PREVALENCE OF INTESTINAL HELMINTHIASES AND ASSOCIATED FACTORS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC OF NIGIST ELENI MOHAMMED MEMORIAL HOSPITAL, HOSSANA, SOUTHERN ETHIOPIA

BY:WASSIE GEBI (BSC)

A THESIS REPORT SUBMITTED TO JIMMA UNIVERSITY, COLLEGE OF PUBLIC HEALTH AND MEDICAL SCIENCES, DEPARTMENT OF EPIDEMIOLOGY; IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF DEGREE IN MASTERS OF PUBLIC HEALTH IN EPIDEMIOLOGY

FEBRUARY; 2014

JIMMA, ETHIOPIA

PREVALENCE OF INTESTINAL HELMINTHIASES AND ASSOCIATED FACTORS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC OF NIGIST ELENI MOHAMMED MEMORIAL HOSPITAL, HOSSANA, SOUTHERN ETHIOPIA

BY:

WASSIE GEBI (BSC)

ADVISORS:

1. MR. TARIKU DEJENE (BSC, MSC)

2. MR. TSEGAYE TEWELDE (BSC, MPHE)

FEBRUARY; 2014

JIMMA, ETHIOPIA

Abstract

Background: In the developing world, young women, pregnant women, and their infants and children frequently experience repeated helminthic infection, that lead to adverse health consequences such as anemia and low birth weight. 44 million (35.5%) of pregnant women were infected with hookworm in low income countries. About 10 million of pregnant women in Africa are infected with schistosomiasis. Ethiopia is one of the high burden countries in Africa for infection of soil transmitted helminthes. Since there is difference of distribution of helminths infection within a country and in different geographic setup, the information on prevalence of intestinal Helminthiases and also the associated risk factors especially in pregnant women in the area is lacking.

Objective: To determine the prevalence of Intestinal helminthic infection among pregnant women attending antenatal care clinic of Nigist Eleni Mohammed Memorial Hospital Hossana, Southern Ethiopia, 2013.

Method and materials: A Hospital based cross sectional study design was employed. Two hundred fifty eight pregnant women attending antenatal clinic at Nigist Eleni Mohamed Memorial Hospital during the study period (September to November 2013) were included in the study. Structured questionnaire was used to collect data using interviewer administered technique which is developed after reviewing related studies. For parasitological examination, formol ether concentration technique was used to detect helminthes from clinical specimen. Data were analyzed using SPSS for windows version 16.0. Statistical tests were performed at the level of significance of 5%. Summary results, univariate and multivariate analysis was done to identify the significant risk factors.

Result: Five species of intestinal helminths were identified in the stool samples, with the overall prevalence of any helminths infection being 29.5% (76 out of total 258) .A. lumbricoides was the predominant helminths infection, detected in 10.1% of pregnant women. There was a statistical significant association between age, place of residence, income, occupation and unprotected water source with the presence of intestinal helminthes. There is positive association between presence of helminths infection and family size *(AOR* = 4.45*; 95% CI* = 1.98, 10.02, p=.001), presence of water body in the vicinity of residence (*AOR* = 3.39*; 95% CI* = 1.20, 9.57, p=.021) and habit of walking bare foot *(AOR* = 3.23*; 95% CI* = 1.28, 8.15, p=.013).

Conclusion: The present study showed a 29% prevalence of intestinal helminthes among pregnant women in the study area. Stool exam should be routinely performed during antenatal care follow-up. Public health measures should continue to emphasize the importance of environmental and personal hygiene as well as provide and monitor the quality of drinking water aiming to obtain a better quality of life.

Acknowledgement

I would like to thank my advisors Mr. Tariku Dejene and Mr. Tsegaye Tewelde for the constructive comments and advices they gave me.

Also, great thanks go to NEMM Hospital, Hossana and all research participants.

Finally, I would like to thank Jimma University, College of public health and medical sciences, Department of Epidemiology. Finally my thank goes to Nigist Eleni Mohammed Memorial hospital.

Table of Contents **page**

List of figures and Tables

List of Tables **Page**

Acronyms & Abbreviations

AIDS	Acquired immune deficiency syndrome
ANC	Antenatal care
CDC	Centers for Disease Control and Prevention
DHS	Demographic and Health Survey
EDHS	Ethiopian Demographic and Health Survey
EOS	Enhanced Outreach Strategy
EPGs	Eggs per gram of feces
HIV	Human Immunodeficiency Virus
IUGR	Intrauterine growth retardation
LBW	Low birth weight
MDA	Mass drug administration
NEMM	Nigist Eleni Mohammed Memorial Hospital
NTD	Neglected Tropical Diseases
SSA	Sub-Saharan Africa
WHO	World Health Organization
STH	Soil-Transmitted Helminths

1. INTRODUCTION

1.1 Background

Parasitic diseases especially caused by helminthes are ancient diseases that continue to cause misery and disability in poor populations. About 2 billion harbor these infections worldwide, of which 300 million suffer associated severe morbidity. School-age children and pregnant women are at greater risk. In 1999, WHO estimated that Schistosomiasis and soil-transmitted helminthiasis represented more than 40% of the disease burden due to all tropical diseases, excluding malaria [1, 2].

Helminths are metazoan organisms and include the cestodes, trematodes and nematodes. Of plenty species that infect humans, the species of greatest medical importance are Ascaris lumbricoides(roundworm), Ancylostoma duodenale and Necator americanus(hookworms), Trichuris trichiura (whipworm),Enterobius vermicularis(pinworm) and Strongyloides stercoralis (threadworm) [1]. Soil-transmitted helminthes (STHs) which refer to the intestinal worms infecting humans that are transmitted through contaminated soil, are among the most common infections worldwide and affect the poorest and most deprived communities [2,3].

Soil-transmitted helminth infection is found mainly in areas with warm and moist climates where sanitation and hygiene are poor, including in temperate zones during warmer months. These STHs are considered Neglected Tropical Diseases (NTDs) because they inflict tremendous disability and suffering yet can be controlled or eliminated [3,4].

Helminths infection can be transmitted directly from infected to uninfected people; in others, eggs must undergo a process of maturation outside the human host in a third category, the parasites may spend a part of their life cycle in the soil before becoming infective to humans. As with other parasitic infections, definitive diagnosis depends on demonstration of the stage of the life cycle in the host [3, 4].

Soil-transmitted helminths live in the intestine and their eggs are passed in the feces of infected persons. If an infected person defecates outside (near bushes, in a garden, or field) or if the feces

of an infected person are used as fertilizer, eggs are deposited on soil. *Ascaris* and hookworm eggs become infective as they mature in soil. People are also infected with *Ascaris* and whipworm when eggs are ingested. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth or by consuming vegetables and fruits that have not been carefully cooked, washed or peeled [3].

Hookworm eggs are not infective, because eggs passed in faeces need about three weeks to mature in the soil before they become infective. They hatch in soil, releasing larvae (immature worms) that mature into a form that can penetrate the skin of humans. Hookworm infection is transmitted primarily by walking barefoot on contaminated soil. One kind of hookworm (*Anclostoma duodenale*) can also be transmitted through the ingestion of larvae [2, 3].

Schistosoma species are transmitted by cercariae penetrating the skin when a person is bathing, washing clothes, fishing, or engaged in agricultural work or other activity involving contact with water that has been faecally contaminated and contains the snail hosts of the parasites. In its snail host the parasite multiplies and develops to its infective cercarial stage [4, 5].

Intestinal helminthes are rampant in the tropics because there are favorable climatic, environmental and sociocultural factors which permit transmission of these parasitic diseases for greater part of the year. These parasitic diseases, whether water-borne, vector-borne, soil transmitted or those that result from some poor sanitary or social habits provide some of the many public health problems in the tropics [4,5,6].

Morbidity is related to the number of worms harbored. People with light infections usually have no symptoms. Heavier infections can cause a range of symptoms including intestinal manifestations (diarrhoea, abdominal pain, rectal prolapse), general malaise and weakness, and impaired cognitive and physical development. Hookworms cause chronic intestinal blood loss that can result in anaemia. These infections are treatable with medication prescribed by health care provider [2, 3].

More than a quarter of women of reproductive age have chronic energy deficiency [9]. Iron deficiency is highest in population subgroups that are at peak rates of growth; namely, infants, young children, and pregnant women. Pregnancy is the most nutritionally demanding period in a woman's life [7].

1.2 Statement of the problem

More than two billion people are infected with helminth parasites worldwide [8]. Soil-transmitted helminth infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia [2]. According to WHO estimate in 2012, a large part of the world's population is infected approximately 807-1,121 million with *Ascaris* 604-795 million with whipworm and 576-740 million with hookworm [3].

According to the early estimate by Bundy and colleague, 44 million (35.5%) of pregnant women were infected with hookworm in low income countries [9]. Estimate in 2004 showed, about 10 million of pregnant women in Africa are infected with schistosomiasis, and half of these women suffer from anaemia of which more than 10% is from worm burdens heavy enough to adversely affect intrauterine growth, prematurity and birth weight [10].

In 2005, Brooker et al. estimated that 26.7% of pregnant women and 37.7 million (25.5%) women of reproductive age in SSA are infected with hookworm [11]. Similarly, studies conducted in different parts of Ethiopia also detected a more than 40% of prevalence of helminthes infection among pregnant women [12, 13].

Anemia is thought to be the major contributory cause of death in 20–40% of these maternal deaths [14]. Also it is estimated that 16–20% of all maternal deaths are associated with iron deficiency anemia [15].

In developing countries, both nutritional deficiencies and parasitic infection, specifically hookworm and malaria infection, contribute most to anemia. In fact, hookworm infections are recognized as the leading cause of pathologic blood loss in tropical and subtropical countries [14]. Hookworm infections contribute to anemia by causing blood loss directly through ingestion and mechanical damage of the mucosa, and indirectly, by affecting the supply of nutrients necessary for erythropoiesis [9, 10, 15, 16].

Most parts of Ethiopia are suitable for the transmission of STHs, except parts of Somali and Afar regions where the annual mean temperature is too high for transmission [17]. Parasitic helminthic infections are the second most predominant causes of outpatient morbidity in the

country. Ethiopia has one of the lowest quality drinking water supply and latrine coverage in the world. The effect of altitude, urbanization, irrigation, and resettlement on the distribution of intestinal parasitism was depicted in previous studies [18].

Ethiopia is one of the high burden countries in Africa for infection of Hookworm, Ascariasis Trichuriasis, schistosomiasis, teaniasis and Hymenolopsis nana [19, 20, and 21].

Intestinal parasitic infections, especially due to the helminthes have been associated with anemia in pregnant women [22]. Hookworm infections induce deficiencies of iron, total energy, protein, and possible folate and zinc. Evidence also suggests that both iron deficiency anemia and, separately, hookworm infection, will inhibit appetite. The results of this are low pregnancy weight gain and intrauterine growth retardation (IUGR), followed by low birth weight (LBW), with its associated adverse birth outcomes; this has been reported in the majority of studies [23-27].

Blood loss can be a feature of Trichuris trichiura infection, but it is less prominent than in hookworm infection; however, it often occurs along with hookworm infections and so this concurrent parasitic coinfections may accelerate the onset of iron-deficiency anemia. A. lumbricoides infection has been associated with impaired fat digestion, reduced vitamin absorption, and temporary lactose intolerance, and treatment has shown to improve nutritional status [25].

Immunomodulatory effects of helminths can differ by species and may affect both a pregnant woman and her fetus. For the overlapping geographic distribution of helminthiasis and malaria that resulted in high rate of co-infection, there is contradicting information on interaction between A.lubricoides and Plasmodium falciparum. The findings are an increase in or a protection from clinical malaria or no association [26, 27]. Both animal models and human studies suggest that chronic trematode, nematode, and protozoan infections can result in decreased vaccine efficacy [28].

In addition, STHs are considered to have potent immune modulatory effects, and may have an impact on the epidemiological distribution of other diseases. For example, A. lumbricoides and T. trichiura infections may contribute to an accelerated progression of HIV, a greater susceptibility to tuberculosis, and modify the development of allergy [29, 30].

In the developing world, young women, pregnant women, and their infants and children frequently experience a cycle, where under nutrition (macronutrient and micronutrient) and repeated infection including parasitic infections, lead to adverse consequences that can continue from one generation to the next. It is undoubtedly much better to enter a pregnancy free of infection and nutritionally replete than the various alternatives [22, 31].

Determinant of helminth infection depend on the route of transmission and lifecycle of the helminth. Commonly helminth infections are related to hygiene, sanitation and, for some species, environmental conditions required for the intermediate hosts or for a free-living soil-dwelling stage. Immunological responses according to the species vary with age, but long-term chronic infection over several years has been observed for many species. Environmental conditions like humidity, temperature, other climatic factors and presence of water affect the distribution of helminthes [32, 33]. For pregnant women the risk factors can be categorized as background: demographic and socioeconomic variables, intermediate :HIV status, gravidity and type of water source, and the proximate risk factors include prior anthelmintic treatment, crowding in the household, exposure to lake or rivers through swimming or bathing, home toilet facilities and walking barefoot [31].

Periodical deworming to eliminate infecting worms, health education to prevent reinfection, improved sanitation to reduce soil contamination with infective eggs. Safe and effective medicines are available to control infection [2].

The treatment of helminthic infections during pregnancy has been shown to have many beneficial effects, including the reduction of HIV mother-to-child transmission (MTCT), low birth weight incidence, and infant mortality and other detrimental effects of chronic maternal parasitic infection on infant outcomes [34,35].

However, despite High burden of helminthes infection in Ethiopia, the control is not well targeted and the sanitary condition is still low. Since there is difference of distribution of helminths infection within a country and in different geographic setup, the information on prevalence of intestinal Helminthiases and also the associated risk factors especially in pregnant women in the area is lacking.

Therefore the study is aimed to determine the prevalence and assess the associated risk factors of intestinal helminthic infection among pregnant women's attending the ANC of Nigist Eleni Mohamed Memorial Hospital (NEMM) hospital, Hosanna, southern Ethiopia.

2. LITRATURE REVIEW

A majority of studies have tried to show the consequence of helminthic infection like anemia in pregnant women. Those studies focused on the helminthic infection in pregnant women are of cross sectional in nature and few longitudinal studies are conducted especially in Ethiopia.

2.1 Prevalence of helminthiasis among pregnant women

A majority of studies conducted elsewhere in low income countries indicated the high prevalence of intestinal parasitosis especially the helminthiases. Among pregnant women in rural Kenya; 3 out of 4 women were infected with geohelminth (76.2%). A. lumbricoides (52.3%) was most prevalent, followed by hookworm (39.5%) and T. trichiura (29.0%) [38]. Similarly a study from Nigeria showed a prevalence of 43.4% helminthic infection among pregnant womens. Hookworm and Ascaris lumbricoides had the highest prevalence of 35.8% (n=62) and 55.5% (n=96) respectively. This was followed by Enterobius vermicularis 6(3.5%), Trichuris trichuira 5(2.9%) and Strongyloides stercoralis had 4(2.3%) respectively. Also, an overall prevalence of co-infection was 13.8%, of which co-infection of A. lumbricoides + Hookwoorm was most predominant 18(85.7%). This was followed by A. lumbricoides +T. trichuria 2(9.5%) and Hookworm + Trichuris trichuria 1(4.8%) [39].

According to the study conducted in Iquitos, Peru, the overall prevalence were 47.22% for hookworm, 82.25% for trichuris, and 63.92% for ascaris. Only 9.31% of the pregnant women were free of any parasite infection; 20.25% of the women had a single infection, 38.96% had two infections and 31.48% were infected with all three worm infections. The prevalence of trichuris and hookworm co-infection was 44.05% [40].

In a study which participated 1038 pregnant women in Venezuela, a high (73.9%) prevalence of Intestinal parasitosis was evidenced. The identified species was A lumbricoides 57.0%, T trichiura 36.0%, G lamblia 14.1%, E hystolitica 12.0%, N americanus 8.1%, E vermicularis 6.3%, S stercoralis 3.3% [41].

Longtudinal study conducted in Gabon with a 3 times stool check, Overall prevalence of intestinal helminths and urinary schistosomiasis was 64% (216 out of 340). The distribution of the species was A. lumbricoides 33%, T. trichiura 24%, hookworm 10%, S. haematobium 12% [42].

Hookworm infection was the predominant species detected in 1112 out of 2498 Ugandan women (44.5%), S. mansoni 458 of 2498 (18.3%), Strongyloides 306 of 2485 (12.3%), Trichuris 226 of 2498 (9.0%), and Ascaris 58 of 2498 (2.3%). Of the 2477 tested for all helminth infections, 1693 (68.3%) had at least one helminth infection. Species identified with low prevalence are Trichostrongylus (26 cases), Hymenolypsis nana (4 cases), Enterobius vermicularis (1 case) [31]. One in four women (23.0%) were found to be infected with one or two of the following helminths: Schistosoma mansoni (12.3%), hookworm (7.0%), Strongyloides stercoralis (2.3%), Ascaris lumbricoides (0.7%) and Trichostrongylus (0.7%). The percentage mixed infection of the helminths was 9.7% with hookworm and S. stercoralis having the highest mixed infection of 4.8% [43].

In Ethiopia, soil transmitted helminthic infections are frequently reported and highly prevalent. Ascaris lumbrcoides (A. lumricoides) and Trichuris trichuria (T. trichuria) are wide spread in Ethiopia but prevalence rate vary considerably: rates are lowest in the low land and dry areas of the country than in more humid high lands [18].

In 2009, the prevalence of intestinal helminthic infection among pregnant women attending ANC of Bushule health center in southern Ethiopia was 64.7%. Out of 218 helminthic infected women 40.4 % (88 women) showed more than one intestinal helminthic infection. A. lumbricod was the leading (48.4%) parasite among pregnant women. About 41% helminthic infected women had mixed infections, due to two or more than two different parasite species [12].

A cohort study on mothers and their infants from Butajira, Ethiopia detected overall prevalence of any STH infection being 43.5% (95% confidence interval (CI) 40.2-46.8%). Hookworm was the predominant intestinal helminth infection, detected in 36.1% of mothers and A. lumbricoides was the second most frequently detected intestinal parasite with prevalence of 8.8% .About one third (36.2%) of mothers had a single infection, while 6.6% had double infections, 0.7% had triple infections [44].

Prevalence is seldom used as the only measure to assess the epidemiological situation for that helminth infection, because morbidity is associated with the number of worms infecting the host (i.e., the worm burden) rather than the absence or presence of infection. Prevalence is commonly combined with worm burden (also referred to as the "intensity of infection"), which is commonly measured by the number of eggs per gram (EPGs) of feces for intestinal helminths and schistosomes [2,13].

2.2 Risk factors of Intestinal helminthiases in pregnant women

Climate and topography are crucial determinants of the distribution of helminth infections [32]. Helminths transmitted by vectors are limited to landscapes in which host and vector come together in the same habitat, resulting highly focal distribution. Soil-transmitted helminths are highly affected by surface temperature, altitude, soil type, and rainfall [5,6,32].

Much epidemiologic research has focused on heterogeneity in the intensity of helminth infection by age. Changes with age in the average intensity of infection tend to be convex, rising in childhood and declining in adulthood. For Ascaris lumbricoides and Trichuris trichiura, the heaviest and most frequent infections are in children aged 5–15 years, with a decline in intensity and frequency in adulthood. In contrast, hookworm frequently exhibits a steady rise in intensity of infection with age, peaking in adulthood [45].

For pregnant womens the risk factors identified according to Woodburn PW et al. are: **Background risk factors:** Maternal age, education and tribe were considered. Socioeconomic variables comprised building materials, number of rooms and items owned. Zone of Residence, **Intermediate risk factors**: for helminths, HIV status, gravidity and type of water source; **Proximate risk factors** considered for helminths were prior anthelmintic treatment, crowding in the household, exposure to lake or rivers through swimming or bathing, home toilet facilities and walking barefoot [31].

A study from Gabon showed primiparous and young women (<21 years of age) had a significantly higher prevalence of helminth infections [42]. However, in Nigeria, the prevalence of intestinal nematode with age shows no significant difference ($p>0.05$), but the prevalence with occupation (farmers with higher prevalence) and with pregnant women with children less than 8 years of age (higher prevalence) shows a significant difference ($p<0.05$) [39].

Increased gravidity number was associated with increased prevalence of A. lumbricoides and decreased prevalence of hookworm infections (trend test P = 0.003 and P = 0.03, respectively); there was no clear pattern for T. trichiura. Complaints in the previous two weeks such as diarrhea, loss of appetite, abdominal pain, itching, fever, cough, or a rash were not associated with geo-helminth infections overall, or by species, or by combination of species [38].

Infections with at least one geo-helminth species were associated with the use of an unprotected water source (adjusted odds ratio [AOR] 1.8, 95% CI 1.1–3.0) and the lack of household treatment of drinking water (AOR 1.8, 95% CI 1.1–3.1, adjusted for each other). However, water source or treatment was not statistically significantly associated with any geohelminth species. A report of eating soil was not associated with geohelminth infection overall or by species [38].

Women living in rural areas had a significantly higher prevalence of hookworm infection compared with women living in periurban areas. Hookworm infected women were generally married or convenient and multiparous, with less than a secondary school education. Women with animals in their house were found to have a significantly lower prevalence than women not having animals in their house. Women not wearing sandals either inside or outside of their houses had higher hookworm prevalence than women wearing sandals [40].

Young age and lack of education were risk factors for all species. Higher household socioeconomic status showed a protective association with hookworm, and Strongyloides infections, but no association with S. mansoni or Trichuris [31].

Significant positive associations were seen between presence of any STH in the mother and living in a house with a thatched roof (Odds Ratio (OR) 1.62; 95% CI 1.18-2.24, p = 0.003), home ownership (OR 1.67, 95% CI 1.04-2.68, p = 0.033), cooking inside (OR 1.68; 95% CI 1.18-2.37, p = 0.003) and for disposing waste in open field relative to burying or burning (overall p = 0.013, OR 1.66; 95% CI 1.23-2.46). In addition, frequency of soap use was significantly associated with maternal infection with increased risk seen for infrequent soap users compared to daily use (overall p = 0.008, OR 1.51, 95% CI 1.14-2.01). A significant negative association was found in relation to urban living (OR 0.48; 95% CI 0.32-0.73, p = 0.001), whereas the association with education level was only of borderline significance (p for trend = 0.051 OR 0.71; 95% CI 0.51-1.00) [44].

The independent predictors of maternal infection identified from multivariate analysis are Soap use (adjusted OR = 1.40; 95% CI 1.04-1.88 for infrequent users compared with daily users, p for trend = 0.018) and urban living (adjusted OR = 0.45; 95% CI 0.28-0.73, p = 0.001), remained significant factors [44].

The consequence of helminthic infection in pregnant women is understood, means of averting the infection is use of anthelminthic drugs. The relationship between hookworm infection and anaemia is well recognized, with numerous intervention trials showing a direct effect of cure of infection with reduction in prevalence and intensity of iron deficiency anaemia. However, for A. lumbricoides and T. trichiura infection, the relationship between infection and specific morbidity measures is less well established. Less easily measured parameters such as hypoproteinemia have been attributed to heavy infection with these parasites, but likewise there is a dearth of quality epidemiological data. Also other than the anemia noted, there is little documentation of other widespread pregnancy-associated consequences of schistosomiasis [25, 33].
Mebendazole and albendazole are considered safe in pregnancy after the first trimester [25]. However only some countries have added deworming to their antenatal care programs [10]. This lack of deworming of pregnant women is explained by the fact that most individuals still fear that anthelmintic treatment will result in adverse birth outcomes. So far studies have validated recommendations to treat infected pregnant women for hookworm infection during pregnancy.

A majority of studies showed a benefit of deworming for maternal or child health, but since a variety of outcomes measures were employed it is difficult to compare study findings quantitatively [10].

As deworming is believed to amplify the effect of vaccination then it is clearly time to intensively test and implement antiworm strategies and their ‘‘indirect vaccination’’ effect on at-risk populations [28, 33].

For sustainable control of helminths infections, while maintaining high coverage of anthelminthic treatment among children and pregnant mothers, it is essential to ensure access to safe water, adequate sanitation facilities and good hygiene at the community level [25, 28, and 33].

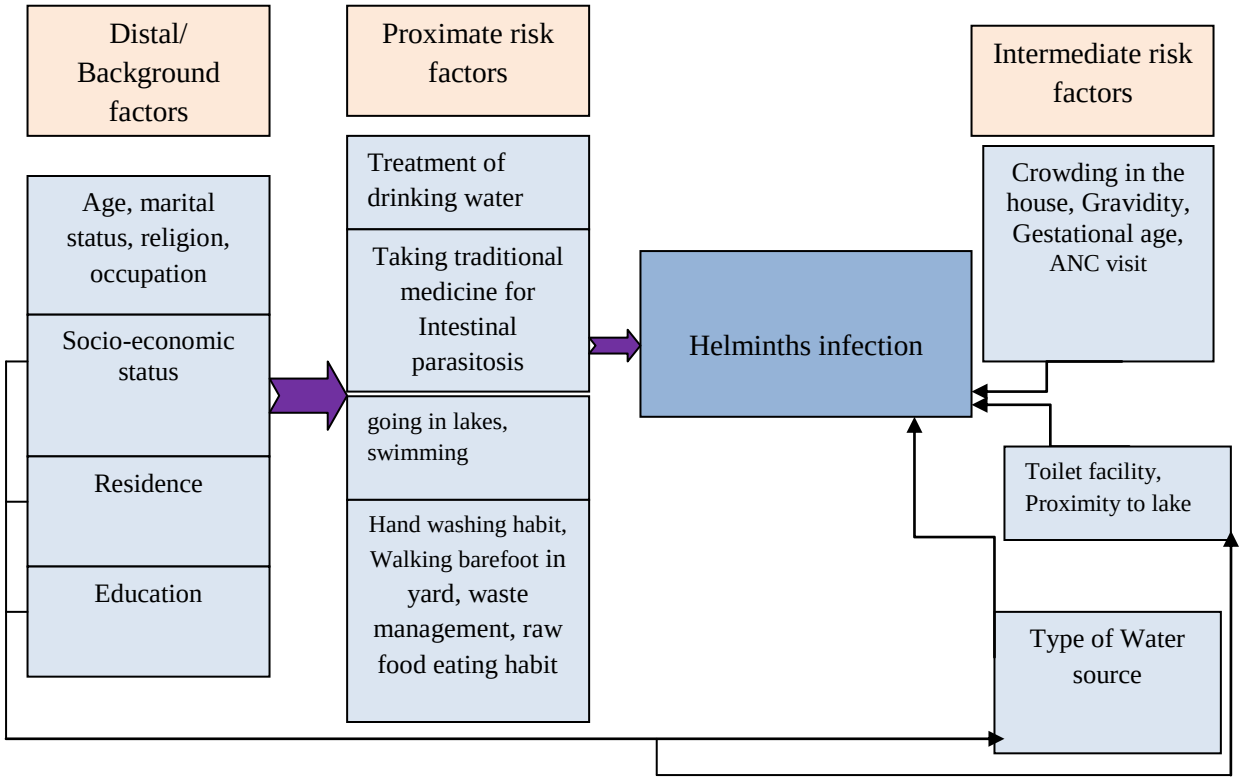

Figure 1. Conceptual framework on risk factors for helminthic infection in pregnant women. Adapted from: Woodburn et al., 2009. doi:10.1371/journal.pntd.0000473.g001

Expected associations are shown using short, solid and larger arrows; possible associations are shown using thinner arrows. Back ground risk factors are variables which are route to all others like socio economic, environmental, and education. Intermediate variables are those factors such as ANC visit, gravidity, and crowding .Immediate practices such as personal and environmental hygiene are taken as proximate risk factors for acquiring helminth infection.

2.3. Significance of the Study

A majority of studies conducted elsewhere identified helminthiasis as a major risk factor for development of anemia in pregnant women. Added to this is the lack of iron in the diet, especially in rural and poor communities in which the problem is exacerbated. Therefore determining the prevalence and their related factors of infection on these risk groups was the primary step for indicating the necessity of control measures to be taken.

The finding of the study was the prevalence and associated factors for major intestinal helminthes among ANC attending pregnant women which will provide information on the extent of helminthes infection among pregnant women which can be utilized for the control measures.

The outcomes of the findings can help in the evidence- based decision to develop control intervention strategies to improve the health status of the most vulnerable group i.e. pregnant women. The findings will indicate groups at risk of infection, and this may help in targeting interventions to prevent, treat, or mitigate the impact of intestinal helminthes infections in pregnancy.

3. OBJECTIVES OF THE STUDY

3.1 General objective

To determine the prevalence and associated factors of intestinal helminthic infection among pregnant women attending ANC clinic of NEMM Hospital Hossana, Southern Ethiopia, 2013.

3.2 Specific objectives

1. To determine the prevalence of Intestinal helminthic infection among pregnant women attending ANC clinic at Nigist Eleni Mohamed Memorial Hospital
2. To assess socio demographic, environmental, and personal factors associated with intestinal helminth infections among pregnant women attending ANC clinic at NEMM Hospital

4. METHODS AND MATERIALS

4.1 Study area and period

The study was conducted at Nigist Eleni Mohamed Memorial Hospital ANC clinic which is located in Hossana Town, Hadiya Zone, Southern Nation's Nationalities and People's Regional sate (SNNPR). Hossana town, a capital of the zone, is located 232 km south west of the capital city Addis Ababa and 194 km far from the regional capital, Hawassa. The total area of the zone is 374.2 Square kilo meter 3542.66 sq. km and comprises ten woredas, one town administration, 305 rural and 24 urban kebeles with a total population of 1,506,733. Expected Pregnant Women are 54,242 (3.6%) of the population [46].

Latitudinal and longitudinal extension is roughly between 7°45'N and 38°28' E. Rainfall distribution in Hadiya zone is seasonal. The amount of rainfall received ranges from 156.32mm.to468.97mm. The rainy season lasts from June to August. Temperature is 22.54°c. Annual mean-maximum temperature and Mean-minimum annual temperature is 10.54°c. This shows the temperature in the zone is moderate except in very low points along the gibe river valley. Then the zone experiences medium temperature or the climate in Hadya zone is mild tropical highland type. The altitudinal variation between the average highest peak and the lowest point in the zone ranges from 2970m at Sengiye in Duna woreda and 840m and 800m at Gortancho and gibe valley in sore worada respectively. High land 24% mid land 65% and low land 11%. As zonal hospital, services like outpatient, emergency, family health, dental, psychiatry, eye, gynyobs, general surgery, radiography and sonography are given [46]. The data was collected from September to November 30, 2013.

4.2 Study Design

A Hospital based cross sectional study design was used

4.3 Population

4.3.1 Source population

All pregnant women attending ANC clinic of Nigist Eleni Mohamed Memorial Hospital

4.3.2 Study population

Pregnant women attending ANC clinic at Nigist Eleni Mohamed Memorial Hospital during the study period that met the inclusion criteria and sampled.

4.3.3 Study unit

Pregnant woman attending ANC clinic at Nigist Eleni Mohamed Memorial Hospital

4.4 Eligibility criteria

4.4.1 Inclusion criteria

- Resident in Hossana town and surrounding kebeles
- Not having received anthehelminthic treatment for the last 6 months

  This was identified by asking the women whether she have complained of gastrointestinal discomforts or symptoms, and what she did for this, where she had gone to health facilty, the findings of diagnosis, the treatment given if she remembers.

4.4.2 Exclusion criteria

- Patients with mental health problems
- Hearing impairments or any other serious health problems

4.5 Sample size determination and sampling technique

4.5.1 Sample size determination

The required sample size was calculated based on the prevalence rate of 64.7% of intestinal helminthic infection in pregnant women reported from southern Ethiopia [42]. The required sample size was computed using single population proportion formula,

$$n = \frac{(Z_{\alpha/2})^2 p(1-p)}{d^2} = \frac{(1.96)^2 * 0.647 * (1-0.647)}{(0.05)^2} = 351$$

Where, P= Estimated proportion of pregnant women infected with intestinal helminthes (64.7%)

$Z_{\alpha/2}$= Critical value at 95% level of confidence (Z =1.96)

d= Margin of error (5%), the calculated sample size = 351.

On average about 16 pregnant women is served per day at the ANC clinic of the hospital and the total number of pregnant women that attend during the two month study period were about 640.

Since the population was finite, then the final sample size, n, were calculated by applying finite population correction formula as follows,

$$n = \frac{n_0}{\left(1 + \frac{n_0}{N}\right)}$$

where, n_o = 351 and N = 640, Therefore n is 234 and by adding 10% non response rate the final sample size was 258

4.5.2 Sampling technique

A systematic random sampling technique was used considering the average no of pregnant women attending ANC clinic per day of 16. Since the sample collection period for the study was for two months, the total number of pregnant women that attend the clinic (N) were 640. To determine the sampling interval (K), the following formula was used, K = N/n = 640/258 = 2.4, so every 2^{nd} pregnant women that came to the ANC clinic from September to October 30 were included in the sample until the required sample was achieved.

4.6 Study Variables

Dependent variable

- Intestinal helminthes infection

Independent Variables

- Age
- Residence
- Occupation
- Ethnicity
- Marital status
- Religion
- Educational status
- Medication
- Gestational period

- Availability of latrine
- Shoe wearing habit
- Water supply
- Presence of animals
- Parity
- Economic status

4.7 Measurement

4.7.1 Data collection instrument and procedure

Questionnaires

Structured questionnaire was used to collect data using interviewer administered technique which is developed after reviewing related studies. The questionnaire has three sections that was used to obtain socio-demographic information, personal, and environmental characteristics.

Questionnaire was prepared in English and translated into Amharic and translated back into English to check its consistency. The Amharic version was used for data collection after pretesting on 10% of the actual sample size at Hosanna health center which is not actual data collection site and before the data collection period. Some clarifications and other corrections on the questionnaire was made after pre-testing.

Unique code was given for each questionnaire and on the laboratory request format which is placed at lab. The participant after interview was requested to give stool sample by giving a code which relates the questionnaire and the laboratory request format.

Parasitological examination

Source of Specimens and Collection

Clinical specimens of stool from pregnant women attending antenatal clinic at NEMM Hospital, Hossana was used for parasitological examination. The selected subjects were given a dry clean bottle. Subjects were instructed to collect stool sample.

Macroscopic Examination

All specimens were examined for the presence of adult worms, or segment, the consistency, color, presence of mucus and blood.

Microscopic Examination (Saline Preparation)

It was carried out on the faecal sample collected using wet preparation. A drop of fresh physiological saline was placed on a clean slide. Using an applicator stick, a small amount of stool specimen was emulsified in saline solution. The preparation was covered with cover slip and examined under the microscope for the presence or absence of intestinal parasite, larvae or ova. The preparation was observed under the microscope using 10x and 40x objectives respectively with the condenser iris closed sufficiently to give good contrast [5].

Concentration technique

Formol-ether concentration: 1g of stool was emulsified in 7ml of 10% formol saline and it was kept for 10 minutes for fixation. Straining through wire gauze, the filtrate was added to 3 ml of ether and centrifuged at 2000 rpm for 2 minutes. It was allowed to settle. The supernatant was removed and a wet mount made of the deposit used to look for parasites [5].

4.8 Data processing & analysis

Data were entered and analyzed using SPSS version 16 computer software (SPSS INC...2007). Summary results were presented by frequency tables and graphs. Bivariate analysis was performed to check the existence of association between dependent and independent variables.

Variables which are significant at a P value of < 25% in binary logistic regression were considered for multiple logistic regression. Finally all groups of selected explanatory variables was fitted to a final model and the p- value less than 0.05 was used as cut off point for presence of statistical significance.

4.9 Quality Assurance

Training was provided to selected data collectors for three days about the objective and process of data collection. Interviewers that can also speak Hadiyigna (local languages) and was midwives and nurses were trained on questionnaire administration to attain standardization and maximize interviewer reliability. Laboratory technicians were also trained to follow the

standard operating procedures. Pre-testing was conducted at Hosanna town health center ANC clinic before actual data collection.

Standard operating procedure (SOP) was used for every laboratory procedures. Closer supervision was undertaken during data collection and problems faced were discussed over night with data collectors and the supervisors. Random specimens were taken and reanalyzed for cross checking of the accuracy of laboratory results.

4.10 Ethical consideration

Ethical clearance was obtained from ethical committee of Jimma University, college of public health and medical science. Permission paper was sought from Hadiya Zone Health Department and Nigist Eleni Mohammed Memorial Hospital. Similarly after clear discussion about the actual study or explaining of purpose of the study, verbal informed consent was obtained from each study participants. Participant's right to refuse participation in the study or withdraw at any time during the course of the interview was respected and it was clarified that this decision will not affect the care they seek to receive. Identification of study participants by name was not recorded to assure the confidentiality of the information obtained.

Pregnant women with positive result were communicated with the ANC clinic worker and were advised and prescribed for anthelminthic treatment as per guideline.

4.11 Dissemination plan

The final result of this study will be presented to Jimma University, College of Public Health and Medicine and disseminated to Hadiya zone health bureau and Nigist Eleni Mohammed memorial hospital.

4.12 Operational definitions

Infrequent soap use: Those who do not use soap after toilet daily. Use some times as soap is available.

Water source pipe inside compound: those who have a pipe inside the compound and usually used privately.

Water source pipe outside compound: are those whose source of water is from a pipe outside the compound mainly shared or public.

5. RESULTS

5.1 Socio-demographic characteristics of the respondents

A total of 258 consented pregnant women who came for their antenatal follow up were enrolled in this study. The mean age of the attendants was 25.4 years old with standard deviation (SD) of 3.8 years. Four (1.6%) were below 18 years old, and six (2.3%) were 36 years old and above. Majority of the study group were 19- 35 years old. One hundred ninety six (76%) of the women came from urban. Out of 258 attendants 127 (49.2%) attended above secondary school, 79 (30.6%) were primary and junior grades and 52 (20.2%) can't read and write.

One hundred thirty three (51.6%) pregnant women were house wife, 89 (34.5%) were employed, 28 (10.9%) merchant or self-employed and 8 (3%) were students. Two hundred forty nine (96.5%) were married. The mean monthly income of the family was 1828.8 Birr (range from 200 – 5000).

5.2 Personal and environmental characteristics

Hundred thirty seven (53.1%) of the respondents live in households with water source with piped inside the compound and 99 (38.4%) use piped water outside their compound. Majority of the respondents (95%) live in households that have toilet facility. Also a high proportion of respondents (95.3%) wash their hands after toilet. Most (98.8%) of them also responded to wash hands before preparing food (Table 5.2).

5.3 Prevalence of Intestinal helminths

Five species of intestinal helminths were identified in the stool samples, with the overall prevalence of any helminths infection being 29.5%. Ascaris lumbricoides was the predominant intestinal helminths infection, detected in 10.1% of pregnant women, and Hookworm was the second most frequently detected intestinal parasite with prevalence of 7.0%. More than one fifth (22.6%) of pregnant women had a single infection, while 6.9% had double infections (Table 5.1).

Table 5.1: Prevalence of intestinal helminths infection in pregnant women in the NEMM hospital, Hosanna, Ethiopia, 2013

Intestinal parasites	No (%) N=258
A.lumbricoides	26 (10.1)
Hookworm spp	18 (7.0)
T.trichuria	9 (3.5)
Taenia spp	3(1.2)
H.nana	2 (.8)
Ascaris with Hook worm	13 (5.0)
Ascaris with Trichuria	5 (1.9)
Total prevalence of any helminths infection	76 (29.5)
No ova or helminthic parasite seen	182 (70.5)

N = total number of study participants

5.4 Bivariate analysis of risk factors for intestinal helminthiasis among pregnant women

The presence of intestinal helminths was assessed based on socio-demographic characteristics of the study subjects. Age, residence, occupation, income family, religion, marital status and educational status were taken as study variables to see the outcome of dependent variable. There was a statistical significant difference between age, place of residence, income, occupation and family size with the presence of intestinal helminthes. No significant difference by religion, ethnicity and marital status (table 5.2).

Table 5.2: Associations of sociodemographic factors of intestinal helminthes infection in pregnant women using binary logistic regression in NEMM Hospital, Sep.-October 2013 (N = 258)

Characteristics	Helminthes		Total	COR (95% CI)	P-value
	No (N/%)	Yes (N/%)			
Age					
<19	4(80)	1(20)	5	1	
20-24	80(81.6)	18(18.4)	98	0.43(0.043, 7.65)	0.455
≥25	98(63.2)	57(38.8)	155	0.38(0.21, 0.71)	0.002
Place of residence					
Urban	160(81.2)	37(18.8)	197	1	
Rural	22(36.1)	39(63.9)	61	7.66(4.07, 14.44)	0.000
Marital status					
Married	174(69.9)	75(30.1)	249	1	
Single/Widowed	8(88.9)	1(11.1)	9	0.29(0.04, 2.36)	0.247

Ethnicity					
Hadiya	109(69)	49(31)	158	1	
Kembata	29(78.4)	8(21.6)	37	0.61(0.26, 1.43)	0.261
Amhara	17(56.7)	13(43.3)	30	1.70(0.77, 3.77)	0.191
Silte	8(88.9)	1(11.1)	9	0.28(0.034, 2.28)	0.234
Guraghe	16(76.2)	5(23.8)	21	0.69(0.24, 2.005)	0.501
Education					
Can't read and write	17(32.7)	35(67.3)	52	1	
1-6 grade	26(70.3)	11(29.7)	37	0.205(0.08, 0.51)	0.001
7-8 grade	36(85.7)	6(14.3)	42	0.08(0.03, 0.23)	0.000
≥9grade	103(81.1)	24(18.9)	127	0.12(0.055, 0.24)	0.000
Religion					
Protestant	127(73.8)	45(26.2)	172	1	
Muslim	20(87.0)	3(13.0)	23	0.423(0.12, 1.49)	0.181
Orthodox	30(55.6)	24(44.4)	54	2.26(1.19, 4.26)	0.012
Catholic	5(62.5)	3(37.5)	8	1.69(0.39, 7.37)	0 .483
Income					
≤1500	86(63.7)	49(36.3)	135	1	
>1500	96(78)	27(22)	123	0.49(0.28, 0.86)	0.012
Family size					
≤2	81(84.4)	15(15.6)	96	1	
≥3	101(62.3)	61(37.7)	162	3.26(1.73, 6.16)	0.000
Occupation					
Employed	58(65.2)	31(34.8)	89	1	
House wife	92(69.2)	41(30.8)	133	0.83(0.47, 1.47)	0.532
Merchant/farmer/student	32(88.9)	4(11.1)	36	0.23(0.08, 0.72)	0.012

Presence of helminths infection was also assessed based on personal and environmental factors. There was significant association between presence of helminths infection and unprotected water source (Odds Ratio (OR) 3.039; 95% CI 1.961, 4.709, p = .000), soap use for hand washing (OR 2.631, 95% CI 1.088-6.363, p = .032), presence of water body in the vicinity of residence (OR 3.356; 95% CI 1.844-6.107, p = 0.000) and habit of walking bare foot (OR 5.883; 95% CI 3.262-10.612, p = 0.000). No significant difference in helminths infection by home ownership (p=0.159), frequency of soap use (p=0.341) (Table 5.3).

Table 5.3: Associations of personal and environmental factors of intestinal helminthes infection in pregnant women using binary logistic regression in NEMM Hospital, Sep.-October 2013 (N =258)

Characteristics	Helminthes		Total	COR (95% CI)	P-value
	No (N/%)	Yes (N/%)	(N/100%)		
Type of House					
Corrugated sheet	163(76.9)	49(23.1)	212	1	
Thatched	19(41.3)	27(58.7)	46	4.73(2.42, 9.22)	0.001
Water source					
Pipe in the compound	111(81)	26(19)	137	1	
Pipe outside compound	66(66.7)	33(33.3)	99	2.13(1.17, 3.88)	0.013
Unprotected source	5(22.7)	17(77.3)	22	14.51(4.90, 42.94)	0.001
Gravida					
Premigravida	80(72.1)	31(27.9)	111	1	
Multigravida	102(69.4)	45(30.6)	147	0.878 (0.51, 1.51)	0.640
Trimester					
First	8(100)	0(0)	8	0.00	0.999
Second	104(65.8)	54(34.2)	158	1.65(0.92, 2.95)	0.090
Third	70(76.1)	22(23.9)	92	1	
Frequency of soap use after toilet					
Daily	164(73.2)	60(26.8)	224	1	
Infrequently	14(63.6)	8(36.4)	22	1.56(0.62, 3.91)	0.340
Presence of water body in the vicinity of households					
Yes	31(50)	31(50)	62	1	
No	151(77)	45(23)	196	0.29(0.16, 0.54)	0.001
Traditional Medicine taken In the last 6^{th} month					
Yes	26(46.4)	30(53.6)	56	1	
No	156(77.2)	46(22.8)	202	0.27(0.14, 0.47)	0.001
Animal live in the House					
Yes	54(59.3)	37(40.7)	91	1	
No	128(76.6)	39(23.4)	167	0.44(0.26, 0.77)	0.004
Habit of walking barefoot					
Yes	33(43.4)	43(56.6)	76	1	
No	149(81.9)	33(18.1)	182	0.17(0.09, 0.31)	0.001
Wear sandal frequently					
Yes	154(74)	54(26)	208	1	
No	28(56)	22(44)	50	2.24(1.18, 4.24)	0.013

COR: crude odds ratio

5.5 Multivariate analysis of risk factors for intestinal helminthiasis among pregnant women

In multivariate analysis, selected variables from binary analysis were fitted by backward method. The significant predictor of helminths infection in pregnant women at NEMM hospital was family size, income, place of residence, type of house, water source, presence of water body and habit of walking barefoot (Table 5.4). After controlling for place of residence the only significant variables

were the presence of water bodies in the vicinity of residence, habit of walking bare foot, and increased risk of infection as family size increases.

Pregnant women who live around or near lakes or any other water bodies were about three times more likely to be infected by intestinal helminthes *(AOR* = 3.39*; 95% CI* = 1.202, 9.573, p=.021). And also those who have habit of walking bare foot have three times more likely to have intestinal helminths *(AOR* = 3.23*; 95% CI* = 1.28, 8.15, p=.013), and those pregnant women with greater than three family size are about five times more likely to have intestinal helminths than those from family size of less than or equal to two *(AOR* = 4.45*; 95% CI* = 1.98, 10.02, p=.000).

Table 5.4: Multivariate analysis of independent risk factors for intestinal helminths infection in pregnant women in the NEMM hospital, Hosanna, Ethiopia, 2013

Characteristics	Helminthes		Total	AOR (95% CI)	P-value
	No (N/%)	Yes (N/%)	(N/100%)		
Family size					
≤2	81(84.4)	15(15.6)	96	1	
≥3	101(62.3)	61(37.7)	162	4.45(1.98, 10.02)	0.001
Income (in Birr)					
≤1500	86(63.7)	49(36.3)	135	1	
>1500	96(78)	27(22)	123	0.48(.23, .99)	0.048
Place of residence					
Urban	160(81.2)	37(18.8)	97	1	
Rural	22(36.1)	39(63.9)	61	3.64(1.33, 9.97)	0.012
Type of House					
Corrugated sheet	163(76.9)	49(23.1)	212	1	
Thatched	19(41.3)	27(58.7)	46	0.24(.06, .89)	0.033
Water source					
Piped in the compound	111(81)	26(19)	137	1	
Piped outside compound	66(66.7)	33(33.3)	99	1.12(.49, 2.58)	0.790
Unprotected source	5(22.7)	17(77.3)	22	8.71(1.60, 27.39)	0.012
Presence of water body					
Yes	31(50)	31(50)	62	3.39(1.20, 9.6)	0.021
No	151(77)	45(23)	196	1	
Habit of walking barefoot					
Yes	33(43.4)	43(56.6)	76	3.23(1.28, 8.15)	0.013
No	149(81.9)	33(18.1)	182	1	

1: Reference category, AOR: adjusted odds ratio

6. DISCUSSION

This study showed the prevalence of intestinal helminthic infection among pregnant women attending antenatal care clinic of Nigist Eleni Mohammed Memorial Hospital Hossana, Southern Ethiopia with total prevalence of 29.5%. This is lower than findings from pregnant women in rural Kenya (76.2%) [38], Venezuela (73.9%) [41], Gabon 64% [42], and Ugandan women (68.3%) [43]. Similarly it is lower from the study conducted in 2009, in southern Ethiopia (64.7%) [12]. This low prevalence in this study might be due to geographic difference , time gap where those studies were done averagely four years ago but nowadays there is a better awareness of about intestinal parasite infection and their cause. Even though a study conducted at Butajira, Ethiopia is on mothers and their infants i.e some difference on study subjects, that detected overall prevalence of any STH infection being 43.5% [44], we may consider as comparable to this study as there is varying prevalence in different parts of Ethiopia.

The predominant parasite detected in this study was Ascaris lumbricoides which is similar with the most of studies conducted in low income countries and also in Ethiopia [12, 38, 39, 41, and 42].
An overall prevalence of co-infection in this study was 7% of which A. lumbricoides and Hookwoorm is the dominant. Similarly A. lumbricoides and Hookwoorm co-infection with 6.6% in Butajira [44] and 13.8% prevance were reported from Nigeria [39]. Also the study from Uganda reported 9.7% co-infection but with a Hookworm and S. stercoralis combination [31].
The prevalent species of intestinal helminthes identified in this study and also in studies conducted elsewhere are A.lumbricoides and Hookworm species.
On bivariate analysis there was a statistical significant difference between age, place of residence, income, occupation and family size with the presence of intestinal helminthes. No significant difference by religion, ethnicity and marital status.
Highest prevalence of helminthes was observed in women aged less than 25(53%). Similarly study from Gabon, young women (<21 years of age) had a significantly higher prevalence of helminth infections [42] and also from Uganda [31]. Regarding occupation a higher prevalence is observed among housewife and employee, lower in farmers and students. This is different from study in Gabon in which prevalence was high among farmers [39]. This is due to difference in study subjects in most of them were from urban area in this study. Women living in rural areas had

significantly higher prevalence of hookworm infection (63.9%) compared with women living in urban (18.8%) area which is similar with study conducted by Larocque. R etal in 2005 [40].

Helminths infected women were generally with less than a secondary school education. Women with animals in their house were found to have a significantly higher prevalence than women not having animals in their house (p=.004) which shows a poor living condition. According to Larocque. R etal a different result was observed in which women with animals in their house were found to have a significantly lower prevalence than women not having animals in their house [40]. This might be explained in other way as owing animals might be related with higher income and these families may be protected from other risk factors for infection. And also animals may not play a role in the transmission of these parasites as some of them are found only in humans.

The independent predictors of helminths infection in pregnant women identified from multivariate analysis are family size (AOR = 5.624; 95% CI = 1.882, 16.804, p=.002), monthly income (AOR=.478 ; 95% CI =.229, .994, p=.048), living in the vicinity of water bodies (AOR = 3.392; 95% CI = 1.202, 9.573, p=.021), habit of waking bare foot (AOR = 3.23; 95% CI = 1.281, 8.147, p=.013), use of unprotected water source (AOR=8.714; 95%CI=1.602, 27.397, P=.012), and type of house (AOR= .236; 95% CI = .063, .892, p = .033) remained significant factors.

Pregnant womens with habit of walking bare foot have three times more likely to have intestinal helminths (AOR = 3.23; 95% CI = 1.281, 8.147, p=.013) than those who do not have the habit. This finding is comparable with study of Larocque .R etal (2005) in which those who do not wear at least sandal either inside or outside of their houses had higher hookworm prevalence than women wearing sandals [40]. In other studies which assess the anemia status of pregnant women, there was a statistical significance difference between anemia and shoe wearing habit [12, 47]. Most rural pregnant women walk barefoot; even those women who have shoe do not wear regularly. They wear shoe when they come to town for antenatal care and for marketing. Walking barefoot may predispose to hookworm infection because the infective stage of the parasite develops in soil.

Type of house was one variable which is significant in the multivariate analysis and found that pregnant women living in corrugated sheet had increased risk of infection compared to those living

in thatched roof (AOR= .236; 95% CI=.063, .892, p = .033) which is different from other studies [44,] this might be because of the small sample size for those subjects coming from rural area.

Infections with at least one intestinal helminth species were associated with the use of an unprotected water source (AOR=8.714; 95%CI=1.602, 27.397, P=.012) this is in line with the study conducted in rural Kenya [38] in which infection was also associated with lack of household treatment of drinking water. However, water source or treatment was not statistically significantly associated with any geohelminth species [38].

Pregnant women who live around or near lakes or any other water bodies were about three times more likely to be infected by intestinal helminthes (AOR = 3.392; 95% CI = 1.202, 9.573, p=.021). Even though the detected helminthes do not have a life cycle or developmental stage in water as seen in Shistosomas, the presence of lake or river might be important in contamination and dissemination of the parasites. One example could be peoples have exposure to these water bodies for washing purpose and may also be contaminated with feces and sewage. Like in many other developing countries, intestinal parasites are widely distributed in Ethiopia largely due to the low level of environmental and personal hygiene, contamination of food and drinking water that results from improper disposal of human excreta [48].

This study focused only on the presence of helminthes infection and its associated factors. Prevalence is seldom used as the only measure to assess the epidemiological situation for that helminth infection, because morbidity is associated with the number of worms infecting the host (i.e., the worm burden) rather than the absence or presence of infection. Prevalence is commonly combined with worm burden (also referred to as the "intensity of infection"), which is commonly measured by the number of eggs per gram (EPGs) of feces for intestinal helminths [2,13].

Other limitations of this study include the use of a single stool specimen to assess infection status, which may have underestimated geohelminth burden.

7. CONCLUSION AND RECOMMENDATION

7.1 Conclusion

The present study showed relatively lower prevalence of intestinal helminthes among pregnant women in the study area. The prevalent species of intestinal helminthes identified in this study and also in studies conducted elsewhere are A.lumbricoides and Hookworm spp.

Infections with at least one intestinal helminth species among pregnant women were associated with the use of an unprotected water source, living around or near lakes or any other water bodies and also those with habit of walking bare foot were more likely to have intestinal helminths.

The other predictors of helminths infection in pregnant women identified from multivariate analysis were family size, monthly income, and type of house remained significant factors.

7.2 Recommendation

Even though guidelines set the importance of stool examination during antenatal follow-up, the practice is still poor and should be routinely performed during antenatal care follow-up.

Public health measures should continue to emphasize the importance of environmental and personal hygiene as well as provide and monitor the quality of drinking water aiming to obtain a better quality of life.

Deworming strategies must also be considered, address provision of safe water and health education about prevention of contamination, particularly among rural residents.

Moreover large scale longitudinal study is needed to determine the effect of helminthiases in pregnants with estimate of worm burden (intensity of infection).

REFERENCES

1. Crompton D.W.T. How much human helminthiasis is there in the world? *J. Parasitol* 1999,85, 397–403.
2. World Health Organization (WHO). Soil-transmitted helminth infections [document on theinternet].[CitedJune2012].Availablefrom:http://www.who.int/mediacentre/factsheets/fs366/en/index.html
3. Centers for Disease Control and Prevention (CDC). Saving lives. Protecting people. [document on the internet].[Cited June 2012] Available at: www.cdc.gov/parasites/sth/
4. World Health Organization. Prevention and control of intestinal parasitic Infection. 1987. WHO technical report series No. 749.
5. Cheesbrough, M. District Laboratory practice in tropical countries part 1, Cambridge University press 2nd ed 2009, pp: 195-216.
6. ORC Macro and CSA. Ethiopian Demographic and Health Survey 2005, 2006.
7. Allen LH. Pregnancy and iron deficiency: unresolved issues. *Nutr Rev* 1997, 55:91–101.
8. Harhay MO, Horton J, Olliaro PLet al. Epidemiology and control of human gastrointestinal parasites in children. Expert Review of Anti-Infective Therapy 2010, 8, 219–234.
9. Bundy DA, Chan MS, Savioli L. Hookworm infection in pregnancy. *Trans R Soc Trop Med Hyg* 1995, 89:521–522.
10. King C. Re-gauging the cost of chronic helminthic infection: meta-analysis of disability-related outcomes in endemic schistosomiasis. *Lancet* 2004, 368: 1106-1118.
11. Brooker S, Hotez PJ, Bunday DAP:Hookworm-Related Anaemia among Pregnant Women: A Systematic Review. *PLoS Negl Trop Dis* 2008,2(9): e291.
12. Tadege B. Determinants of anaemia in pregnant women with emphasis on intestinal helminthic infection at bushulo health center southern Ethiopia. Addis Ababa University: Libraries Electronic, Thesis and Dissertations; 2009. AAU-ETD.
13. Getachewet al. Anaemia and associated risk factors among pregnant women in Gilgel Gibe dam area, South west Ethiopia. *Parasites & Vectors* 2012,5:296.
14. Viteri FE. The consequences of iron deficiency and anemia in pregnancy. *Adv Exp Med Biol* 1994, 352:127–139.
15. Crompton DWT. The public health importance of hook-worm disease. *Parasitology* 2000,121 (Suppl.):39–50
16. Pawlowski ZS, Schad GA, Stott GJ, 1991. Hookworm infection and anemia - approaches to prevention and control. Geneva: World Health Organization.
17. Pullan LR, Brooker SJ: The global limits and population at risk of soil transmitted helminth infections in 2010. *Parasit Vectors* 2012, 5(81):
18. Jemaneh L. Comparative prevalence of some common intestinal helminthic infections in different altitudinal regions in Ethiopia. *Ethiop Med J*.1998;36:1-8.
19. Hotez PJ, Kamath A: Neglected tropical diseases in sub-saharan Africa: review of their prevalence, distribution, and disease burden. *PLoS Negl Trop Dis* 2009, 3(8):e412.

20. Tadesse Z, Hailemariam A, Kolaczinski JH:Potential for integrated control of neglected tropical diseases in Ethiopia. *Trans R Soc Trop Med Hyg* 2008,102(3):213-214.
21. Steinmann P, Keiser J, Bos R, Tanner M, Utzinger J: Schistosomiasis and water resources development: systematic review, meta-analysis, and estimates of people at risk. *Lancet Infect Dis* 2006, 6(7):411–425.
22. Steketee RW. Pregnancy, nutrition and parasitic diseases. *The Journal of Nutrition* 2003;133(5 suppl 2):1661S–1667S.
23. Nurdia DS, Sumarni S, Suyoko , Hakim M, Winkvist A. Impact of intestinal helminth infection on anemia and iron status during pregnancy: a community based study in Indonesia.*The Southeast Asian Journal of Tropical Medicine and Public Health*. 2001;32(1):14–22.
24. Stephenson LS, Latham MC, Ottesen EA. Malnutrition and parasitic helminth infections.*Parasitology*.2000;121(7):23–38.
25. World Health Organization. Prevention and control of schistosomiasis and soil-transmitted helminthiasis: report of a WHO expert committee 2002. Geneva, Switzerland: World Health Organization.
26. Le Hesran JY, Akiana J, Ndiaye el HM, Dia M, Senghor P, et al. Severe malaria attack is associated with high prevalence of Ascaris lumbricoides infection among children in rural Senegal. *Trans R Soc Trop Med Hyg* 2004, 98: 397–399.
27. Nacher M, Singhasivanon P, Traore B, Vannaphan S, Gay F, et al. Helminth infections are associated with protection from cerebral malaria and increased nitrogen derivatives concentrations in Thailand. *Am J Trop Med Hyg* 2002, 66: 304–309.
28. LaBeaud AD, Malhotra I, King MJ, King CL, King CH. Do Antenatal Parasite Infections Devalue Childhood Vaccination?. *PLoS Negl Trop Dis* 2009, 3(5): e442. doi:10.1371/journal.pntd.0000442
29. Hotez PJ, Mistry N, Rubinstein J, Sachs JD. Integrating neglected tropical diseases into AIDS, tuberculosis, and malaria control. *N Engl J Med* 2011, 364: 2086–2089.
30. Mehta RS, Rodriguez A, Chico M, Guadalupe I, Broncano N, et al. Maternal Geohelminth Infections Are Associated with an Increased Susceptibility to Geohelminth Infection in Children: A Case-Control Study. *PLoS Negl Trop Dis* 2012, 6(7): e1753. doi:10.1371/journal.pntd.0001753
31. Woodburn PW, Muhangi L, Hillier S, Ndibazza J, Namujju PB, et al. Risk Factors for Helminth, Malaria, and HIV Infection in Pregnancy in Entebbe, Uganda. *PLoS Negl Trop Dis* 2009, 3(6): e473. doi:10.1371/journal.pntd.0000473.
32. Brooker S, Clements AC. Spatial heterogeneity of parasite co-infection: Determinants and geostatistical prediction at regional scales. *Int J Parasitol* 2009, 39: 591–597.
33. Lustigman S, Prichard RK, Gazzinelli A, Grant WN, Boatin BA, et al. AResearch Agenda for Helminth Diseases of Humans: The Problem of Helminthiases. *PLoS Negl Trop Dis* 2012, 6(4): e1582. doi:10.1371/journal.pntd.0001582

34. Gyorkos TW, Larocque R, Casapia M, Gotuzzo E. Lack of risk of adverse birth outcomes after deworming in pregnant women. *Pediatr Infect Dis J* 2006, 25:791–794.
35. Christian P, Khatry SK, West KP Jr. Antenatal anthelmintic treatment, birthweight, and infant survival in rural Nepal. *Lancet* 2004, 364: 981–983.
36. Liese B, Rosenberg M, Schratz A: Programmes, partnerships, and governance for elimination and control of neglected tropical diseases. *Lancet* 2010, 375(9708):67–76.
37. Federal Ministry of Health: Guidelines for the Enhanced Outreach Strategy (EOS) for Child Survival Interventions. Addis Ababa, Ethiopia 2004.
38. Van Eijk AM, Lindblade KA, Odhiambo F, Peterson E, Rosen DH, et al. Geohelminth Infections among Pregnant Women in Rural Western Kenya; a Cross-Sectional Study. *PLoS Negl Trop Dis* 2009, 3(1): e370. doi:10.1371/journal.pntd.0000370
39. Alli JA et al. Prevalence of intestinal nematode infection among pregnant women attending antenatal clinic at the University College Hospital, Ibadan, Nigeria . *Adv. Appl. Sci. Res* 2011, 2 (4):1-13
40. Larocque .R, Easapia .M, Gotuzzo .E, and Gyorkos .T. Relationship between intensity of soil-transmitted helminth Infections and anemia during pregnancy. *Am. J. Trop. Med. Hyg* 2005, 73(4), pp. 783–789.
41. Alfonso J. Rodr´ıguez-Morales et al.). Intestinal Parasitic Infections among Pregnant Women in Venezuela. *Infect Dis Obstet Gynecol* 2006, 10(1155): 23125.
42. Adegnikaet A.A. al. Epidemiology of parasitic co-infections during pregnancy in Lambare´ne´, Gabon. *Trop. Med and Int Health* 2010, 15(10) 1204-1209.
43. Fuseini et al. Parasitic infections and anaemia during pregnancy in the Kassena-Nankana district of Northern Ghana. *J. Public Health Epidemiol* 2010, Vol. 2(3), pp. 48-52.
44. Belyhun et al. Prevalence and risk factors for soil-transmitted helminth infection in mothers and their infants in Butajira, Ethiopia: a population based study. *BMC Public Health* 2010,10:21.
45. Bethony J. Emerging patterns of hookworm infection: influence of aging on the intensity of Necator infection in Hainan Province, People's Republic of China. *Clin. Infect. Dis* 2002, 35:1366-1344.
46. Southern Nation's Nationalities and People's Regional State (SNNPR), hadiya zone statistical abstract /2007 E.C/
47. Belachew T., Yosef L. (2006). Risk factors for anaemia among pregnant women attending antenatal clinic at Jimma University Hospital, Ethiop Med J, 44, No.3.
48. Kumie A, Ali A: An overview of environmental health status in Ethiopia with particular emphasis to its organization, drinking water and sanitation: a literature survey. Ethiop J Health Dev 2005, 19:89–103.

ANNEXES

ANNEX I: English Version of the Questionnaire

Jimma University College of

Medical and public health sciences, Department of Epidemiology

Questionnaire for Data Collection on intestinal helminthiases and associated factors among pregnant women attending antenatal clinic of Nigist Eleni Mohammed memorial hospital, Hossana, Southern Ethiopia

Consent form

CODE_____

Verbal consent form before conducting interview

Greeting: Hello, my name is _____. I am working with Jimma university research team. The objective of this study is to determine the prevalence and associated risk factors of intestinal helminthic infection among pregnant. The outcomes of the findings can help in the evidence-based decision to develop control intervention strategies to improve the health status of the most vulnerable group i.e. pregnant women. . I would like to ask you a few questions about intestinal helminthiases and associated factors. Also you requested to provide stool sample for investigation. Your cooperation and willingness for the interview is helpful in identifying problems related to the subject matter. Your name will not be written in this form. All information that you give was kept strictly confidential. Your participation is voluntary and you are not obliged to answer any question you do not wish to answer. If you are not still comfortable with the interview please feel free to drop it any time you want. Do I have your permission to continue?

1. If yes, continue to the next page.

2. If no, skip to the next participant.

Interviewer name and code _____ signature _____

Supervisors name _____ signature _____

General instruction

Almost all of the questions do have a pre coded response. So it is important to follow the following instructions while you are interviewing the respondents and recording their responses

- Ask each questions exactly as written on the questionnaire
- Circle the responses that best match with the answer of the respondent
- Do not read the pre coded responses for the respondents, listen only the response of the respondents.

I. Socio-economic and demographic characteristics			
Sr.no	Question	Response	code
101	Age in years	_____	/_____/
102	What is your ethnicity	Hadiya… 1 Kembata…. 2 Amhara… 3 Silte… 4 Guraghe…. 5 Other…. 6	/_____ _/
103	What is your marital status?	Single 1 Married 2 Divorced 3 Widowed 4	/_____ _/
104	What is your educational level?	Illiterate (cannot read and write) 1 Primary (grade 1-6)……. 2 Junior(7&8)…….……... 3 Secondary (9-12) and above…. 4	/_____ _/
105	What is your religion?	Protestant . . . . . 1 Muslim . . . . 2 Orthodox……..... 3 Catholic . . . . . … 4 Others 5	/_____ _/
106	Where is your usual place of residence?	Urban…….1 Rural……..2	/_____/

107	What is your main occupation?	Employed(GO/NGO) ……..1 House wife……2 Student…….…3 Self employee/merchant……..4 Daily worker ……...5 Others_____ (specify)	/_____/
108	What is your husband's occupation?	Employee(GO/NGO) ……1 Student…….…...2 Self employee/merchant……..…3 Daily worker ……..…..4 Others_____ (specify)	/_____/
109	What is your family size?	In Number	/_____/
110	What is your source of income? **Enter response**	_____	/_____/
111	What is your monthly income in birr? **Enter response in birr**	_____	/_____/
112	Type of house. Living in thatched house vs. corrugated sheet	Thatched house ……1 Corrugated sheet ……2	/_____/
113	Home ownership	1)yes 2)no	/_____/
114	TV/Radio ownership	1)yes 2)no	/_____/
II.	**Intermediate risk factors for helminth infection**		
201	Gestational age in weeks		/_____/

202	Have you had any pregnancy before?	Yes……1 No…….2	/_____/
203	If yes to ques.202 how many pregnancies have you had? Enter No	_____	/_____/
204	How many live births have you had?	Number _____	/_____/
205	How many live children do you have now? **Enter response**	_____	/_____/
206	Type of water source	Pipe water Inside compound…….1 pipe water Outside compound….2 Well/stream/rain ……..3 River ……4	/_____/
207	presence of other Chronic disease	1)yes (_____) 2)no	/_____/
III. Proximate risk factors for Helminthic infections			
301	Do you have Toilet facilities	1)yes 2)no	/_____/
302	Do you wash your hands after toilet?	1)yes 2)no	/_____/
303	Do you use soap or any antiseptic while washing your hands?	1)yes 2)no	/_____/
304	If yes to Q 303, how frequent?	Daily ……..1 At least once a wk ……..….2 Less frequent than once a week…..3	

305	Do you wash your hands before preparing food?	1)yes 2)no	/_____/
306	availability of lake or other water bodies in the vicinity	1)yes 2)no	/_____/
307	If yes proximity to lake in meters estimated	_____	/_____/
308	exposure to lake or rivers through swimming or bathing	1)yes 2)no	/_____/
309	Have you taken traditional medicines for intestinal helminthes during your pregnancy	1)yes 2)no	/_____/
310	Animal spend the night inside	1)yes 2)no	/_____/
311	Do you have habit of walking barefoot	1)yes 2)no	/_____/
312	Do you wear sandals frequently	1)yes 2)no	/_____/
313	Household waste disposal	Buried/Burned ……..1 Open field ……..2 Used as fertilizers ……3	/_____/

ANNEX II: LABORATORY REQUESTING AND RECORDING FORMAT

1. Personal data

1.1 ***Code no*_____**

1.2 Age _____

1.3 Address _____

1.4 Date of sample collection_____

2. Laboratory data

2.1 Physical examinations (encircle the answer)

2.1.1 Consistency of the stool

1. Formed
2. Soft
3. Semi-formed
4. Watery diarrhea
5. Bloody diarrhea

2.1.2 Appearance of stool

1. Blood stained
2. Mucus
3. Normal

2.1.3 If macroscopic worm is present, type of the worm_____

2.2 Microscopic examination

2.2.1 Direct microscopic examination

1. No ova or parasite seen
2. If O/P seen, Types of ova parasite seen

1. A.lumbricoides	***5.*** S.stercolaris
2. Hookworm spps	***6.*** Taenia spps
3. T.tricuria	***7.*** H.nana
4. E.vermicularis	***8.*** S.mansoni
	9. Other_____

3. Other intestinal **protozoa** _____

2.2.2 Concentration technique

1. No ova or parasite seen
2. Types of ova/ parasite seen (*fill no from above code)*_____
3. Other intestinal protozoa seen

Name of investigator _____

Signature _____ Date _____

ANNEX III: Amharic Version of the Questionnaire

ጅማ ዩኒቨርሲቲ ህክምናና የህብረተሰብ ጤና ሳይንስ ኮሌጅ የኤፒዲሞሎጂ ትምህርት ክፍል

ስምምነት መጠየቂያ ቅፅ

የጥናቱ ተካፋይ መለያ ቁጥር _____

ጤና ይስጥልኝ፡ ስሜ _____ ይባላል፡ እኔ በጅማ ዩኒቨርሲቲ ጥናት ቡድን ጋር እየሰራው እገኛለሁ ::

የጥናቱ አላማ አንጀት ጥገኛ ተህዋሲያን ለነፍሰጡር እናቶች ላይ ያለውን ስርጭት እና ተያያዥ ምክንያቶችን ለማወቅ ነው :: የጥናቱ ውጤት በተጨባጭ መረጃ ላይ የተመሰረተ የመከላከል ስልትን ለመዘርጋት ይጠቅማል :: እናም ከጥናቱ ጋር ተየያዥ ያላቸውን ጥያቄዎችን እንዲመልሱልንና የሰገራ ናሙናም ለምርመራ የሚሆን ይስጡን ዘንድ እንጠይቃለን :: የእርሶ መልካም ፍቃድና ተሳትፎ ይህን ችግር ለማወቅና ለመለየት በጣም ጠቃሚ ነው :: የእርሶ ስም በዚህ ጥናት ላይ አይፃፍም የሰጡንን የግል መረጃም ይፋ አይደረግም :: ተሳትፎዎት በፍቃደኝነት ላይ የተመሠረተ ነው በፈለጉት ሰዓት ከጥናቱ ማቆረጥ ቀወይም የማይፈልጉትን ጥያቄ ያለመመለስ መብት አልዎት ::

ስለዚህ የእርሶን ፍቃደኝነት ማግኘት እንችላለን ?

1. አዎ _____ ጥያቄዎቹን ቀጥሉ
2. አይደለም _____ ወደ ሚቀጥለው ተጠያቂ ሂዱ

የጠያቂው ስም _____ ፊርማ _____

የጥናቱ ተካፋይ መለያ ቁጥር (Code no) _____

ስነ ማህበራዊ እና ህዝባዊ መጠይቅ			
ተራ ቁ	ጥያቄዎች		መልስ
101	እድሜዎት ስንትነው	_____	
102	ብሔሮት ምንድነው	ሀድያ 1 ስልጤ 4 ከንባታ 2 ጉራጌ 5 አማራ 3	
103	የጋብቻ ሁኔታ	ያገባች 1፣ ያላገባች 2 ፣ አግብታ የፈታች 3 ባል የሞተባት 4	
104	የትምህርት ደረጃ	ያልተማረች መፃፍ ማንበብ የማትችል 1 ፣ አንደኛ ደረጃ (ከ1-6) 2 ፣ ከ7-8 3 ፣ ሁለተኛ ደረጃ (9-12) 4	
105	ሀይማኖት	ፕሮቴስታንት 1 ሙስሊም 2 ኦርቶዶክስ 3 ካቶሊክ 4 ሌላ 5	
106	የት ነው የሚኖሩት	ከተማ 1 ገጠር 2	
107	ስራዎት ምንድነው	ተቀጣሪ 1 የቤት እመቤት 2 ተማሪ 3 የግል ስራ 4 የቀን ሰራተኛ 5 ሌላ ካለ ----------	
108	የባለቤቶት ስራ	ተቀጣሪ 1 የቤት እመቤት 2 ተማሪ 3 የግል ስራ 4 የቀን ሰራተኛ 5 ሌላ ካለ ----------	
109	የቤተሰቦ ብዛት	_____	

110	የገቢዎት ምጭ ምንድነው	_____	
111	የወር ገቢዎት ምን ያህል ነው **(በብር)**	_____	
112	የቤትዎ አይነት	**የ**ቆርቆሮ ቤት **1** የሳር ቤት **2**	
113	የራስዎ ቤት አልዎት	አዎ**1** የለም**2**	
114	ቴሌቭዥን ወይንም ራድዮ አሎት	አዎ**1** የለም**2**	
201	የእርግዝናዎ ጊዜ በሳምንታት ሲቆጠር		
202	ከዚህ በፊት ፀንሰው ያውቃሉ	አዎ **1** አይደለም **2**	
203	ለ**202** ጥያቄ መልስ አዎ ከሆነ ለምን ያህል ጊዜ ፀንሰው ያውቃሉ	_____	
204	ስንት ልጆችን ወልደው ያውቃሉ	_____	
205	አሁን በህይወት ያሉ ስንት ልጆች አልዎት	_____	
206	ውሃ ከየት ነው የሚያገኙት	የቦንባ ውሃ ጊቢ ውስጥ **1** የባንባ ውሃ ከጊቢ ውጪ **2** ከኩሬ ዝናብ **3** የወንዝ **4**	
207	በአሁኑ ሰአት ሌላ በሽታ አለቦት (እንደነ ስኮር ደም ግፊት የመሳሰሉት)	አዎ**1** የለም**2**	
301	የሽን ቤት አሎት	አዎ**1** የለም **2**	
302	ከሽንት ቤት መልስ እጆትን ይታጠባሉ	አዎ**1**	

		የለም 2	
303	እጆትን ሲታጠቡ ሳሙና ይጠቀማሉ	አዎ 1 የለም 2	
304	ለጥያቄ ቁ. **303** መልሶ አዎ ከሆነ ምን ያህል ጊዜ	በየቀኑ 1 በሳምንት አንዳንዴ 2 በሳምን አንዴ 3	
305	ምግብ ከማዘጋጀትዎ በፊት እጆትን ይታጠባሉ	አዎ 1 አልታጠበም2	
306	በአካባቢዎ የውሃ አካላት አሉ? ወንዝና ኩሬ የመሳሰሉት	አዎ1 የለም2	
307	ለ ጥያቄ ቁ **306** መልሶ አዎ ከሆነ ምን ያሕል ይርቃል; በሜትር	_____	
308	ከነኝህ የውሃ አካላት ጋር በዋናም ይሁን በመታጠብ ግንኙነት አሎት ወይ?	አዎ1 የለም2	
309	ለሆድ ህመም ባህላዊ መድሃኒት ወስደው ያውቃሉ ወይ?	አዎ1 የለም2	
310	ከቤትዎት ውስጥ የቤት እንስሳዎች ይገባሉ	አዎ1 የለም2	
311	በባዶ እግሮ የመሄድ ልምድ አሎት	አዎ1 የለም2	
312	ብዙ ጊዜ ነጠላ ጫማ ይመጠቀማሉ	አዎ1 የለም2	
313	ቆሻሻ ማስወገጃ ሰልት	መቅበር ወይም ማቃጠል 1 ሜዳ ላይ በመጣል 2 እንደ ብስባሽ መጠቀም 3	