ የት የት ነዉ የሚያሰግሩ?	ጣና ሓይቅ አባይ ወንዝ ሌላ
7	በሳምንት ስንት ቀን ያሰግራሉ?	
8	ጥሬ አሳ ይመገባሉ?	አዎ የለም
9	አሳ በምን ነዉ የሚያሰግሩ?	በጀልባ በታንኳ
10	በሀይቁ ላይ ይዋኛሉ?	አዎ የለም
11	ተራ ቁ. 10 ላይ አዎ ካሉ መቼ መቼ?	በአብዛኛዉ አልፎ አልፎ
12	ልብስዎን ጣና ሓይቅ ላይ ያጥባሉ?	አዎ የለም
13	ጣና ሓይቅ ላይ ይታጠባሉ?	አዎ የለም
14	የመስኖ ስራ ይሰራሉ?	አዎ የለም
15	ከምግብ በፊት እጅዎን ይታጠባሉ?	አዎ የለም
16	ከሽንት ቤት መልስ እጅዎን ይታጠባሉ?	አዎ የለም
17	በባዶ እግርዎ ስራ ይሰራሉ?	አዎ የለም
18	አትክልቶችንና ፍራፍሬዎችን ከመመገብዎ በፊት ያጥባሉ?	አዎ የለም
19	በሚኖሩበት አካባቢ በብዛት ያለ ምን አይነት አፈር ነዉ?	ጥቁር ቀይ ሸክላማ አሸዋማ
20	አሳ ሲያሰግሩ ከሀይቁ ዳርቻ ምን ያህል ይርቃሉ?	በአብዛኛዉ አልርቅም __________ኪ.ሜ.

Annex V: Stool collection and examination procedures

Stool collection

A clean, dry, leak-proof and tightly screwed stool cup was given to each study participants. Instruction was given by data collectors how to collect stool sample and the benefit of a good sample for a good result. Stool sample collection instructions are as follows:-

1. Unscrew the lid from the specimen container

2. Collect the sample. Do not collect stool that has been mixed with water or urine

3. Using the plastic spoon attached to the lid transfer enough of the selected stool to the specimen container to the level of a "fill to here" line marked by marker

4. Screw the lid back on the container. Make sure it is closed tightly

Procedure for Kato-Katz technique

1. Put a small amount of stool sample on a clean newspaper and press it through a sieve to remove large particles

2. Transfer the sieved stool to the template which was put on a slide until the template hole (about 41.7 mg) is filled

3. Then, remove the template and cover the stool sample with cellophane (previously immersed with glycerol-malachite green for 24 hrs) and press with a new slide

4. The glycerol clears the faecal debris, enabling the ova to be seen. Examine Kato thick smears within 30 minutes for hookworm and after one hour up to 24 hours for other intestinal parasites.

5. For STHs and *S. mansoni* positive samples estimate the infection intensity based on the eggs per gram of stool. The number of eggs counted and multiplied by 24 to calculate intensity in epg.

Procedure for spontaneous tube sedimentation technique

1. Mix approximately 3 g of feces with 10ml of normal saline solution until homogenized (30–60 s)

2. Pour the homogenate into a conical tube using a filter (surgical gauze) at the top of the tube

3. Discard gauze and fill out tube with normal saline solution; close cap tightly

4. Shake for 30 s and leave the tube in the vertical position for 45 min and then, discard the supernatant

5. Take a sample using a plastic pipette from the bottom and put on a microscope slide and seen for the ova of intestinal parasites by a microscope