COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF PUBLIC HEALTH

MAGNITUDE AND ASSOCIATED FACTORS OF INTESTINAL PARASITE INFECTION AMONG PREGNANT WOMEN AT SHEWAROBIT HEALTH FACILITIES, NORTH SHOA, AMHARA REGION, ETHIOPIA, 2020

BY:

MAMUSH SAHLIE

A THESIS REPORT SUBMITTED TO DEBRE BERHAN UNIVERSITY, COLLEGE OF HEALTH SCIENCE, DEPARTMENT OF PUBLIC HEALTH, IN PARTIAL FULFILLMENT FOR THE REQUIREMENT FOR MPH IN EPIDEMIOLOGY

DEBRE BERHAN, ETHIOPIA

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DECLARATION

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ACRONYM

ANC	Antenatal Care
CDC	Centers for Disease Control and Prevention
DALYs	Disability-Adjusted Life-Years
IPIs	Intestinal Parasite Infections
NPIs	Neglected Parasitic Infections
NTDs	Neglected Tropical Diseases
PC	Preventive Chemotherapy
SDGP	Sustainable Developmental Goal Program
STH	Soil-Transmitted Helminths
UNICEF	United Nations Children's Fund
VIF	Variance Inflation Factor
WASH	Water, Sanitation and hygiene
WHO	World Health organization
WRA	Women and Reproductive Age
YLDs	Years Life of Disabilities

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ABSTRACT

Introduction: intestinal parasites are the most abundant and common infectious microorganism in developing countries. Globally, it remains the public health problem by affecting 3.2 billion people from which 10% were pregnant women. In Sub Saharan Africa, pregnant women are the most risky group next to children for this infection.

Objective: To assess magnitude and factors associated with intestinal parasite infection among pregnant women in Shewarobit health facilities, North Shoa Zone, Amhara Region.

Method: Facility-based cross-sectional study was conducted in health facilities at Shewarobit. Using a systematic sampling technique 356 pregnant women were selected and the first pregnant women was selected using lottery method. Data was collected by interview and laboratory microscopic stool examination. Data entry was carried out by Epidata and analyzed by using SPSS version 23.0. Binary and multiple logistic regression were performed. All variables with p-value <0.20 on bivariate analysis were taken to multivariate analysis. AOR was calculated and P-value less than 0.05 taken as statistically significant.

Result: Total 347 pregnant women participated in this study with a mean age of 27.5 years old. The magnitude of total parasite (Protozoa and helminths) infection was 27.7% (95% CI: 23.1, 32.6). From protozoan; G.lmblia and from helminths; S.mansoni were the most identified parasites with magnitude of 44.8% and 31.3% respectively. Unimproved water source (AOR: 5.12, 95% CI: 1.24, 21.4) and dumping solid waste on an open field (AOR: 5.13, 95% CI: 1.38, 19.10), using toilet water for other purpose (AOR: 3.69, 95% CI: 1.18, 11.59), practice of hand washing after toilet (AOR: 3.90, 95% CI: 1.38, 10.89) and status of health education about intestinal parasites (AOR: 6.12, 95% CI: 2.34, 12.20) were significantly associated with intestinal parasites infection.

Conclusion and recommendation: The magnitude parasitic infection is high (World Health Organization cut off point) and associated with environmental factors, personal hygiene practice health-related factors. Therefore, the environment and sanitation program and health education should be strengthened as well as early screening and deworming of pregnant is needed to prevent and control intestinal parasites infection.

Key words: Pregnant women, Intestinal parasites infection, Shewarobit, Ethiopia

1. INTRODUCTION

1.1. Background

An intestinal parasite infection is a condition in which a parasite infects the gastrointestinal tract of humans and other animals. These parasites may live in different part of the body, but mostly it prefers and affects the intestinal wall (1). These parasites have different mechanisms of infection and their signs and symptoms depend on the infection type. Most of the manifestations include inflammation of the small and/or large intestine, diarrhea/dysentery, abdominal pains, and nausea/vomiting (2).

Intestinal Parasite infection includes both protozoan (pathogenic protozoa) and helminths (platyhelminths and nematodes) by which the worldwide common infections occurred (3) and may cause acute or chronic disease on human (4). After the parasites infected the human and entered to the intestine, some of them will develop and process their life cycle in the intestine and excreted with feces, and some of them will migrate to the lung and heart when they become larva stage (5).

A.lumbricoides, T.trichiura, Hookworms and schistosomes species are parasites grouped under Neglected Tropical Diseases (NTD) causing high burden, especially where there are endemic and susceptible population group (like pregnant women) were living (6). Those infections generally, negatively affect nutritional status, including decreased absorption of micronutrients, loss of appetite, weight loss, skin irritation around the anus, and intestinal blood loss that can often result in anemia for mothers, and physical and mental disabilities, delayed growth in the infant (2). They occur worldwide and constitute a considerable public health burden in countries with low socioeconomic conditions where the barriers between human feces, food and water are inadequate (7). Soil-Transmitted helminths and schistosomes combined affect more than 3 billion people worldwide and occur mainly in sub-Saharan Africa, the Americas, China and East Asia (8-10). Globally, it is estimated that 120 million pregnant women are suffering from intestinal helminths (11) and E.histolytica is also the major cause of death for pregnant (12).

In Africa, intestinal parasites have high load and distribution in different continent regions affecting especially children and pregnant (13). Prevalence of infection at any time-point may be high and high intensity of transmission reflects the long life span of parasites while hosts do not recover, do not produce an ample infection-clearing immune response, and exposed to repeated infection throughout their lives (14).

1.2. Statement of the problem

As Sustainable Developmental Goals of 2030, identifying intestinal parasites infection (IPIs), controlling the transmission and the mitigation of their possible risk factors are the means to decrease and eliminate Neglected Tropical Diseases (NTD) and intestinal enteric parasites (15).

As World Health Organization (WHO) reported in 2018, intestinal parasites infection remains the global health problem, which more affects the low-income countries with poor sanitation practice, and nowadays worldwide, the Soil Transmitted Helminths (STH) affects around 1.2 billion population (6). More than half million people are infected and more than 10,000 deaths occurred globally by intestinal protozoan (especially E.histolytica and G.lablia), which occurred in areas where sanitation and hygiene are poorly practiced (16). Even though everyone suffer the intestinal parasite infection, children and reproductive age women (pregnant and lactating), are among the vulnerable groups (6).

From different intestinal parasites infection, Hookworm infection is a leading cause of severe anemia in up to one-third of pregnant women in sub-Saharan Africa, resulting in an increased likelihood of premature births, babies with low birth weight and impaired lactation (17, 18). The global disease burden of neglected tropical diseases report showed as intestinal parasites have different health consequences. This includes; Anemia by Hookworm and E.histolytica; wasting and malnutrition by most intestinal parasites: bowel obstruction by A.lumbricoide. Globally the intestinal parasite STH causes around 4.98 million Years Life of Disabilities (YLDs) from which 65% are attributable to hookworm, 22% to A.lumbricoides and the remaining 13% to T. trichuiria (8). Among others, intestinal parasitic infection remains the largest problem in sub-Saharan Africa; by which pregnant women are from mainly affected groups (19).

Intestinal parasitosis has also an effect on the neonate's health and women's hemoglobin level. As the study conducted in Cairo SidiSelam Hospital showed neonates born from the women with intestinal parasitosis, have asphyxia (70.4% moderate and 29.6% severe Asphyxia), and mothers have also low hemoglobin level. And also, pregnant women who have the intestinal parasitosis were underweight (12.1%) and delivered under-weight neonates (25.8%) (20).

Some intestinal parasites have nature to cause bloody diarrhea and dysenteric stool. The pregnant women infected with intestinal parasites like E.histolytica (bloody stool) and G.lamblia (diarrhea) cause the secondary effects of fluid loss, mal-absorption and electrolyte imbalance, which may adversely affect the nutrition status of women and outcome of pregnancy (21).

As studies showed in Africa, intestinal parasites infection among pregnant women is highly distributed in a different parts of Africa with a prevalence of 23% in Ghana to 68% in Uganda (13). The study in Tanzania showed anemia increased by 29% for parasite-infected women and a preterm delivery increased by 79% than those who hadn't parasitic infection (22). Another study showed Pregnant women with intestinal parasites were five times at risk of anemia than those of non-infected pregnant women (23). Intestinal parasitosis is the result of commonalities in ecological and environmental requirements, infection routes, host exposures and susceptibility. The behavioral, sociological, and economic factors are also predictors that enable the co-occurrence of parasite and diminish host systems in time and space (14). As non-governmental organization (24) reported population who were living in Shewarobit and near to the big river, are using the river for hygiene (showering and clothes washing) that will expose them to different pathogenic organisms including parasites.

In Ethiopia, in spites of no nationwide survey performed to assess the pregnant women burden from intestinal parasites infection, some local researches showed that there is high prevalence of intestinal parasitosis, Facility-based studies showed the prevalence of 31.5% at Bahir Dar (25), 38.7% at Wondo Genet in Southern Ethiopia (26). The studies only on helminths infection showed a prevalence of 29.5% at Hossaena in Southern Ethiopia (27) and 24.9% at East Wollega (28).

In Ethiopia, 31.3 million adults are living in areas where STH is highly prevalent (29). Though different programs of Preventive Chemotherapy (PC) globally (30) and nationwide in Ethiopia (29) with an international organization (31) have been implemented to prevent and control the intestinal parasites, they have focused on preschool and school-age population. Even if pregnant women are the riskiest group for intestinal parasites infection (32) they were not included in the 2020 road map preventive chemotherapy program (33). EDHS 2016 report showed only 6% of pregnant women were dewormed (34). As a clinical experience, there is a high intestinal parasites infection report from the study area. In addition, screening pregnant women for intestinal parasites infection is low which showed less emphasis intervention program on intestinal parasites for pregnant. Studies were carried out in different area but still, there are some factors like health education and deworming status of pregnant were not yet well addressed. Thus, this study will provide the magnitude of pregnant women infected by intestinal parasite, and the relation of different factors (behavioral, environmental, socioeconomic and other health-related factors) that have a contribution to intestinal parasites infection on pregnant women.

1.3. Significance of the Study

Ethiopia is one of the country, which is endemic for intestinal parasitic infection with poor environmental sanitation, lacking drinking water source and poor hygiene practice. The report of intestinal parasite infection from the health facility in the study area is high and its magnitude on pregnant women is unknown. As clinical experience, there is no screening test for the intestinal parasite infection of pregnant women when they come to Antenatal Care (ANC) follow up and no deworming of pregnant women. Most studies about intestinal parasites focused on child and school age population. Even some studies performed on pregnant women, there is a paucity of information about the relation of deworming of pregnant women, intestinal parasites screening test, getting health education and finger trimming with intestinal parasites infection. Thus, this study aimed to show the magnitude of intestinal parasites infection in the study area and associated factors, which were not well addressed. Therefore, it is important to prepare evidence-based approaches for the preventive intervention of intestinal parasites. It will also be as baseline information for other researchers to conduct further studies on related health problem.

2. LITERATURE REVIEW

2.1 General Overview of Intestinal Parasites Infection

Intestinal parasites infection remains a major health problem worldwide, especially in low-income countries. At least one-third of the world's population is infected with intestinal parasites with a total estimation of 3.6 billion cases and causes 2.5 billion DALYs. From these different intestinal helminths infection; Ascariasis, Trichuriasis, Hookworm, and Schistosomiasis accounts for two billion cases (4, 35) and intestinal protozoan infection accounts more than half-million cases and greater than 100,000 deaths contributed to amebiasis and giardiasis (16). Approximately 250 million girls and adult women are living in areas that are endemic for soil-transmitted helminths. Globally the greatest numbers of intestinal parasites infection occur in Sub-Saharan Africa, the Americas, and Asia; from these most countries are found in tropical and subtropical countries including Ethiopia (6). In Ethiopia, there are 21.6 million, and 44.6 million people are living where schistosomes and soil-transmitted helminths are endemic respectively. The protozoan infection is also distributed nationwide (29).

2.2 Magnitude of Intestinal Parasites Infection

In 2015 worldwide, there is an estimation of 688 million Women and the Reproductive Age (WRA) population in 102 countries that are endemic for intestinal parasite infection. The pregnant women, who are living in the endemic area, are over 25 million. From the total intestinal parasitic infection, pregnant women covered 10% (36). Most intestinal parasitic diseases are included in neglected tropical diseases, like infection by Schistosomiasis species, roundworm, whipworm and hookworm (35). These all are endemic in places where the soil is warm and humid and where sanitation is inadequate especially in Sub Saharan region (35) and this transmitted mainly where water supply and sanitation is not optimal (37). From protozoan infection, Amebiasis (E.histolytica) is the third cause of death from parasitic infection, causing 40,000 to 100,000 deaths each year (38).

The study conducted in Columbia Bogota district among pregnant women who lived in selected poor residential areas showed the overall prevalence of intestinal parasitism was 41% and there 9% polyparasitism (multi-parasite infection) (39).

In Africa, different studies from different countries showed the magnitude of a range of 23% to 68%. (13). A community-based study in Northern Western Nigeria and in Vietnam on pregnant women reflected that protozoan infection; E.histolytica and G.lamblia were found the commonest and prevalent parasites (40, 41). A Similar study from Côte d'Ivoire, Abidjan, showed both intestinal protozoan and helminths infection have a prevalence of 54.1% with a parasitic load of 6.5 eggs/gram of stool and one parasites/1 microscopic field (19). Other cohort study conducted on pregnant women

at Coastal Kenya reflected the overall prevalence of the intestinal helminths infection accounted for 36.2% (42).

In Ethiopia, the estimation was 38.3 million people who are living in Schistosomiasis endemic areas. From those, 21.6 million are adults and there was an estimated of more half-million schistosomiasis cases (29). There is a high distribution of protozoa intestinal parasite and over 112.3 million people are living in soil-transmitted helminths and shcistomiasis endemic areas (43). Different studies showed that the prevalence of intestinal parasites infection in Ethiopia is above the WHO acceptable cut off point (20%) for deworming intervention (25, 27, 44, 45). G.lamplia on the study done in Bahir Dar Felegehiwot hospital (25), A.lumricoide and Hookworm on study done in Oromia region Lalo Kile (44) and in Amhara region Mecha district (46) were the predominant infective parasites for pregnant women.

2.3 Associated Factors of Intestinal Parasites Infection

There are different factors that contribute to the transmission of intestinal parasite infection. Poor sanitation, contaminated water irrigation and human behaviors are the major contributors for intestinal parasites infection and its transmission (6, 7). Water source and environmental sanitation are taken as major factors and intervention areas by the Sustainable Development Goals program (SDGP) (15). People in developing countries are at the highest risk due to drinking water from contaminated sources and because of decreased sanitation levels (6). The most common intestinal parasite infection factors or causes are categorized into socio-economic factors, personal hygiene practice factors, health-related and environmental factors (47).

2.3.1 Socio-demographic factors

The study in Turkey showed that the income, mothers' education status and living in shanty areas have a significant association with the intestinal parasite infection (48). Similarly, a hospital-based study in India showed that illiteracy is associated with the infection of intestinal parasites (49).

Northern Western Nigeria study reflected that intestinal parasite infection has a significant association with occupation and education level. The people who were farmers and laundry workers were more likely infected by intestinal parasites than population who work other than these two fields and the population who had not formal education and elementary school education werre more at risk than the population who had above elementary school education (40). Other study from Ethiopia Amhara regional state at Felegehiwot referral hospital indicated intestinal parasite infection had different factors. The illiterate populations were almost two times more likely infected than a population whose

educational level was at college or university. The infection also significantly associated with income status of the population. The odd of infection for low-income participants increased by 43% than those whose monthly income was above 1000 Ethiopian Birr. For residency, the odds increased by 14 % in those who lived in rural areas compared to those who lived in urban areas (25).

A study in Oromia region (44) and in Amhara region west Gojam (50) showed that being a farmer is significantly associated with intestinal parasites infection. An unpublished study conducted in Amhara region Borena district reflected that illiterate people were more at risk than literate ones (51). In contrast, the study conducted in Côte d'Ivoire showed that there is no relation of intestinal parasite infection with occupation and level of mothers' education (19).

Age is another socio-demographic character that has a contribution for intestinal parasites infection. As the study in Tanzania (22) showed pregnant women with age of less than 30 years old were more likely infected by intestinal parasites than those elder pregnant women. but in contrast studies in Kenya Kitale district, in Ethiopia, Hosaena (27) and East Wollega (28) reflected there is no relation between the age of pregnant women and intestinal parasites infection.

2.3.2 Personal hygiene factors of intestinal parasite infection

The other factors that contribute to intestinal parasite infection distribution are behavioral factors including hand washing before the meal, hand washing after toilet, eating unwashed and uncooked food, walking barefoot and open defecation practice.

Behavioral factors like personal hygiene practices and nail trimming of the individuals had much influence on the parasitic prevalence and rate of infection (52). Pregnant women who had not washed their hands after toilet were four times more likely infected than those who had washed their hands after toilet, and pregnant women who did not use toilet for defecation were two times more likely infected than those who used toilet (25). On the same study it was also found that as the soil contact was increased by one, the odds for intestinal parasitic infection were increased by 27 % (25).

The practice of hand washing has also the relation with intestinal parasite infection. On the study in Kenya at Kitale, the authors reported there is a high prevalence of intestinal parasites infection among pregnant women who hadn't practice of hand washing than those who washed their hands (53). Study at Borena Ethiopia showed not washing hands before the meal was associated with intestinal protozoan infection but an absence of toilet and drinking water source do not have association with the infection (51). Study in East Wellega, Mecha, Northen Ethiopia and Soth Wollo Ethiopia showed that eating not decontaminated fruits and vegetables or uncooked meal increase intestinal protozoan

infection than eating decontaminated fruit and vegetable (28, 46, 54, 55). Another personal behavior factor for intestinal parasites infection is practice of walking with barefoot. It exposes women for parasites that have transmission route of skin penetration like S.stericularis and Hookworm. The study conducted in Columbia Bogota (38) showed walking with barefoot did not have an association with intestinal parasite infection. Similarly, a study in Ethiopia Oromia region at East wollega (28) showed that walking with barefoot was not a factor for intestinal parasites infection. In contrast, studies conducted in Southern part Ethiopia at Hosaena (27) and Oromia region at Lalo Kitale (44) showed a significant association of walking with barefoot with intestinal parasites infection.

2.3.3 Environmental factors and health related factors

Environmental factors include waste disposal activities, toilet presence, solid and liquid waste disposal method and water source are factors indicated in different studies.

A study done in Kenya at Kitale district also reflected that pregnant women who hadn't latrine were more likely infected than those pregnant who had latrine (53). But a study conducted in Côte d'Ivoire showed that there is no relation of intestinal parasite infection with type of toilet present in the compound of the participant (19, 40). Similarly, the study conducted in Ethiopia, East Wellega indicated that the presence of latrine is not protective from intestinal parasite infection for pregnant women (28).

As the Water and Sanitation Health (WASH) showed the environmental factors relating to water sanitation and hygiene practice are the major factor for the transmission of intestinal parasites (56). Studies conducted in Bangladesh and in Turkey showed that source of water for drinking is significantly associated with intestinal parasite infections; the population who had untreated/unprotected water source were more likely infected than those who had protected water source (48, 52). Other studies in Tanzania and Benue state showed that drinking water source was the contributing factor for intestinal parasites infection (22, 57). Similarly, a study on wastewater in northern Vietnam: health risks and environmental impacts showed that using tap water for drinking was protective against any intestinal parasite infection (7). As the study done in Hosaena (27), in Gondar (58) and South Wollo Haik (unpublished) (54) showed using water from unimproved/unprotected water source had a significant association with intestinal parasites infection, that the infection among women who had used unimproved water was 8 folds and 4 folds respectively than those who were using improved/protected water source.

Unavailability of appropriate waste disposal or sanitary facility has a major role for the transmission of intestinal parasite. The study in Columbia indicated pregnant women who lived in poor residential areas were more infected than those who were living in a safe environment (39). Participants who did not dispose wastes properly were more likely at risk for intestinal parasite than those who did properly (53). Similarly, the studies in Aksum and Mecha district showed that the intestinal parasite infection is significantly associated with waste disposal methods (46, 59, 60). In addition, studies in Amhara region, West Gojam showed good environmental sanitation is protective from intestinal parasite infection (23) this is due to waste dumping area are the major sites for intestinal parasites infection and it facilitates the transmission of pathogenic parasites (61).

Another factor for increasing of intestinal parasites infection is deworming of pregnant women. The study conducted in Columbia Bogota district showed pregnant women who were dewormed within 1 year had the odd of infection two times than pregnant who took deworming before one year (39). A study in Anbasem Health center in Gondar also indicated the infection of intestinal parasites infection for women who didn't take an anti-helminths drug is almost three folds than those women who took the anti-helminths drug (62).

2.4 Conceptual Frame work

The conceptual framework below is built on existing evidence and shows the relation of intestinal parasites infection status (dependent variable) and different factors (independent variables). The factors for intestinal parasites infection reviewed from different literature categorized and summarized on the figure.

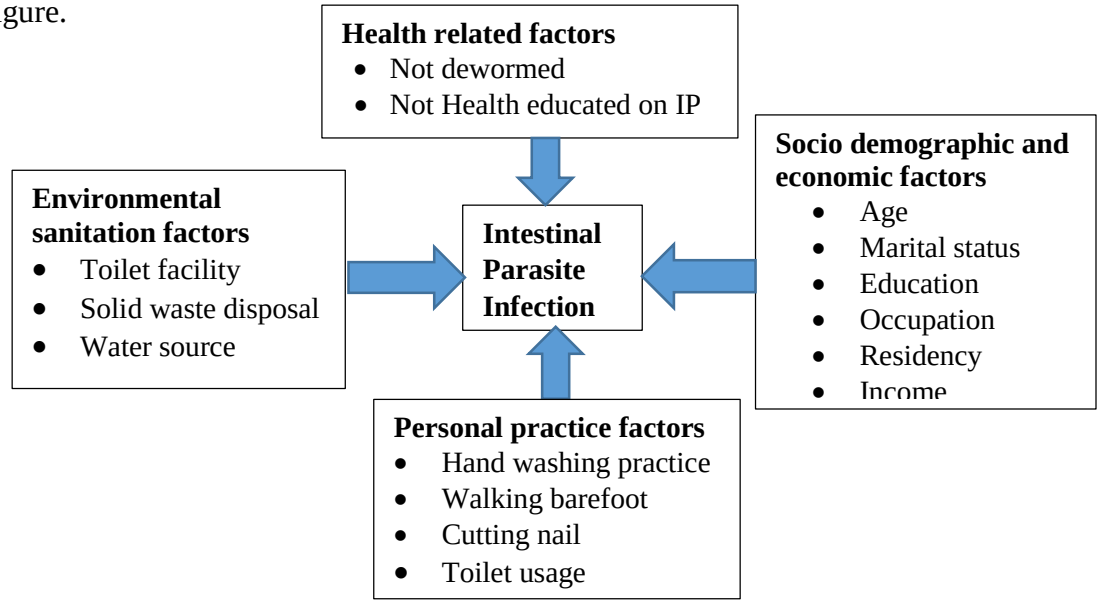

Figure 1: Conceptual framework of study among pregnant women attending ANC at Shewarobit health facilities, North Shoa, Amhara region, Ethiopia, 2020

3. OBJECTIVE OF THE STUDY

3.1. General objective

To assess the magnitude and factors associated with intestinal parasite infection among pregnant women at Shewarobit, North Shoa zone, Amhara region, Ethiopia, 2020.

3.2 Specific objectives

To determine the magnitude of intestinal parasite infection among pregnant women

To identify factors associated with intestinal parasite infection among pregnant women

4. METHODS AND MATERIALS

4.1 Study Area and Study Period

The study was conducted in Shewarobit district at three health facilities; Shewarobit health center, Shewarobit district hospital and Yifat private hospital. It is one of the administrative town from 24 districts in North Shoa zone of Amhara region. The district is located at 225 Km from Addis Ababa (national capital city) and 480 Km from Bahir Dar (the capital city of Amhara Region). It has total 58,199 populations from these 30,034 15-49 years old women population and 1962 pregnant women. The district has 1 governmental health center, 1 District hospital, 1 private general hospital, 3 private clinics and 7 private drug dispensaries. The health facilities serve for the community from the district and neighbouring districts. The study was conducted from February 1, 2020 to March 30, 2020.

4.2 Study Design

Institution-based cross-sectional study design was used.

4.3 Source Population

The source population was all pregnant women who came at the MCH unit to get ANC service at health facilities in Showarobit.

4.4 Study Population

The study population was all pregnant women attending ANC service in selected Health facilities in Shewarobit during the study period.

4.5 Study Unit

The study unit was selected pregnant woman.

4.6 Eligibility Criteria

Inclusion Criteria: all pregnant women who are attending ANC service in selected health facilities in Shewaronit during the study period, was included in the study.

Exclusion Criteria: Pregnant women who were unable to be interviewed and dewormed in the last 1 months were excluded from the study.

4.7 Sample size Determination

The sample size required for the study was calculated using the formula to estimate a single population proportion by considering the following assumptions:

$$N = \frac{(Z\alpha/2)^2 P(1-P)}{d^2} \quad \text{……Equation 1}$$

Where

- ✓ **Assumptions:** 95% Confidence level,

- ✓ **d=** desired precision (5% margin of error).
- ✓ $z\alpha/2$= critical value for normal distribution at 95% confidence level which equals to 1.96 (Z value at alpha=0.05),
- ✓ **n=** required sample size,
- ✓ **P=** Established prevalence intestinal parasites infection among pregnant women and based on the previous study prevalence (P=31.5%) (25), the sample size (N) is calculated as

$$N = \frac{(1.96)^2 * 0.315(1-0.315)}{0.05^2} = 332$$

For the second objective (associated factors), by taking significantly associated variables, the sample size is calculated by using Epi Info 7 STATCAL software, cross-sectional study calculation option as follows.

Table 1: Sample size calculation based on variables for the study among pregnant women at Shewarobit in North Shoa, from February 1 to March 30, 2020.

Variables	CI	Power	Ratio (Unexposed: Exposed)	Prevalence of IP on Exposed	Prevalence of IP on Unexposed	OR	Sample size
Barefoot	95	80	2.395	43(56.6)	33(18.8)	3.23	302
HE access	95	80	0.313	107(44.6)	31(41.3)	3.74	120
Latrine	95	80	3.96	30(40)	62(21)	4.62	207
Literacy	95	80	1.93	39(30.7)	53(21.6)	2.21	295

The calculated sample size is smaller than the prevalence based calculated sample size so that the largest one (prevalence based calculated sample size= 332) was taken.

Therefore, with a 10% non-response rate, the sample size for this study was 365 participants who were attending ANC service at selected health institutions during the study period.

4.8 Sampling Technique

Participants were taken from three health facility in Shewarobit, namely; Shewarobit Health Center, Shewarobit District Hospital and Yifat Private Hospital. A systematic random sampling technique was used to select pregnant women from all ANC service attendants during the study period. To allocate the sample size for each health facility proportionally, the last 6 months data was taken and the number of pregnant women who would get ANC service in the study period was calculated. Based on the last

6 months record, pregnant women who had gotten ANC service were 1223, 916 and 115 for Shewarobit health center, Shwarobit district hospital and Yifat private hospital respectively. The k^{th} value (calculated using total pregnant women in two months and total sample size) was 2.05 (≈2). The first participant was selected using the lottery method.

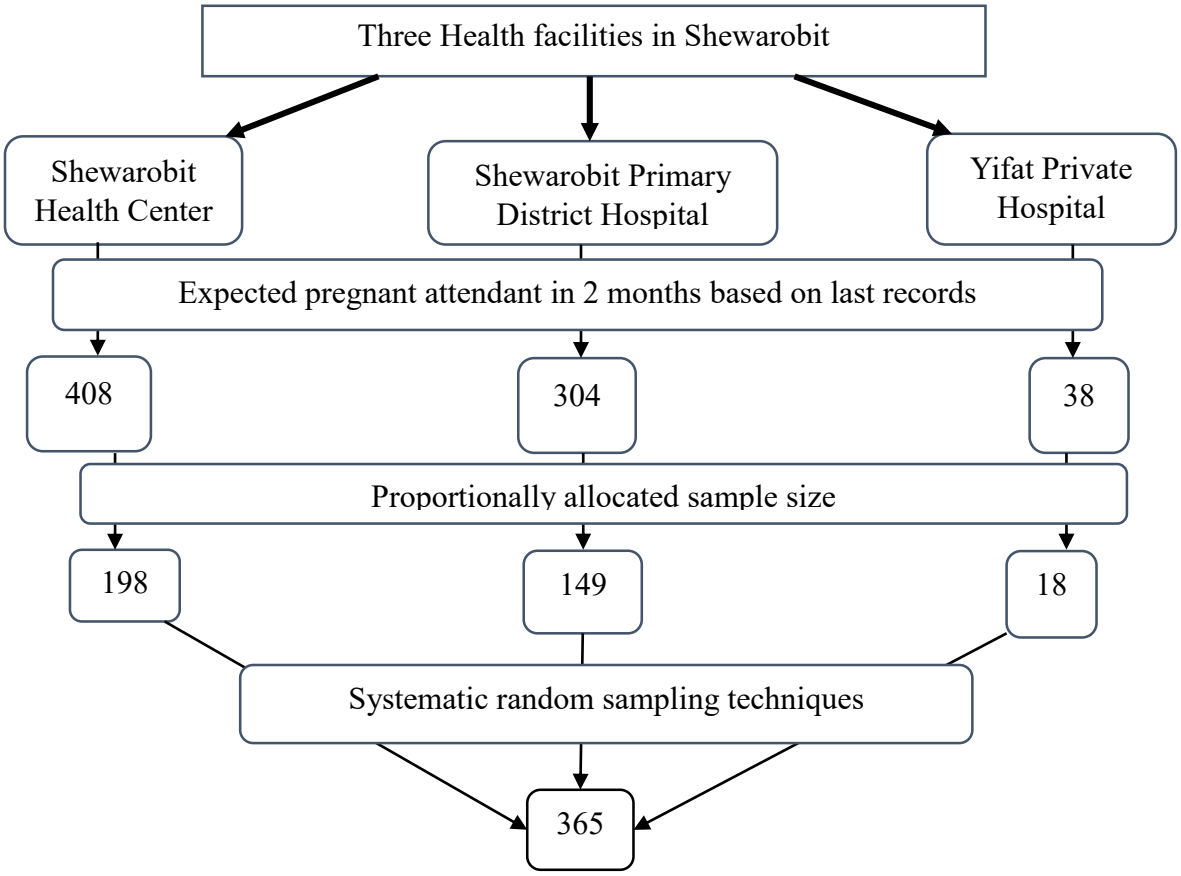

Figure 2: Sampling technique of study on pregnant women attending ANC at Shewarobit health facilities, North Shoa, Ethiopia, 2020.

4.9 Study Variables

Dependent Variable

Intestinal parasite infection status of pregnant

Independent Variables

Socio demographic and economic factors

Age, occupation, education status, marital status, monthly income, residency area.

Environmental and sanitation factors

Water source, toilet facility, solid waste disposal,

Personal hygiene practice factors

Latrine usage, hand-washing practice at a critical point, walking barefoot, practice of using anal cleaning water for other and eating uncooked meal or unwashed fruit/vegetable

Health related variables

Deworming, health education, screened for IP at the first visit

4.10 Operational Definitions

Acceptable (Short) distance water source: water found up to 1000meters distance from the house hold (63).

Critical time for hand washing: It includes washing hands before eating food and after visiting toilet (64).

Dewormed: Pregnant woman who has taken antihelminthic drug within the last one year for eliminating or ridding the helminths from her body.

Drainage: the channel constructed beside of the road for the purpose of removing/flowing of liquid.

Health educated: pregnant who got health education about personal hygiene practice and intestinal parasites infection by health extension worker or by the health care provider.

Improved water source: water source for the participant that, by nature of their construction or through active intervention, are protected from outside contamination, particularly fecal matter water (65).

Intestinal parasite negative status: is when the result of the pregnant woman stool examination showed no parasites on either wet mount or concentrated method.

Intestinal parasite positive status: is when a pregnant women stool examination either on wet a mount or concentrated method shows any parasite developmental stage; eggs/ova, cyst, trophozoite, larva or more than one of this diagnostic stage of intestinal parasites.

Intestinal parasites: A parasite lives in and takes its nourishment from the intestinal tract of pregnant women (66).

Mixed infections: when two or more parasites simultaneous present when a pregnant women stool specimen examined either by wet mount or concentration technique.

Non-improved water source: water source of a participant from unprotected spring, river, pond, stream, irrigation channels), (65).

4.11 Data Collection Tool

Interviewer administered questionnaires were applied to collect socio demographic characteristics, environmental condition, personal hygiene practice and health related characteristics of participants. Intestinal parasites infection was examined using laboratory stool wet mount microscopic examination and formol ether concentration technique.

Questionnaire

Questionnaire was adopted from CDC house hold and water safety survey, UNICEF WASH survey (67, 68) and previously done studies (22) and modified in the form that it has answered the study objectives. The questionnaire was prepared in English language and translated to Amharic by language expert profession for ease of data collection then translated back to English language for consistency of the data.

Stool specimen collection and processing

Stool was collected from each volunteer participants using clear plastic container with good instruction to bring good sample. A part of specimen was examined by saline wet mount for protozoan and helminths developmental stage detection. Lugo's Iodine stain was used to identify cyst of protozoa. Some part of specimen was preserved by 10% formalin for concentration process by formol ether sedimentation technique to detect missed parasites. The sediment of concentrated sample was examined for the detection of Cyst of protozoa and ova of helminths. The trained laboratory technicians had performed microscopic examination.

Rejection Criteria for Stool Specimen

Specimen rejection was for three specimens that was contaminated with other body fluid, with soil and others' fecal matter, collected from others, delayed above 30 minutes from defecation and is mismatch labeled. For all rejected specimens recollection was performed.

Saline Wet Mount Procedure

1. Using the plastic container with (with spoon), the participant was ordered to provide stool specimen from both central and external part of defecated stool. The participants were informed to keep the specimen from any soil or other body fluid contamination.
2. When they provided, it was checked whether it is their own or not and ID is given on the container.
3. By applicator stick, approximately 2mg of stool was taken on microscopic slide and normal saline dropped.

4. Using applicator stick, it is emulsified and cover slide is applied.
5. Scanning the field is done using 10x microscopic objective and observed systematically for the presence of any Cysts, trophozoite, larva and/or ova of parasite (for confirmation of some parasite stages 40X objective is used)
6. Finding was reported using the prepared form.

4.12 Data Quality Assurance

The quality assurance of the study was started at the very beginning of study instrument development. The data collection instrument was developed based on the literature review and discussed variables. The questionnaire was translated to Amharic language and back to English for its consistency. Before actual data collection, the data collectors were trained for this specific study to attain standardization, maximize interviewer reliability and minimize bias during collection. A pre-test study was conducted by administering the questionnaire to ANC attendants at the Ataye health center before going to the actual field. It was to test the clarity of the items in the questionnaire tools, the time needed to answer the questions and to identify any difficulties that may arise and need to be clarified before applying the questionnaire for actual data collection then some arrangements were done.

During data collection, close supervision was performed. Based on the challenges and errors detected during data collection, frequent communication was held to overcome it. The collected data was checked for completeness and correctness of the information before data entry and analysis. All the laboratory investigations were performed based on standard operating procedures (SOP). To get a quality specimen, the participants was appropriately instructed and provided specimen was crosschecked with participant based on specimen acceptance/rejection criteria. The specimen was processed as possible immediately after collection to decrease the errors. Before the examination of the sample, internal quality control was performed to assure the materials and reagents are well to proceed examination.

4.13 Data Processing and Analysis

Data was entered by using Epidata software version 3.1.1 and then transferred to SPSS version 23.0 for analysis. Missing data were managed by observing cross tabulation results and percentages. Logistic regression analysis was used to see an association between dependent and independent variables. Hosmer-Lemeshow test was used to check the model fitness and VIF test used to see the presence of multicolinearity. Variables with p-value less than 0.20 were analyzed by multiple logistic regression to control confounders and observe the significance association of independent variables with dependent variable. Adjusted odd ratios with 95% confidence interval were calculated and P-

value less than 0.05 were considered as statistically significant. Finally, data was displayed by tables, graphs and statements.

4.14 Ethical consideration

The protocol was approved by the Institutional Research Ethics review Board of Debre Berhan University, and ethical clearance letter was gotten. Before the commencing of data collection, permission was gotten from health institutions, and supportive letters are given to the ANC unit of the facilities. Prior to engaging the participant in the study, verbal consent was gotten from each participant. Throughout the study, the data was confidentially protected and anonymity of the study participants. Interview was conducted in the closed room, enclosed whenever possible to protect the study participants' privacy. In order to protect the study participants' identities, unique code was given to each participant. The pregnant women who were positive for intestinal parasites diagnosis and were on second and third trimester treated for the parasites but the participants who were on first trimester managed based on the health care provider decision.

4.15 Dissemination of result

The findings of this study will be presented to Debre berhan University, College of Medicine and Health Sciences Public Health Department, distributed to Shewarobit town health department, Health center facilities concerning bodies and to other organizations working on related area if they want. The findings may also be presented in different seminars, meetings and workshops.

5. RESULT

5.1 Socio demographic characteristics of participant

Totally, 347 pregnant women were participated in the study with a response rate of 98%. The mean age of participants was 25.7years old with a standard deviation of ±5.1. Majority of the study participants (61.4%) were Orthodox Tewahdo religion followers followed by 33.4% Islamic religion. About one-third of the participants live in an urban area and the majority of pregnant (90.2%) were married. Almost one-third (105/347) and two-fifth of participants were private workers and have primary school education, respectively. More than half (53.3%) of participants had a monthly income of less than 2480 ETB (Table2).

Table 2: Socio-demographic characteristics of pregnant women in Shewarobit Health facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N= 347).

Variables	Category	Frequency	Percent
Age	15-24	155	44.7
	25-34	168	48.4
	35-44	24	6.9
Marital Status	Single	21	6.1
	Married	302	87.0
	Others **	24	6.9
Religion	Muslim	116	33.4
	Orthodox	213	61.4
	Others*	18	5.2
Residence	Urban	232	66.9
	Rural	115	33.1
Education Status	Illiterate	51	14.7
	Read and write	34	9.8
	Primary school	149	42.9
	Secondary School	62	17.9
	Higher education	51	14.7
Occupation	Gov'tal employee	64	18.4
	Private worker	105	30.3
	Farmer	74	21.3
	Daily labor	12	3.5
	House wife	92	26.5
Monthly Income	=<2480	185	53.3
	>2480	162	46.7

-** protestant and Catholic *-** divorced and widowed

5.2 Personal hygiene and Environmental characteristics of participants

Almost 309 (89%) of participants have a practice of using the toilet for defecation. Three fourth of participants use water for anal cleaning while using the toilet, and two hundred twelve (82.2%) of participants did not use water returned from the toilet for other purposes like leg and hand washing purpose. Almost, three-fourth and more than half of participants hand washing practice and eating of uncooked meal respectively. Three hundred fourteen (90.5%) of participants have used water from an improved source. From 32.6% of participants who get water out of their house, thirty-two (28.3%) travel for more than 1000meters distance (Table3).

Table 3: Personal hygiene characteristics of pregnant women in Shewarobit Health facilities, North Shoa, Amhara region, Ethiopia, 2020 (N= 347).

Variable	Category	Frequency	(%)
Using toilet for defecation	Yes	309	89
	No	38	11
Using toilet water for other purpose (N=347)	Yes	46	17.8
	No	212	82.2
Hand washing before meal	Yes always	293	84.4
	Yes sometimes	54	15.6
Hand washing after toilet	Yes always	254	73.2
	Yes sometimes	93	26.8
Cutting finger nail	Yes always	184	53
	Yes sometimes	163	47
Eating uncooked meal	Yes	155	44.7
	No	192	55.3
Walking with barefoot	Yes	27	7.8
	No	320	92.2
Toilet Presence	Yes	322	92.8
	No	25	7.2
Water Source for house	Improved	314	90.5
	Unimproved	33	9.5
Distance of water source	=<1000	81	71.7
	>1000	32	28.3
Disposing solid waste by	Burn	118	34
	Dump	116	33.4
	Compost	28	8.1
	Dustbin	85	24.5
Disposing liquid waste in to	Spill to drainage	159	45.8
	Open field	144	41.5
	Spill to river	44	12.7

Health related characteristics of participants

More than half of the participants (54.5%) did not get health education about intestinal parasites infection, and more than three-fourth of participants were not screened for intestinal parasites during their first ANC visit (Figure 3).

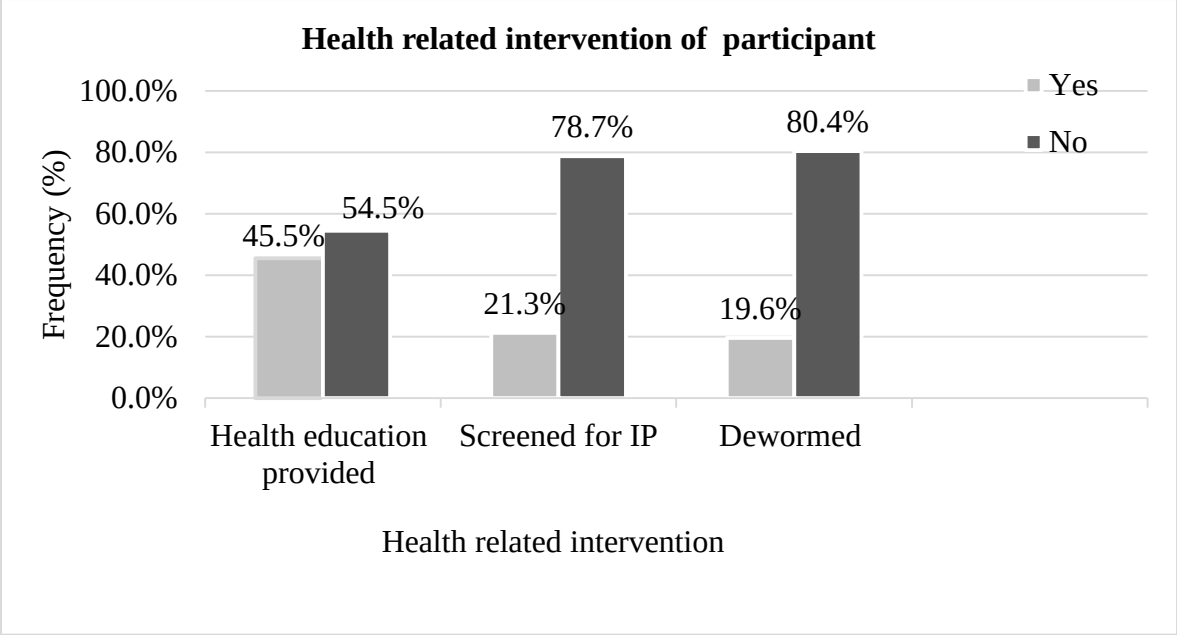

Figure 3: Health related characteristics of pregnant women in Shewarobit Health facilities, North Shoa, Amhara region, Ethiopia, 2020

5.1 Magnitude and distribution of intestinal parasite infection

From the total respondents, intestinal parasite infection was seen on ninety-six (27.7%) with 95% CI: (23.1, 32.6) respondents. Regarding the infectious agent, both protozoan and helminths infection were identified through laboratory examination. Fifty-six (58.3%) of infected respondents were positive of intestinal protozoan and forty (41.7%) were positive for intestinal helminths. From the total infected respondents, twenty-three (24%) have two or more intestinal parasites. G.lamblia infection covers the highest percent (36.1%) followed by S.mansoni that accounts 25.2% (Fig 4).

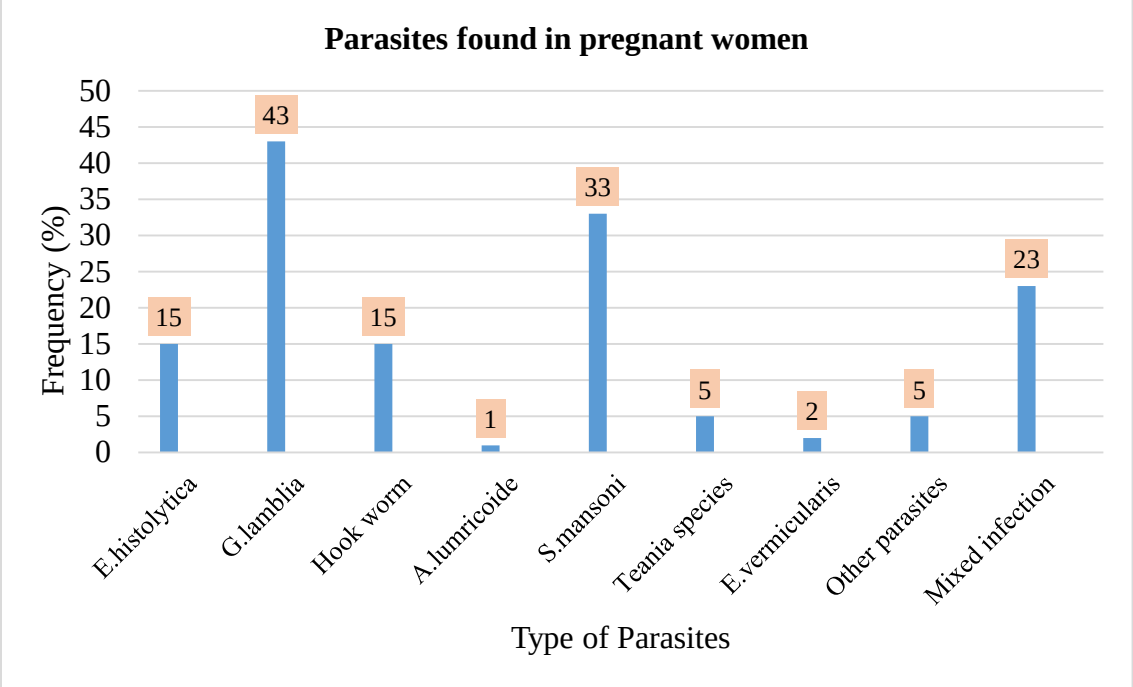

Figure 4: Prevalence and type of parasites among pregnant women in Shewarobit Health facilities, North Shoa, Amhara region, Ethiopia, 2020

5.2 Associated factors of intestinal parasites infection: Bivariate analysis

5.2.1 Socio demographic determinants of intestinal parasites infection

For socio-demographic factors, bivariate analysis with a contingency table was performed as showed below. Intestinal parasites infection was more observed in the elder age group (35-44) of participants (38.3%). Twenty-seven percent of married pregnant women were infected with intestinal parasites. From illiterate pregnant women, 41.2% of them were infected by intestinal parasites infection. Thirty-eight percent of farmer pregnant women and thirty-six percent of pregnant women who have low income were infected by intestinal parasites (Table 4). All socio-demographic factors with p-values less than 0.20 on bivariate analysis were further analyzed by multivariate analysis.

Table 4: Socio-demographic determinants of intestinal parasite among pregnant women in Shewarobit Health facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N=347).

Variable Category	Intestinal parasite		COR[a] (95% CI)	P-value
	Yes (%)	No (%)		
Age				
15-24	46(29.7)	109(70.3)	1	
25-34	40(23.8)	128(76.2)	0.74 (0.41, 1.21)	0.234
35-44	10(41.7)	14(58.3)	1.69(0.70, 4.09)	0.242
Residence				
Urban	52(22.4)	180(77.6)	1	
Rural	44(38.3)	71(61.7)	2.15 (1.32, 3.49)	0.002
Marital Status				
Single	2(9.5)	19(90.5)	1	
Married	87(28.8)	215(71.2)	3.84 (0.88, 16.86)	0.074
Others	7(29.2)	17(70.8)	3.91 (0.71, 21.46)	0.116
Education Status				
Illiterate	21(41.2)	30(58.8)	2.55 (1.07, 6.07)	0.035
Read and write	16(74.1)	18(52.9)	3.23 (1.25, 8.34)	0.015
1^0 school	36(24.2)	113(75.8)	1.16 (0.54, 2.49)	0.706
2^0 School	12(19.4)	50(80.6)	0.873(.349, 2.185)	0.771
Higher education	11(21.6)	40(78.4)	1	
Occupation				
Gov'tal employee	12(18.7)	52(81.3)	1	
Private worker	23(21.9)	82(78.1)	1.22 (0.56, 2.65)	0.624
Farmer	28(37.8)	46(62.2)	2.64 (1.20, 5.78)	0.015
Daily labor	6(50)	6(50)	4.33 (1.19, 15.81)	0.026
House wife	27(29.3)	65(70.7)	1.80 (0.82, 3.89)	0.135
Monthly Income				
=<2480	67(36.2)	118(63.8)	2.60 (1.58, 4.30)	0.000
>2480	29(17.9)	133(82.1)	1	

a: Crude Odd ratio CI: Confidence Interval

5.2.2 Personal hygiene, environmental and health related determinants of intestinal parasite infection

As the table below showed, the bivariate analysis was also performed for environmental and sanitation personal hygiene and health-related factors associated with intestinal parasites infection. Among pregnant women who had a toilet in their compound and used unimproved water, 48% and 69.7% were infected with intestinal parasites respectively. Almost half of the pregnant women who used toilet

leftover water for other purposes (hand washing and leg washing), and didn't wash their hands before and after the toilet were infected by intestinal parasites. Above thirty percent of pregnant women, who didn't get health education about intestinal parasites and who were not deworm exposed for the infection. All environmental and sanitation, personal hygiene and health-related factors with a p-value of less than 0.20 on bivariate analysis were further analyzed on multivariate analysis (Table5).

Table 5: Hygiene, environmental and health related determinants of intestinal parasites among pregnant women in Shewarobit Health facilities, North Shoa, Amhara Region, Ethiopia, 2020(N=347)

	Intestinal parasites		COR[a] (95% CI)	P-value
Variable Category	Yes (%)	No (%)		
Toilet Presence				
Yes	84(26.1)	238(73.9)	1	
No	12(48)	13(52)	2.62 (1.15, 5.96)	0.022
Water Source for house				
Improved	73(23.2)	241(76.8)	1	
Unimproved	23(69.7)	10(30.3)	7.59 (3.46, 16.68)	0.000
Distance of water source				
=<1000	35(43.2)	46(56.8)		
>1000	16(50)	16(50)	1.31 (0.58, 2.99)	0.514
Disposing solid waste by				
Burn	15(12.7)	103(87.3)	1	
Dump open field	54(46.6)	62(53.4)	5.98 (3.11, 11.49)	0.000
Compost	10(35.7)	18(64.3)	3.81 (1.48, 9.80)	0.005
Dustbin	17(20)	68(80)	1.72 (0.80, 3.67)	0.163
Disposing liquid waste in to				
Spill to drainage	32(20.1)	127(79.9)	1	
Spill open field	54(37.5)	90(62.5)	2.38 (1.42, 3.98)	0.001
Spill to river	10(22.7)	34(77.3)	1.17 (0.52, 2.61)	0.706
Using toilet for defecation				
Yes	75(24.3)	234(75.7)	1	
No	21(55.3)	17(44.7)	3.85 (1.93, 7.69)	0.000
Using toilet water for other purpose (N=258**)**				
Yes	21(45.7)	25(54.3)	4.56 (2.29, 9.07)	0.000
No	33(15.6)	179(84.4)	1	
Hand washing before meal				

Always	71(24.2)	222(75.8)	1	
Sometimes	25(46.3)	29(53.7)	2.70 (1.48, 4.90)	0.001
Hand washing after toilet				
Always	48(18.9)	206(81.1)	1	
Sometimes	48(51.6)	45(48.4)	4.58 (2.74, 7.65)	0.000
Cutting finger nail				
Always	38(20.7)	146(79.3)	1	
Sometimes	58(35.6)	105(64.4)	2.12 (1.31, 3.43)	.002
Eating uncooked meal				
Yes	59(38.1)	96(61.9)	2.58 (1.59, 4.18)	0.000
No	37(19.3)	155(80.7)	1	
Walking with barefoot				
Yes	20(74.1)	7(25.9)	9.17 (3.74, 22.53)	0.000
No	76(23.8)	244(76.3)	1	
Getting Health Education				
Yes	24(15.2)	134(84.8)	1	
No	72(38.1)	117(61.9)	3.44 (2.03, 5.80)	0.000
IP Screening at firs ANC				
Yes	12(24.5)	37(75.5)	1	
No	84(28.2)	214(71.8)	1.21 (0.60, 2.43)	0.592
Taking Deworming				
Yes	11(12.7)	60(87.3)	1	
No	85(31)	191(69)	2.43(1.23, 4.85)	0.012

a: Crude Odd ratio CI: Confidence Interval

5.3 Associated factors of intestinal parasite infection: Multivariate analysis

Even though the socio-demographic characters of study participants seem like associated with the infection of intestinal parasites on binary analysis, after analyzing all variables which were a candidate for multivariate analysis, there is no significant association between socio-demographic characters and intestinal parasites infection of pregnant women. Nevertheless, from participants who are living in a rural area, 38.3% were infected. Relating to the education level of participants and intestinal parasites infection, sixteen (74.2%) of participants who can read and write are infected, and twenty (41.1%) of participants who have elementary education were infected by intestinal parasites. From the participants, 45% of daily labor and 43% of farmers were infected by intestinal parasites (Table 6).

Table 6: Multiple logistic regression for selected factors of intestinal parasites infection among pregnant women at Shewarobit health facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N=347).

Variable Category	Intestinal parasite		COR[a] (95% CI)	AOR[b] (95% CI)
	Positive (%)	Negative (%)		
Residence				
Urban	52(22.4)	180(77.6)	1	1
Rural	44(38.3)	71(61.7)	2.15(1.32, 3.49)	0.83(0.70, 2.57)
Education Status				
Illiterate	21(41.2)	30(58.8)	2.55(1.07, 6.07)	5.16(0.55, 48.10)
Read and write	16(74.1)	18(52.9)	3.23(1.25, 8.34)	2.98(0.29, 30.75)
1^0 school	36(24.2)	113(75.8)	1.16(0.54, 2.49)	1.92(0.25, 14.66)
2^0 School	12(19.4)	50(80.6)	0.87(0.35, 2.19)	1.48(0.21, 10.30)
Higher education	11(21.6)	40(78.4)	1	1
Occupation				
Gov'tal employee	12(18.7)	52(81.3)	1	1
Private worker	23(21.9)	82(78.1)	1.22(0.56, 2.65)	0.53(0.16, 2.65)
Farmer	28(43)	46(57)	2.64(1.20, 5.78)	0.68(0.10, 4.64)
Daily labor	6(50)	6(50)	4.33(1.19, 15.81)	0.21(0.01, 5.50)
House wife	27(28.3)	65(71.7)	1.80(0.83, 3.90)	0.75(0.13, 4.26)
Monthly Income				
=<2480	67(36.2)	118(63.8)	2.60(1.58, 4.30)	1.82(0.70, 4.71)
>2480	29(17.9)	133(82.1)	1	1

a: Crude Odd Ratio CI: Confidence Interval

b: Adjusted Odd ratio

After carrying out multiple logistic regression, some personal hygiene practices, environmental and health-related factors were significantly associated with intestinal parasites infection. Dumping solid waste at the open field was significantly associated with intestinal parasites infection; it's odd of infection was five [AOR: 5.13, 95% CI (1.38, 19.10)] times higher compared to pregnant women who burn the wastes. The odd infection for pregnant who used unimproved water was five times higher [AOR: 5.12, 95% CI (1.24, 21.14)] than those who use improved water. Pregnant women who did not wash their hands after the toilet regularly were almost four [AOR: 3.90, 95% CI (1.38, 10.89)] times more likely to be infected with intestinal parasites than their counterparts. The odd of intestinal parasites infection among participants who used water leftover (returned) from the toilet for other purposes like hand and leg washing was four [AOR: 3.69, 95% CI (1.18, 11.59)] times higher

compared to those who did not use water returned from the toilet. Not taking deworming drugs is also taken as a risk factor for intestinal parasites infection among pregnant women in the study area. However, the absence of toilets didn't use the toilet for defecation, cutting fingers sometimes and the practice of walking with barefoot did not significantly associate with intestinal parasites infection (Table 9).

Table 7: Multiple logistic regression for selected factors of intestinal parasites infection among pregnant women at Shewarobit health facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N=347).

Variable Category	Intestinal parasite		COR (95% CI)[a]	AOR (95% CI)[b]
	Yes (%)	No (%)		
Toilet Presence				
Yes	84(26.1)	238(73.9)	1	1
No	12(48)	13(52)	2.62(1.15, 5.96)	0.75(0.04, 1.33)
Water Source for house				
Improved	73(23.2)	241(76.8)	1	1
Unimproved	23(69.7)	10(30.3)	7.59(3.46, 16.68)	5.12 (1.24, 21.14) *
Disposing solid waste by				
Burn	15(12.7)	103(87.3)	1	1
Open dump	54(46.6)	62(53.4)	5.98(3.11, 11.49)	5.13(1.38, 19.10) *
Compost	10(35.7)	18(64.3)	3.82(1.48, 9.80)	1.24(0.22, 7.08)
Dump in yard	17(20)	68(80)	1.72(0.80, 3.67)	1.40(0.43, 4.61)
Disposing liquid waste in to				
Spill to drainage	32(20.1)	127(79.9)	1	1
Open field	54(37.5)	90(62.5)	2.38(1.42, 3.98)	0.49(0.16, 1.54)
Spill to river	10(22.7)	34(77.3)	1.17(.52, 2.61)	0.48(0.11, 2.06)
Using toilet for defecation				
Yes	75(24.3)	234(75.7)	1	1
No	21(55.3)	17(44.7)	3.85(1.93, 7.69)	4.09(0.38, 43.91)
Toilet water for other purpose (N=258)				
Yes	21(45.7)	25(54.3)	4.56(2.29, 9.07)	3.69(1.18, 11.59) *
No	33(15.6)	179(84.4)	1	1
Hand washing before meal				
Yes always	71(24.2)	222(75.8)	1	1
Yes sometimes	25(46.3)	29(53.7)	2.70(1.48, 4.90)	1.09(0.33, 3.64)
Hand washing after toilet				
Yes always	48(18.9)	206(81.1)	1	1
Yes sometimes	48(51.6)	45(48.4)	4.58(2.74, 7.65)	3.90(1.38, 10.89) *
Cutting finger nail				
Yes always	38(20.7)	146(79.3)	1	1
Yes s\ometimes	58(35.6)	105(64.4)	2.12(1.31, 3.43)	0.51(0.19, 1.32)

Eating uncooked meal				
Yes	66(41.5)	93(58.5)	2.575(1.588, 4.175)	5.78(2.18, 15.03) **
No	30(16)	158(84)	1	1
Walking with barefoot				
Yes	20(74.1)	7(25.9)	9.17(3.74, 22.53)	2.23(0.39, 12.88)
No	76(23.8)	244(76.3)	1	1
Getting Health Education				
Yes	24(15.2)	134(84.8)	1	1
No	72(38.1)	117(61.9)	3.44(2.03, 5.80)	6.12(2.34, 12.20) **
Taking Deworming				
Yes	11(12.7)	60(87.3)	1	1
No	85(31)	191(69)	2.43(1.23, .85)	4.82(1.22, 23.00) *

a: Crude Odd ratio

b: Adjusted Odd Ratio

CI: Confidence Interval

* Significantly associated p-value<0.05 on multiple logistic regression

** Significantly associated p-value<0.001 on multiple logistic regression

6. DISCUSSION

This study focused on the magnitude of intestinal parasite infection and its possible associated factors among pregnant women. The overall intestinal parasite infection of pregnant women was 27.7% (95% CI: 23.1, 32.6).

The observed magnitude of intestinal parasite in this study was in line with the studies conducted in Ethiopia at Bahir Dar Felege Hiwot Hospital (25), Southern part of Ethiopia at Hossana (27) and at East Wellega (28) with the prevalence of 31.7%, 29.7%, and 24.7% respectively. But this finding is in contrast much lower than the finding of a study conducted in Ziway (45) which reported 64.2%. This difference might be due to the difference of socio-demographic characteristics, time gaps between two studies, differences of study conducting season and using different number of slides for microscopic stool examination. This finding is also lower than the study done in Oromia region Kalo kile district which showed the prevalence of 43.8% (44). This inconsistency might be due to the difference of participants characteristics in two studies; farmer (77.5%) than the current study (21.3%) who are more exposed to soil contact and infection of parasites (32).

In this study, the first and second predominant parasites observed were G.lamblia and S.mansoni, respectively. It is similar with the study conducted in Bahir Dar Felegehiwot Hospital (25) in which G.lamblia is the predominant parasite. In contrast, this study debates with the studies in Oromia and Amhara regions of Ethiopia and Vietnam (41, 44, 46) showed that A.lumbricoide, Hookworm and T.trichuriaare the predominant parasites. This inconsistency might be justified as the study area in the current being warm climate and presence of water body makes a suitable environment for survival of cyst of G.lamblia and Schistosome transmission so its prevalence will be increased.

Water source, solid waste disposal method, hand-washing practice after using the toilet, eating uncooked/unwashed meal, using leftover water from the toilet, health education and deworming were factors associated with intestinal parasites infection among pregnant in this study.

In this study, pregnant women who used unimproved water sources were five times [AOR: 5.12 95% CI (1.24, 21.14)] more likely infected by intestinal parasites compared to mothers who used improved/protected water source. It was consistent with the studies conducted in South Wollo Haik health center (54), in Hossaena at Nigist Eleni Mohammed Memorial Hospital (27) and at Gondar Hospital (58) all implied that using unprotected water source significantly associated with infection of the intestinal parasites. This might be due to that unprotected water most likely contaminated with fecal material and other wastes (6). But this study differs from study in East Wollega, Ethiopia (28)

and in Bogota Columbia (39) where authors reported there is no significant association of water source and intestinal parasites infection on pregnant women. The disagreement of these studies might be explained as different socio-demographic characteristics and implementation of water and sanitation programs. Using river water (contaminated) for showering and clothes washing in the current setting might be the reason (24).

In the current study, the dumping solid waste to open field has a contribution to the increment of intestinal parasite infection. The pregnant women who dump the household solid wastes in an open field are almost five [AOR: 5.13 95% CI (1.38, 19.10)] times at risk of infection than those who burn their household wastes. This finding is supported by a study that focused on the impact of poor solid wastes management on health (61) that indicated dumping of solid waste associated with intestinal parasites infection. This might be due to that solid waste may contain different pathogenic parasites and dumping sites become the major source of these pathogenic parasites so that it increases the infection rate.

Pregnant women who had the habit of eating an uncooked meal (including not disinfected fruit and vegetables) had the odd of infection five times [AOR: 5.78, 95% CI (2.18, 15.03)] than those pregnant women who didn't eat uncooked meal. This finding is comparable with the study conducted in Ethiopia, at East wellega (28), Mecha (46), South Wollo Haik (54) on those studies the odd of infection is higher for groups who ate uncooked meal. But this result is not consistent with the studies conducted in Oromia region Lalo Kile district (44) and in Columbia Bogota district (39). The possible explanation for this inconsistency could be the difference on personal hygiene practice and socio-demographic characters; residence area, occupation and educational level of the participants.

In addition, deworming status of pregnant women was one of the factors of intestinal parasite infection in this study. Pregnant women who had not taken deworming drug were almost five [AOR: 4.82, 95% CI (1.22, 23.00)] times more likely infected compared to those pregnant who were dewormed. It has an argument with the study conducted in Columbia Bogota district (39) and study done in Ethiopia Gondar (62). The possible explanation for this difference might be difference on the implementation of chemotherapy preventive program, and also in the current study setting, the population has used river for clothes wash and showering so that contaminated with different pathogenic organisms (24).

Pregnant women who had not washed their hand always after toilet were four [AOR: 3.90, 95% CI (1.38, 10.89)] times more likely to be infected by intestinal parasites compared to their counterparts. This result agreed with studies conducted in Ethiopia at South Wollo (54) which indicated not washing hands always the after

toilet had a significant association with intestinal parasites infection. However, the study performed at Hossaena (27), Bahir Dar (25) and Columbia (39) debate with current findings. This difference might be due to differences in the prevention and control program implementation. It might also be due to difference on geographic distribution of parasites and socio-demographic characteristics (occupation and education).

Another factor identified in this study is using water returned from toilet or leftover after using toilet. Even though there was no study performed about using left over water from anal cleaning for other purpose (like leg and hand washing purpose) and intestinal parasites infection, it is highly associated with the infection of pregnant women. Odd of infection for pregnant women who use left over water from anal cleaning for other purpose was four [AOR: 3.69 95% CI (1.18, 11.59)] folds compared to those pregnant women who did not practice it. This might be due to that toilet water may be contaminated with excreted materials and facilitates the feco-oral infection of parasites.

7. LIMITATION

Despite the above nice characteristics, this study used only a single stool specimen and used only wet mount and formol ether concentration techniques (didn't incorporate other techniques; AFB staining, trichrome, floatation, Harada Mori Baerman techniques) which underestimate the magnitude of parasites. Due to the nature of the cross-sectional study, seasonal variation of parasitosis is not explained. It did not also use a specific method to differentiate E.histolytica from E.dispar and Tinea species (T.saginata from T.solium).

8. CONCLUSION

8.1 Conclusion

Magnitude of intestinal parasite infection in the study area was 27.7%, which is higher than WHO cut off point (20%) to implement preventive chemotherapy program. Protozoa (G.lamblia and E.histolytica) and helminths (S.mansoni and Hookworm) infected pregnant women more. Personal hygiene practice: not washing hand after toilet, eating unwashed/uncooked meal and using leftover water from toilet for hand and leg washing; Health related interventions: not taking deworming drug and not being health educated, and environmental factors: unimproved water source for house use were significantly associated with intestinal parasites infection of pregnant women.

9. RECOMMEND6ATION

Based on the study findings, the following recommendations were forwarded.

For regional health bureau, zonal and district health department

It is better if the implementation of deworming of the pregnant women strengthened and implementing the intestinal parasites screening during ANC follow up.

Enhance and monitor water and environmental sanitation strategies to decrease poor sanitation and provide the quality of drinking water aiming to obtain a better quality of life.

For health care workers and health Extension Workers

- ✓ Strengthening routine deworming and screening of pregnant women at the first antenatal care follow up.
- ✓ Delivering information about intestinal parasites infection and its preventive methods
- ✓ Expand and address the health education service about intestinal parasites infection, transmission prevention and its consequence.
- ✓ Addressing to the community about personal hygiene practice (hand washing during critical points, to avoid using left over water from anal cleaning)
- ✓ Incorporating using toilet for defecation, environmental sanitation and preferred solid and liquid wastes disposal methods in the health education service.

For Researchers

- ✓ Additional large-scale longitudinal study is needed to determine the effect of helminths in pregnant with estimate of worm burden (intensity of infection).
- ✓ It is recommended to conduct study using more sensitive methods (AFB staining and culture) to address all intestinal parasites
- ✓ Reasoning out why health education and deworming were not well delivered is also recommended.

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APPENDIX

Appendix A: Informed consent form

This is question prepared to interview pregnant women who have follow up at Shewarobit Health Center to know some variables, which are related to intestinal parasite infection among pregnant women. I kindly ask you to participate in this study and give pertinent information regarding to the questions. At the end of the question, you will provide stool specimen to diagnose weather you are infected or not. If there is parasite, based on the health care provider consultation, you will get treatment. Any information that you will provide was secured and the anonymity was kept confidentially. If you are not comfortable to continue it up to the end, you can leave at any phase of the study process. If you agree to participate, we will proceed to the questions.

Appendix B: Questionnaire

Questionnaire on intestinal parasite infection associated factors prepared to interview pregnant women attending ANC at Shewarobit, 2020.

Part- I Socio demographic characteristics **Code: _____**

1.	How old are you?	_____ years old	MRN No: _____
2.	How many times do you become pregnant including current one?	_____	
3.	Where do you live?	1. Urban	2. Rural
4.	What is your religion ?	1. Muslim	3. Protestant
		2. Orthodox	4. Others specify: _____
5.	What is your marital status?	1. Single	3. Divorced
		2. Married	4. Widowed
6.	What is your highest level of education completed?	1. Illiterate 2. Secondary school 3. Reading and writing 4. Higher education 5. Primary school	
7.	What is your current occupation?	1. Governmental employee 2. Private worker 3. Farmer 4. Daily labor 5. Housewife	
8.	How much is your monthly income?	_____ Ethiopian Birr	

Personal practice and environmental related questions

1.	Do you have toilet	1. Yes	2. No	
2.	If question No-1 is yes, what type of toilet?	1. Pit latrine	2. Flush	3. Others: ___
3.	Do you use the toilet for defecation?	1. Yes	2. No	
4.	If your answer for Q No: 4, where do you defect?	_____		
5.	What cleaning materials do you use for toilet?	1. Water	2. Paper/soft	3. Stone/leaf /other
6.	If Question No: 6 answer is water, do you use remnant water for other purpose?	1. Yes 2. No		

7.	What type of water source do you use for your home	1. Improved 2. Unimproved
8.	What is the distance of water source from your home?	_____
9.	How do you dispose your solid waste?	1.Burn 2. Dumb 3. Compost 4. In Dustbin/garbage 5.Others (…….)
10.	Where do you dispose your liquid waste?	1. Spill to Sewer 2. Open field 3. Spill to river
11.	Do you wash your hand with soap/ash before meal?	1. Yes, always 3. Not at all 2. Yes, sometimes
12.	Do you wash your hand after toilet with soap/ash before meal?	1. Yes, always 3. Not at all 2. Yes, sometimes
13.	Do you cut your finger regularly?	1. Yes, always 3. Not at all 2. Yes, sometimes
14.	Do you eat uncooked meat	1. Yes 2. No
15.	Do you walk with barefoot frequently	1. Yes 2. No

Health Related questions

16.	Did you attend health education previously about intestinal parasites	1. Yes 2. No
17.	Have you been screened for Intestinal parasites during your first ANC visit?	1. Yes 2. No
18.	Did you take deworming drug previously?	1. Yes 2. No If yes; when: _____

የፈቃደኝነት ስምምነት ሰነድ

ይህቃለ-መጠይቅ የተዘጋጀው ከአንጀት ጥገኛ ትላትል ጋር ተዛማጅነት ያላቸው ጉዳዮች ላይ በሸዋሮቢት ጤና አጠባበቅ ጣቢያ ክትትል የሚያደርጉ ነፍሰጡር እናቶችን ለመጠየቅ የተዘጋጀነው። በዚህ ጥናት ውስጥ ተሳታፊ ትሆኑ ዘንድና ከበሽታው ጋር ተዛማጅ ስለሆኑ ጉዳዮች አስፈላጊ መረጃዎችን እንዲሰጡ ይጋበዛሉ። ከቃለ-መጠይቁ በኋላ በአንጀት ጥገኛ ትላትል መጠቃዎትን ለማወቅ የላቦራቶሪ ምርመራ ስለሚያስፈልግ የሰገራ ናሙና ይሰጣሉ። የትላትሉ ተጠቂ ከሆኑ በጤና ባለሙያዎች ትዕዛዝ መሰረት መድሃኒት ሊወስዱ ይችላሉ። ማንኛውም ከእርስዎና ክሰጡት ምላሽ የተያያዙ መረጃዎች ምስጢራዊ ሆነው ተጠብቀው ይያዛሉ። በዚህ ጥናት ጊዜ ያልተመቸዎት ነገር ካለ በማንኛውም ሰዓት ከጥናቱ ያለመሳተፍ መብት አለዎት። ስለዚህ በጥናት ውስጥ ተሳታፊ ለመሆን ከተስማሙ ወደ ቃለ-መጠይቁ ማለፍ እንችላለን።

በሸዋሮቢት በአንጀት ጥገኛ ትላትል በነፍሰጡር እናቶች ላይ ያለውን ስርጭት እና ተያየዥ ምክንያቶችን ለማወቅ ለሚደረግ ጥናት የተዘጋጀ ቃለመጠይቅ

ክፍል-1 መለያቁጥር፡ _____

1	እድ ሜዎት ስንት ነው?	_____
2	የአሁኑን እርግዝና ጨምሮ ስንት ጊዜ አርግዘዋል?	_____
3	በአሁኑ ሰዓት የሚኖሩበት አካባቢ የት ነው?	1. ገጠር 2.ከተማ
4	ሀይማኖትዎ ምንድነው?	1. እስልምና 2.ኦርቶዶክስ 3. ፕሮቴስታንት 4. ሌላ፡ _____
5	የጋብቻ ሁኔታ፡	1. ያላገባች 2.ያገባች 3. የፈታች 4.ባልየሞተባት
6	የእርስዎ ከፍተኛው የትምህርት ደረጃ ሰንተኛ ክፍል ነው?	1. ያልተማረች 2. ማንበብናመጻፍ 3. ከ1-8 ክፍል 4. ከ9-12 5. ዲፕሎማ/ከ12+ ክፍል
7	በአሁን ሰዓት የሚተዳደሩበት የስራ ዘርፍ ምንድነው?	1. የመንግስትተቀጣሪ 2.የግልስራ 3. ግብርና 4.የቀንሰራተኛ 5. የቤትእመቤት 6 ሌላ: ____
8	የእርስዎ የነፍስ ወከፍ ገቢ በወር በአማካይ ሲታሰብ ምን ያህል ነው?	_____ብር

ክፍል- 2

1	በቤታችሁ ሽንት ቤት አለ?	1. አዎን 2.የለም
2	የጥያቄ ቁጥር 1 መልስዎ አዎን ከሆነ ምን ዓይነት ሽንት ቤት?	1. ጉድጓድ 2.ወራጅ ሽንት ቤት 3 ሌላ፡ _____
3	እርስዎ ለመጻዳዳት ሽንት ቤት ይጠቀማሉ?	1. አዎን 2.አልጠቀምም
4	ለጥያቄ ቁጥር-4 መልስዎ አልጠቀምም ከሆነ የት ይጸዳዳሉ?	
5	እርስዎ ሲጸዳዱ ንጽህናዎትን የሚጠብቁት በምንድነው?	1. በውሃ 2.በሶፍት/ወረቀት 3. ድንጋይ/ቅጠል/ሌላ
6	ለጥያቄ ቁጥር-5 መልስዎ ውሃ ከሆነ የተረፈውን ውሃ ቤት ውስጥ ለሌላ ስራ ይጠቀሙታል?	1. አዎን2.አልጠቀምም
7	በቤት ውስጥ የሚጠቀሙትን ዉሃ የሚያገኙት ከየት ነው?	1. ንጽህናው የተጠበቀ የዉሃ ምንጭ 2. ንጽህናው ያልተጠበቀ የውሃ ምንጭ

8	ውሃ ለመቅዳት ከቤታችሁ ምን ያህል ርቀት ይጓዛሉ?	_____
9	ከቤታችሁ የሚወጣውን ደረቅ ቆሻሻ የምታስወግዱት በምን መልኩ ነው?	1. በማቃጠል 2.መሬት ላይ በመድፋት 3.በማበስበስ 4.በማጠራቀሚያ በመሰብሰብ
10	ከቤትዎ የሚወጣውን ፈሳሽ ቆሻሻ የሚያስወግዱት የት ነው?	1. ቆሻሽ ማስወገጃ ቱቦ ውስጥ በመድፋት 2. መሬት ላይ በመድፋት 3. ወንዝ ዉስጥ በመድፋት
11	ምግብ ከመብላትዎ በፊት እጅዎትን በሳሙና/በአመድ ይታጠባሉ?	1. አዎን ሁልጊዜ 2.አዎን አንዳድ ጊዜ 3. አልታጠብም
12	ሽንት ቤት ከተጠቀሙ በኋላ እጅዎትን በሳሙና/በአመድ ይታጠባሉ?	1. አዎን ሁልጊዜ 2.አዎን አንዳድ ጊዜ 3. አልታጠብም
13	የጣትዎትን ጥፍር በየጊዜው ይቆርጣሉ?	1. አዎን ሁልጊዜ 2.አዎን አንዳድ ጊዜ 3. አልቆርጥም/በራሱ ጊዜ ይቆረጣል
14	በእሳት ያልበሰለ/በደንብ ያልታጠበ የአትክልት ምግብ ይጠቀማሉ?	1. አዎን 2.አልጠቀምም
15	ብዙ ጊዜ በባዶ እግር አንቅስቃሴ ያደርጋሉ;	1. አዎን 2.አላደርገም
16	ስለ አንጀት ጥገኛ ትላትል የጤና ት/ት አግኝተው ያውቃሉ?	1. አዎን 2.አላገኘሁም
17	በዚህእርግዝናበመጀመሪያውክትትልየአንጀትጥገኛትላትልምርመራተደርጎልዎታል?	1. አዎን 2.አልተደረገልኝም
18	ከአሁን በፊት የአንጀት ጥገኛ ትላትል ማጥፊያ መድሃኒት ወስደው ያውቃሉ?	1. አዎን 2.አላውቅም አዎን ከሆነ የወሰዱበትን ጊዜ ይጥቀሱ፡

“በዚህ ጥናት ስለተሳተፉና ለቃለ-መጠይቁ ስለተባበሩን ከልብ እናመሰግናለን።”

የሰገ ራምርመራ ውጤት፡ _____

Appendix C: Saline Wet Mount Procedure

1. Using the plastic container with applicator stick (if the cap has not spoon), order the participant to provide stool specimen from both central and external part of defecated stool. (ware them to keep from any soil or other body fluid contamination)
2. When they provide, check whether it is their own or not and give ID on the container
3. Take approximately 1gm of stool on microscopic slide and droop normal saline
4. Using applicator stick, emulsify it then apply cover slide
5. Using 10x microscopic objective scan the field and observe systematically for the presernce of any Cysyt, trophozoite, larva and/or ova of parasite (if there is need of confirmation, use 40X objective).
6. Report the finding using the prepared form

Appendix D: Formol Ether Concentration Technique Procedure

1. Using a rod or stick, emulsify an estimated 1 g (pea-size) of faeces in about 4 ml of 10% formol water contained in a screw-cap bottle or tube. *Note:* Include in the sample, faeces from the surface and several places in the specimen.
2. Add a further 3–4 ml of 10% v/v formol water, cap the bottle, and mix well by shaking.
3. Sieve the emulsified faeces, collecting the sieved suspension in a beaker.
4. Transfer the suspension to a conical (centrifuge) tube made of strong glass, copolymer, or polypropylene. Add 3–4 ml of diethyl ether or ethyl acetate. *Caution:* Ether is highly flammable and ethyl acetate is flammable, therefore use well away from an open flame, e.g. flame from the burner of a gas refrigerator, Bunsen burner, or spirit lamp. Ether vapor is anesthetic therefore make sure the laboratory is well ventilated.
5. Stopper the tube and mix for 1 minute. If using a Vortex mixer, leave the tube unstoppered and mix for about 15 seconds (it is best to use a boiling tube). * Do not use a rubber bung or a cap with a rubber liner because ether attacks rubber.
6. With a tissue or piece of cloth wrapped around the top of the tube, loosen the stopper (considerable pressure will have built up inside the tube).

7. Centrifuge immediately at 750–1 000 g (approx. 3000 rpm) for 1 minute. After centrifuging, the parasites will have sedimented to the bottom of the tube and the faecal debris will have collected in a layer between the ether and formol water as shown in Figure

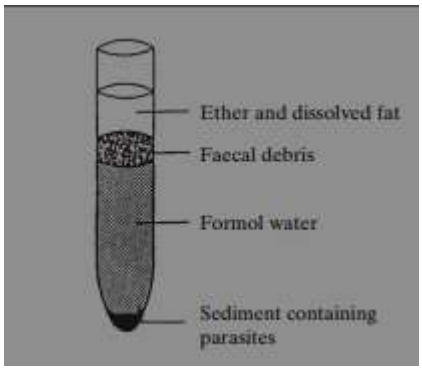

Figure 5: Formal-ether sedimentation of concentration technique layers, after centrifugation

8. Using a stick or the stem of a plastic bulb pipette, loosen the layer of faecal debris from the side of the tube and *invert* the tube to discard the ether, faecal debris, and formol water. The sediment will remain.
9. Return the tube to its upright position and allow the fluid from the side of the tube to drain to the bottom. Tap the bottom of the tube to resuspend and mix the sediment. Transfer the sediment to a slide, and cover with a cover glass.
10. Examine the preparation microscopically using the 10 objective with the condenser iris closed sufficientlyto give good contrast. Use the 40 objective to examine small cysts and eggs. To assist in the identification of cysts, run a small drop of iodine under the cover glass
11. If required, count the number of each species of egg in the entire preparation. This will give the approximate number per gram of faeces.