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COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF EPIDEMIOLOGY

CORRELATION OF SOIL TRANSMITTED HELMINTH INFECTIONS AND NUTRITIONAL STATUS AMONG PRIMARY SCHOOL CHILDREN IN SHASHOGO DISTRICT, HADIYA ZONE, SOUTHERN ETHIOPIA:

COMPARATIVE CROSS-SECTIONAL STUDY

BY

BIRHANU SEYOUM (BSc)

THESIS SUBMITTED TO JIMMA UNIVERSITY COLLEGE OF HEALTH SCIENCES, DEPARTMENT OF EPIDEMIOLOGY FOR PARTIAL FULIFILMENT OF THE REQUIRMENTS FOR THE DEGREE OF MASTRES IN GENERAL PUBLIC HEALTH

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ABSTRACT

Background: Soil-transmitted helminth(STH) infections are among the most common infections worldwide and affect the poor and deprived communities. Soil-transmitted helminth infections are one of the top causes of morbidity among school aged children. Heavy worm burdens lead to malnutrition, anemia, diarrhea, abdominal pain, weight loss, loss of appetite and impaired mental and physical development in children.

Objective: The main objective of this study is to determine the association/correlation between Soil-transmitted helminth infection and nutritional status among primary school children in Shashogo District, Hadiya zone, Southern Ethiopia, 2016.

Methods: An institution (school) based comparative cross-sectional study was conducted from March to April. All school children who attend primary schools of Shashogo district were the source population and samples of students in the selected primary schools were included into this study. To select the study units, simple random sampling technique was used after screening the children for the presence of STH infections and absence of the infection. Then 75 infected and 148 non-infected children's were selected by simple random sampling. Anthropometric and socio-economic characteristics were collected. The collected data were coded and entered into EpiData and analyzed by using the Statistical package for Social Sciences and Anthroplus software. Descriptive statistics, bivariate and multivariate logistic regression was used.

Results: A total of 222 children (74 STH infected and 148 non infected) age 5-14 years were studied. The overall prevalence rate of malnutrition among children with soil transmitted helminth infected and non-infected was 12.2% and 10.8%, respectively. Malnutrition was found to be higher in infected than non-infected children and this difference was not statistically significant.

Conclusion : Prevalence of malnutrition in STH infected and non-infected children were similar. The present study shows family size is important determinants of nutritional status of school children.

Key words: Soil transmitted helminth, Nutritional status, School children; Shashogo; Ethiopia

ACKNOWLEDGMENTS

I would like to provide special thanks to Jimma University, Hadiya Zone Heath department, Shashogo District health and education office for their facilitation and allowing me to carry out this thesis.

I would like to express my deep appreciation and sincerely thanks to my advisors, Dr. Lelisa Sena and Mr. Teshome Kabeta for their technical comments and advices.

I have also deep interest to extend my gratitude and respect enthusiastically to Department of epidemiology of Jimma University for creating such a conducive learning environment.

Finally, my families and all my colleagues who, supported and encouraged me during my stay in the school and the study period.

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ACRONYMS

AOR	Adjusted Odds Ratio
BAZ	Body Mass Index
BSC	Bachelor of Sciences
COR	Cruds Odds Ratio
CI	Confident Interval
EPG	Eggs per grams of feaces (stool)
HAZ	Height for Age z-score
OR	Odds Ratio
SD	Standard Deviation
SNNPR	Southern Nations, Nationalities and Peoples Region
SPSS	Statistical Package for the Social Science
STH	Soil-Transmitted Helminthes
UNICEF	United Nation International, Children and Education Fund
WAZ	Weight for Age z-score
WHO	World Health Organization

1. INTRODUCTION

1.1 BACKGROUND

Soil-transmitted helminth (STH) infections are among the most common infections worldwide and affect the poor and deprived communities. They are transmitted by eggs present in human faeces which in turn contaminate soil in areas where sanitation is poor. The main species that infect people are the roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*) and hookworms (*Necator americanus* and *Ancylostoma duodenale*) (1). Adult hookworm inhabit the upper part of the human small intestine, while *Ascaris lumbricoides* parasitize the entire small intestine and adult *Trichuris trichiura* lives in the large intestine of the human gastro-intestinal tract. The parasites can live for several years in the human gastro-intestinal tract (2).

Recent estimate suggests that *Ascaris lumbricoides* infects over one billion people, *Trichuris trichiura* 795 million and hookworm 740 million (3). Generally, more than 1.5 billion people, or over 24% of the world's population, are infected with these infections. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia (1).STH infections are one of the top causes of morbidity among school aged children. Heavy worm burdens lead to malnutrition, anemia, diarrhea, abdominal pain, weight loss, loss of appetite and impaired cognitive and physical development in children (4).

Malnutrition remains the world's most serious health problem and the single biggest contributor to child mortality. According to the UNICEF, WHO-World Bank Joint Child Malnutrition Estimates of 2011, globally, about 165 million children under-five years of age (26%) were stunted, an estimated 101 million (16%) were underweight and about 52 million (8%) were wasted. The problem is more serious in developing countries. For example, More than 90% of the world's stunted children live in Africa and Asia (5).

Malnutrition is a major public health problem in many developing countries. It is one of the main health problems facing women and children in Ethiopia. The 2011 Demographic Health Survey (DHS) has shown that about 44 %, 10% and 29 % of Ethiopian children under five years of age were stunted, wasted and underweight respectively. From this 21%,3%,9% of children under five years of age were severely stunted, wasted and underweight respectively and also 44% of children's were anemic (6).

The Prevalence of STH infection among school-aged children has been studied in different parts of Ethiopia (7-9). However, the current STH infection and its association with nutritional status are not well addressed in different parts of Ethiopia including the present study area. Therefore, the aim of this study was designed to determine the correlation of STH infections and nutritional status among primary school children of Shashogo District, Hadiya zone, SNNPR, Ethiopia.

1.2 STATEMENT OF THE PROBLEM

It is estimated that over 35.4 million African school-aged children are infected with *Ascaris lumbricoides*, 40.1 million with *Trichuris trichiura* and 41.1 million with hookworm. Since many children have multiple infections, it is estimated that 89.9 million are infected with any STH species (10). Poverty and inadequate water supplies and sanitation are important determinants of transmission of STH infections. In such conditions, soil-transmitted helminthes species are commonly co-endemic (2). In Ethiopia 38% of households have no toilet facility, 16% in urban areas and 45% in rural and around half of households (46 percent) have no access to an improved source of drinking water (6). STH infections are endemic in Ethiopia (11).

Children are the group with the highest prevalence and infection intensities and are also very vulnerable to the effects of worm infection including nutritional deficiencies which aggravate malnutrition and amplify the rates of anemia and impede physical and cognitive development, contributing significantly to school absenteeism (12, 13).

The burden of disease from STH is mainly attributed to their chronic and insidious impact on the health and quality of life of those infected rather than to the mortality they cause. Infections of heavy intensity impair physical growth and cognitive development and are a cause of micronutrient deficiencies including iron deficiency anemia leading to poor school performance and absenteeism in children, reduced work productivity in adults and adverse pregnancy outcomes (14).

However there is no information on the relationship of STH infections and nutritional status of school age children in Shashogo District. Therefore, the purpose of this study will be to find out the relationship of STH infections and malnutrition in school children and to design a good programme that can prevent STH infections and then improve the health status of Shashogo District, Zonal, and as well as regional school age children.

1.3 SIGNIFICANCE OF THE STUDY

This study will be designed to provide current epidemiological data with regards to STH infections and its association with nutritional status of the school age children in Shashogo District. Depending on the findings of the study, the District can apply evidence based interventions. The study is also envisaged to provide baseline data for monitoring and evaluation of control programme aimed at improving health, nutritional status and cognitive functioning of School-age children in Shashogo District.

This will also provide baseline information for the district health office, health professionals, policy makers and other governmental and nongovernmental organizations to maximize efforts on the prevention of STH infection and malnutrition in the study area and at country wide in general. The result of this study also will provide baseline information for other researches in future.

2. LETERATURE REVIEW

2.1 OVERVIEW OF STH INFECTIONS AND NUTRITIONAL STATUS

STH are considered together because it is common for a single individual, especially a child living in a less developed country, to be chronically infected with all three worms. Such children have malnutrition, growth stunting, intellectual retardation, and cognitive and educational deficits (2). Control program in endemic countries have demonstrated that the benefits of regular de-worming are not limited to reducing direct morbidity. School attendance, school results and productivity improve (13).

2.2 PREVALENCE AND INTENSITY OF STH INFECTIONS IN SCHOOL CHILDREN

The prevalence and intensity of infection with *Ascaris* and *Trichuris* typically reach a peak among children aged 5–14 years and subsequently decline among adults. However, although heavy hookworm infections may occur in children, the peak of their prevalence and intensity is commonly reported among those aged 30–44 years or even among people who are older than 50 years. Soil-transmitted helminthiases (especially hookworm) are particularly detrimental to the health of childbearing women and on pregnancy outcomes owing to their impact on nutrition, since they cause iron deficiency and anemia (14). Therefore school-age children are the group that bears the greatest prevalence's and worm intensities.

This was reported in a cross–sectional study carried out in school children in Zarima town, northwest Ethiopia, where it was observed that 82.4% of the study subjects were infected with one or more parasites. From soil-transmitted helminths, *Ascaris lumbricoides* was the predominant isolate (22%) followed by Hookworms (19%) and *Trichuris trichiura* (2.5%) (9).
A cross–sectional study carried out in school children in Gorgora and Chuahit towns, northwest Ethiopia, where it was observed that 66.7% of the study subjects were infected with one or more parasites. From soil-transmitted helminths, *Ascaris lumbricoides* was the predominant isolate (39.8%) followed by Trichuris trichiura (6.1%) and Hookworms (4.9%) (9).

Another study on school aged children in, Kwara State, Nigeria, the overall prevalence of STH infection was 41.9 and the ova/larvae of STH parasites detected were hookworm, *Ascaris*

lumbricoides, Trichuris trichiura and *Strongyloides stercoralis* with prevalence of 15.4, 11.3, 8.1 and 7.1%, respectively (15). A study among school aged children in, rural communities of Honduras, shows that 72.5% were infected by soil-transmitted helminths. Among these *Trichuris trichiura* had the highest overall infection rate of 67%. Overall prevalence of other STHs were *Ascaris lumbricoides (*30%) and hookworm (16%) (16).

The most striking epidemiological features of human helminth infections are aggregated distributions in human communities and predisposition of individuals to heavy (or light) infection (17). A study done in northwest Ethiopia in Zarima town shows that, from the infected children, 38.5%, 53.6% and 7.9% of the infected children harbored low, moderate and heavy infection, respectively for different STH. In endemic communities, infection by more than one soil-transmitted helminths species is also a common phenomenon. From the study done in north west Ethiopia in Zarma town reported that like this, among the infected school children 45.5%, 43.7% and 10.8% harbored single, double and triple parasites, respectively (9).

Findings from different literatures shows that school-age children in most developing countries like Ethiopia are highly infected by soil-transmitted helminthes. Therefore , the aim of this study will be to explore the prevalence of STH and its intensity among school aged children in Shashogo woreda,Hadiya zone, SNNPR.

2.3 RELATIONSHIP BETWEEN STH INFECTIONS AND NUTRITIONAL STATUS OF SCHOOL CHILDREN

STH Infections of heavy intensity impair physical growth and mental development and are a cause of micronutrient deficiencies including iron-deficiency anemia leading to poor school performance and absenteeism in children, reduced work productivity in adults and adverse pregnancy outcomes. There is now a substantial body of research that clearly demonstrates how STH infections impair healthy nutrition (18).

2.3.1 SOCIO-DEMOGRAPHIC AND SOCIO ECONOMIC RELATED FACTORS

Among the socio-demographic and socio economic factors age ,sex and education level of children; educational status of the mother, family size and income will reviewed like this:

As the study done among 320 school children's [of age 7-14] in Honduras, showed that children's of age > 10 years were generally more infected than 7- 10 years old. Also a statistical difference was not observed in terms of overall STH positivity and the sex of the children. However, a closer look at infection by species revealed that boys of any age were twice as likely as girls to be infected by hookworms (16).

Another study on school aged children in Northwest Ethiopia in Zarima town even though there was no overall statistical significant association between age and parasite prevalence; age group between 5-9 years showed statistical significant association compared to other categories. Also there is no statistical significant association were observed in parasite prevalence between male versus female, first versus second cycle and maternal educational status of the students (9).

From the study done in Kwara state in Nigeria STH infection was more in 15-20 years age groups than those of 5-9 years and 10-14 years and Pupils in first basic primary school had a higher prevalence of 42.7% of helminthes infection than 40.0% of second basic primary school. From the study done in Angolela(Ethiopia) Severely underweight boys were 3.88-times more likely than boys of adequate weight to be diagnosed with protozoan infections. Among girls, those who were severely stunted were approximately 12 times as likely to be infected with a helminthes parasite, than those who were not (19). Also from study done in Northwest Ethiopia there is no statistically significant association between parasite prevalence and being male and female (8). A cross-sectional study done in Orang Asli (Malaysia) school children the high prevalence of malnutrition likely related to low socioeconomic status of households (20).

2.3.2 SANITATION AND HYGIENE RELATED FACTORS

Many literatures reveals that sanitation and hygiene related factors were also the major indicator for the prevalence and nutritional status of school children. A Study conducted in Angolela woreda(Ethiopia), STH infections were most prevalent in populations with low household income, poor handling of personal and environmental sanitation, overcrowding, and limited access to clean water (19).

Also from the study conducted in Zarima town(Ethiopia) there is a significant association between parasite prevalence and family water source with the highest prevalence was observed in those getting their water from protected spring (89.5%), and the lowest in those using pipe line (74.4%). In addition, frequency of hand washing habit with soap was significantly associated with children infection with increased risk seen for infrequent hand washing habit with soap compared to daily use and separate univariate analysis for specific parasite prevalence and risk factors indicated significant positive associations were seen between presence of Hook worm infection and none-shoe wearing habits (9).

From the study done in Kwara state in Nigeria Parasites were found at higher frequency in pupils that use well (54.1%), than river/stream, 47.1% and bore hole, 38.6%. However, the difference was not significant. Higher prevalence of STH parasites were found among pupils that use opened field (45.7%) than 27.0% and 22% for public and private latrine respectively, this difference was significant at $P< 0.05$. The prevalence of helminthes parasites detected was 13.8, 12.5 and 14.0% in those that wash hands before meals, those that wash hands after use of latrine and those that neither wash before meals nor after use of latrine, respectively (15).

2.3.3 STH INFECTION AND NUTRITIONAL STATUS OF THE SCHOOL CHILD

Several studies have established an association between STH infections and nutritional status of children[stunting or wasting]: A cross-sectional study conducted in Makurdi Central Nigeria[January-June 2006] shows that from 567 primary school children a total of 330(57.99%) children were infected by intestinal parasites ,hookworm (52.24%) recorded the highest prevalence rate followed by *Ascaris lumbricoides* (19.39%) and *Trichuris trichiura* (11.81%) and 103 (31.21%) cases of multiple parasitism were also reported. Infection was recorded among

all age groups but with high prevalence in the lower ages (10-13) and (13-15) and the prevalence decreases in the age group (16-18).

A difference was found to be non significant since parasites were recorded in all age groups. The prevalence of malnutrition i.e. those with body mass index (BMI < 18.5) is found to be higher in infected than uninfected children and this difference was not significant among these children. Males recorded a high infection rate of 53.33% while female recorded a high malnutrition rate of 57.48%. However the association of intestinal parasitic infections and malnutrition is found to be significant with a coefficient of correlation ($r = 0.99$, $P<0.05$) (21).

From the study conducted in Rural Honduras shows that the nutritional status of most children was within healthy parameters but a few cases of stunting 18(5.6%), thinness 7(2.2%) and underweight 3(1.3%) were observed. Of the children who were stunted, thin or underweight, girls accounted for 50%, 43% and 67% of the cases, respectively. Overall, of 320 children, 33 (10.3%) had at least a form of nutritional deficit. Five of these children (15.2%) were negative for any STH, while 28 (84.8%) were infected with one or more STH (16). Another study done in wakiso district(Uganda) among primary schools children revealed that 26.6%, 46% and 10.3% of incidences of stunting, underweight and MAM respectively were attributable to helminth infections (22).

CONCEPTUAL FRAME WORK OF THE STUDY

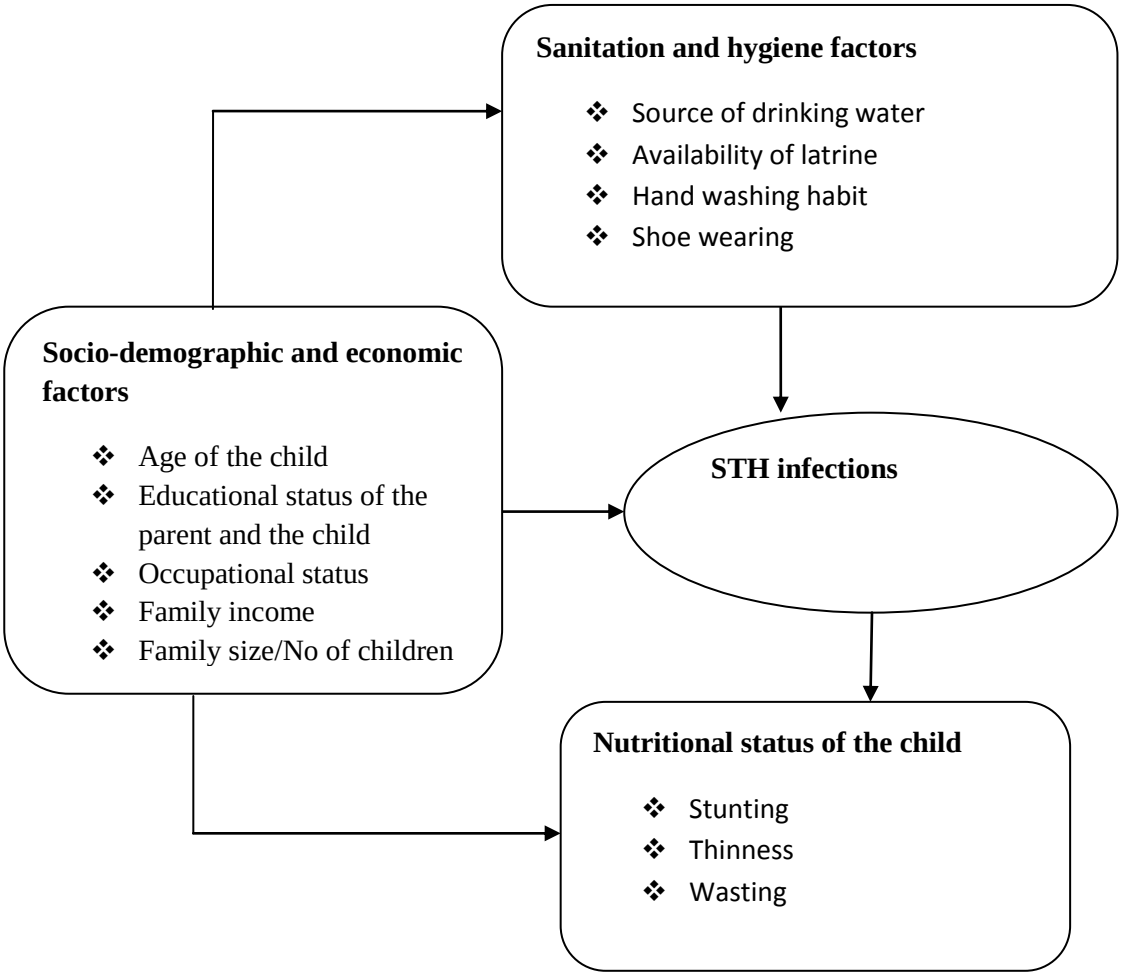

Figure 1. Conceptual frame work of STH infections and Nutritional status of school age children [developed from different literature review]

3. OBJECTIVE

3.1 GENERAL OBJECTIVE

- To determine the association/correlation between STH infections and nutritional status among primary school children in Shashogo District, Hadiya zone, Southern Ethiopia, 2016.

3.2 SPECIFIC OBJECTIVES

- To determine the association between STH infections and nutritional status among primary school children in the study area;
- To identify risk factors for STH infections and nutritional status among primary school children;
- To compare nutritional status of primary school children who infected with STH and those who do not have the infections.

4. MATERIALS AND METHODS

4.1 STUDY AREA AND PERIOD

The study was carried out in Shashogo District, Hadiya zone, Southern Ethiopia. The district is bounded by Silte zone in North east, Halaba Special Woreda in South east and North west by Ana lemo and West by Lemo and Kembata-Tembaro zone in South. The administrative centre Bonosha is 224 Km from Addis Ababa to the southern part of Ethiopia, 117 km west of the regional capital Hawassa and 54 km from the zonal town Hosanna.

An estimated area of the district is 34695.14 hectares. There are 36 kebeles and of which two are urban and 34 are rural kebeles. Based on the 2007 Census conducted by the Central Statistical Agency(CSA), the district has a total population of 103,722, among which 52,435 are males and 51,287 are females; 8,219 or 7.92% of its population are urban dwellers. The majority of the inhabitants were Protestants, with 51.96% of the population reporting that belief, 42.48% were Muslim, and 4.96% practiced Ethiopian Orthodox Christianity (23). The infrastructure condition of the district includes:- 5 health centers, 36 health pots, 5 high school, 25 primary schools and 11 firs primary cycle school in the district (24). The study was conducted from March to April 2016.

4.2 STUDY DESIGN

An institution based comparative cross-sectional study was conducted.

4.3 POPULATION

4.3.1 SOURCE POPULATION

All school children who attend primary schools of Shashogo District of Hadiya zone.

4.3.2 STUDY POPULATION

All sampled students in the selected primary schools were included into this study.

4.4 INCLUSION AND EXCLUSION CRITERIA

4.4.1 INCLUSION CRITERIA

Students who attend the selected primary schools during data collection period were studied.

4.4.2 EXCLUSION CRITERIA

One child was excluded during data collection due to disability (unable to stand).

4.5 SAMPLE SIZE DETERMINATION

The required sample size for the study has been estimated using EpiInfo version 7.0. The following assumptions has been considered: significance level of 95%, power 80%, contingency for non-response rate 10%, a design effect of 2 and from previous study done in Dale woreda Sidama zone[Ethiopia] the prevalence of under nutrition(stunting) among infected(*Trichuris trichiura)* and non-infected children were 52.6% and 24.4%, respectively (25). The exposed to unexposed ratio has been taken to be 1:2. Therefore, the final sample size was 223, that is 75 exposed (with STH infection) and 148 unexposed (without STH infection).

4.6 SAMPLING TECHNIQUE AND PROCEDURE

Two-stage sampling technique was used to select a representative sample of school children from the study area; the district that has 25 public primary schools. Then, out of 25 schools 8 were taken by lottery (simple random sampling) method by considering the minimum sample size assumption [30%]. Then, the total sample was allocated to each school by using probability proportion to sample size of each school and grade. Then to select the study units, registration book of the school was used to identify eligible children. Then , simple random sampling technique was used after screening the eligible children for the presence of STH infection (exposed) and absence of the infection (unexposed).

- Exposed- Children's those infected by at least one parasites of STH (*Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm).
- Unexposed- Children's those not infected by *Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm.

Accordingly, Laygna gibicho, Deda, Tachigna gimbicho, Jora, Missie No.1, Shamsa gibicho, Alage ginbichu, Bonosha wanchkota, were include.

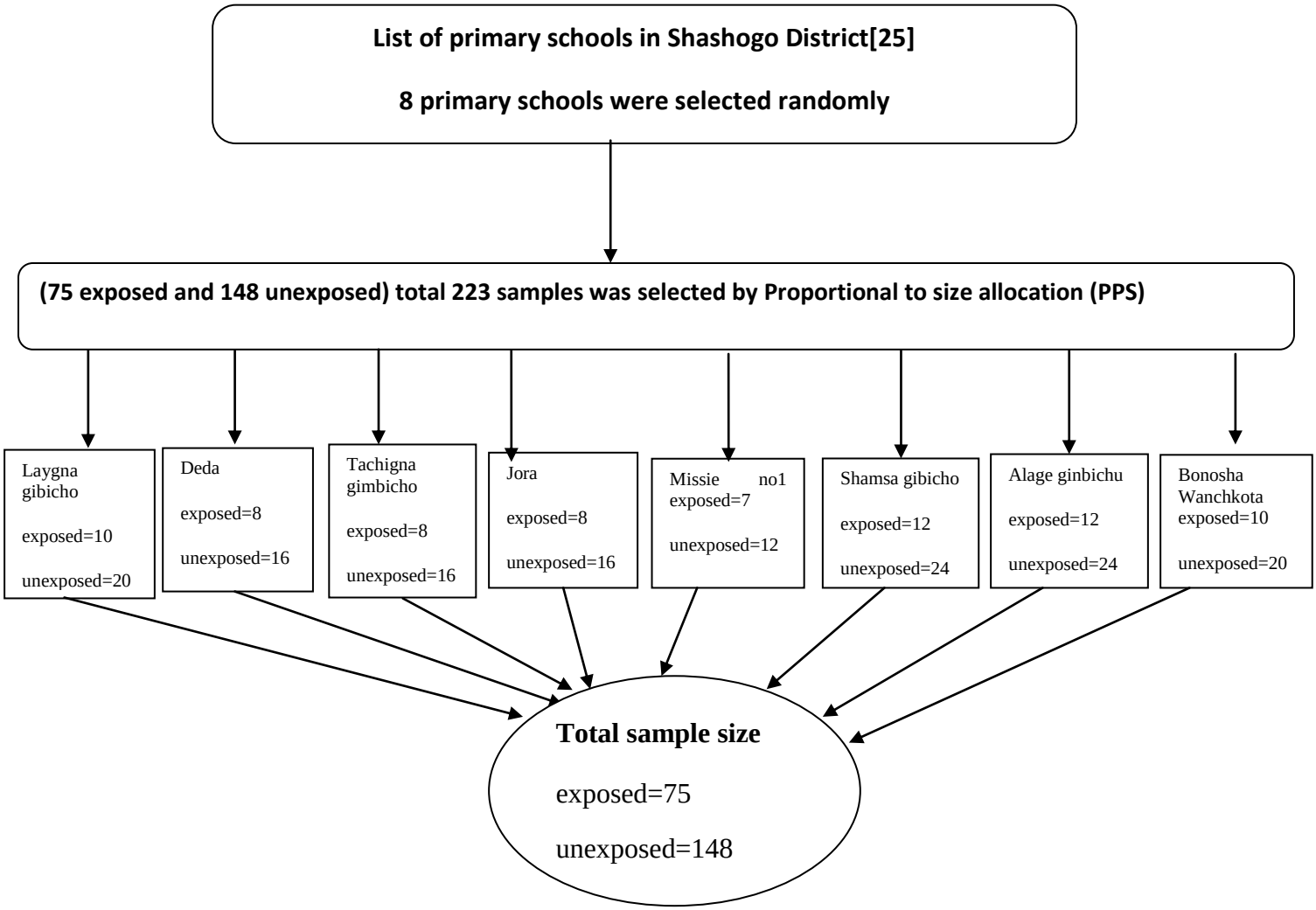

Figure 2. Schematic presentation of sampling procedure, Shashogo District, 2016

4.6.1 DATA COLLECTION PROCESS

Firs the structured questionnaire was developed in English and translated to Hadiyigna (local language) and translated back to English with the assistance of linguistic expert to check its consistency. Six data collectors comprising two diploma nurses, one health officer, two laboratory technicians and one senior laboratory technologist were recruited and trained on the structured questionnaire administration, standard operating procedure of anthropometric measurements and stool specimens examination for three days. Nutritional Status of the children were assessed with anthropometric measurements using the specified trained data collectors.

4.6.2 DATA COLLECTION TOOLS

A pre tested and structured questionnaire was used to collect socio demographic and socio economic data and possible risk factors. Anthropometric measurements(age, height, weight) were taken from each child to calculate height for-age (HAZ), BMI-for-age (BAZ) and weight-for-age (WAZ) to determine stunting, thinness and underweight, respectively

Children were weighed by using a weighing scale. The scales was tasted and validated with standard weights before actual weighing of the children started. The scales was placed on a hard flat surface. The children were weighed wearing soft lightly clothes, without shoes and empty pockets. Weighing scale was calibrated to zero before taking every measurement and reading to the nearest 0.1 kg. Children's height were measured using a height scale and reading to the nearest 0.1 cm.

Stool samples were collected in polyethylene containers and examined in the field using a direct faecal smear technique (26). Each smear was examined twice by two different laboratory technicians. Examination of the specimen in the field was carried out in order to capture hookworms which tend to clear in the stool if not examined within a few hours of collecting the stool. Depending on the laboratory result for STH infected children a single- dose of albendazol (400 mg) were given.

4.6.3 QUALITY CONTROL

Training of data collectors and pre-testing of tools were done prior to the study.

Weighing scales was checked and validated with standard weights every day before actual weighing of the children started. The laboratory reagents, materials, process of transportation and functionality of microscopy at the center was checked by senior laboratory professional.

Five percent (5%) of the slide was re-checked by senior laboratory technologists during field work.

The Supervisors check on daily basis the data collection process. There was a meeting with data collectors every day after completion of the daily data collection process to check data inconsistencies. The principal investigator monitor or maintain the overall activity.

4.6.4 DATA ANALYSIS

After checking for completeness, data were coded and entered in to EpiData version 3.1 and analyzed by using the SPSS software version 20. Anthropometric measurements of the children were entered and analyzed by using AnthroPlus software to determine the nutritional status as recommended by the WHO (27) then exported to SPSS for further analysis. Checking of data code and completeness, data cleaning and exploring were done before data analysis. Frequency tables and cross tabulation tables were used to summarize descriptive statistics.

Chi-Square tests were used to evaluate the differences in the distribution of categorical variables for study groups. The association between malnutrition and explanatory variables was assessed first by Bivariate logistic regression. In Bivariate logistic regression, the variables with P-value <0.25 were candidates to Multivariate logistic regression. Multivariate logistic regression analysis was done controlling for possible confounders using Enter likelihood ratio with 0.01 probability removal was used to develop the model. The exposure variable (STH infection) will be entered into the multiple logistic regression model whether or not it fulfills the criteria because that is the exposure variable this study want to test. OR was presented at 95 % CI and P-value < 0.05 was considered statistically significant. Goodness of fit of the final model was checked using Hosmer-Lemeshow test of goodness of fit considering good fit at P-value < 0.05.

Age, height and weight were used to calculate the following indicators: a) Height-for-age Z-score (HAZ) to assess stunting; b) Weight-for-age Z-score (WAZ) to assess underweight; and c) Body mass- index-for-age Z-score (BAZ) to assess thinness. If the BAZ and HAZ are above-2SD scores the children were considered well nourished and those below -2SD scores were considered malnourished. Further, comparison of the undernourished and normal ones was made on the basis of presence or absence of STH infection, where odds ratios and 95% CI were used to assess the level of association between STH infection and nutritional status.

4.6.5 STUDY VARIABLES

Dependent variable

- Nutritional status of primary school children(stunting, underweight, thinness);

Independent variable

- Exposure variable-STH infections or not among primary school children
- Socio-demographic related characteristics of child (age, sex and educational level of child, presence of shoes);
- Sanitation and hygiene related factors (water source, latrine availability, Hand washing practice, and shoe wearing);
- Socioeconomic status of the parents (educational status, income/housing, house hold size/family size, etc)

4.7 OPERATIONAL DEFINITION

Exposed (with infection) - Children's those infected by at least one parasites of STH (*Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm).

Unexposed (without infection) - Children's those non-infected by *Ascaris lumbricoides, Trichuris trichiura*, Hookworm.

Malnutrition(underweight, stunting, thinness)- If children they WAZ, HAZ, BAZ above -2SD scores they were considered as well nourished and those below -2SD scores as being malnourished.

School-age children - children whose age were in the interval of 5-14 years.

soil-transmitted helminth(STH) infections - Intestinal infections in humans caused by worms such as *Ascaris lumbricoides* (the roundworm), *Trichuris trichiura* (the whipworm) and *Necator americanus* or *Ancylostoma duodenale* (the hookworms).

4.8 ETHICAL ISSUE

Ethical clearance was obtained from Jimma University College of Health Science Ethical Review Board. Supporting letter was also obtained from Department of Epidemiology to zonal education bureau and the zonal education bureau was written to district education office then, district education office was written a letter of support to each primary school.

Oral informed consent was duly obtained from all the parent or guardians of study participants, and the school head before commencing the study. Child assent was taken for stool examination and anthropometric measurements. Confidentiality of information collected from each study participant was maintained. Those who found to be positive for STH infections and those undernourished children were treated according by linking to the local health facilities.

4.9 DISSEMINATION OF THE FINDIN

Findings of the study was submitted to department of Epidemiology college of health sciences of Jimma University. It was also presented to Jimma University. The dissemination also goes Primary Health Care Unit, District health and educational administration offices as well as, to zonal health department, to regional health bureau and to none governmental organization and to other stakeholders. Presentation at scientific symposia & conferences, Publication will also be considered.

5. RESULTS

5.1 BACKGROUND CHARACTERISTICS OF STUDY PARTICIPANTS

From eight selected primary schools, a total of 420 children age 5-14 years were screened for STH infections or not. Then a total of 222 children (75 with STH infections and 148 without infections) were enrolled for anthropometry measurement and questionnaire interview. From this 74 STH infected and 148 non infected were studied, with a response rate of 98% and 100%, respectively.

The background characteristics of study participants were summarized in Table - 1.Majorty of the exposed (with STH infection) and unexposed (without STH infection) children's were rural in residence 86.5% and 86.6%, respectively. About 60% exposed and 51% unexposed children's were female in sex and 59.5% exposed and unexposed were in 10-14 years of age. The mean (SD) age of the exposed and non-exposed study participants were 10.23 (±2.04) and 10.7 (1.9) years, respectively.

About 62% exposed and 49% unexposed were learn in grade 1-3. Majority of the exposed and unexposed family size were in the range of 6-10 in numbers that means 66.2% and 72.3, respectively. Household wealth index of both exposed and unexposed children's were relatively similar in distribution and majority of both exposed and unexposed study participants were Hadiya by ethnicity (Table 1).

Table 1: Background characteristics of study participants between STH infected and non-infected group and their comparison without the exposure variable of primary school, Shashogo District, Southern Ethiopia, March, 2016

Variables	Categories	With STH infection (Total no = 74) No (%)	Without STH infection (Total no = 148) No (%)	Chi-square
Residence	Urban	10 (13.5)	20 (13.5)	0.589
	Rural	64 (86.5)	128 (86.5)	
Sex	Female	30 (40.5)	72 (48.6)	0.159
	Male	44 (59.5)	76 (51.4)	
Age in years	7-9	30 (40.5)	45 (30.4)	0.088
	10-14	44 (59.5)	103 (69.6)	
Grade	1-3	46 (62.2)	73 (49.3)	0.048
	4-6	28 (37.8)	75 (50.7)	
Family size	1-3	11 (14.9)	12 (8.1)	
	4-5	14 (18.9)	29 (19.6)	
	6-10	49 (66.2)	107 (72.3)	
Household wealth index	Richest	25 (16.9)	25 (16.9)	
	Rich	10 (13.5)	34 (23.0)	
	Medium	10 (13.5)	28 (18.9)	
	Poor	21 (28.4)	31 (20.9)	
	Poorest	14 (18.9)	30 (20.3)	
Religion	Protestant	48 (64.9)	76 (51.4)	
	Orthodox	3 (4.1)	6 (4.1)	
	Muslim	23 (31.1)	66 (44.6)	
Ethnicity	Hadiya	74 (100)	144 (97.3)	0.195
	Others*	0	4 (2.7)	
Latrine availability	Yes	66 (89.2)	135 (91.2)	0.396
	No	8 (10.8)	13 (8.8)	

*Silte, Kembeta

The results of this finding showed that the overall prevalent rates of malnutrition with STH infected and non-infected in primary school children of Shashogo District was found to be 12.2% and 10.8%, respectively (Table 2). Also from total malnourished children stunting 12(5.4%), thinness 19(8.6%) and underweight1(0.9%) were observed

Table 2: Nutritional status among STH infected and non-infected of study participants, primary school, Shashogo District, Southern Ethiopia, March, 2016

		Nutritional status		
		Malnourished N (%)	**Well nourished N(%)**	**Total**
STHs	Yes	9 (12.2)	65 (87.8)	74 (100)
	No	16 (10.8)	132 (89.2)	148 (100)
Total		**25 (11.3)**	**197 (88.7)**	**222 (100)**

5.2 FACTORS AFFECTING NUTRITIONAL STATUS OF THE CHILDREN

Binary logistic analysis showed hand washing habit, household wealth index and family size were independently associated with malnutrition. The multivariate logistic regression model showed that primary school children of the households with family size of greater than 5 were seen associated with malnutrition of the children (AOR : 3.6; 95% CI: 1.5, 9.1) at p. value < 0.05 (Table 3).

Table 3: Bivariate and multivariate logistic regression analysis of factors associated with malnutrition among STH infected and non-infected of study participants, primary schools, Shashogo District, Southern Ethiopia, March, 2016

Variables	**Malnutrition (n = 222)**		**COR**	**P. value**	**AOR**
	Malnourished No = 25; N(%)	Well nourished No = 197; N(%)	**(95% CI)**		**(95% C.I)**
Family size(1-3)	3(13.0)	20 (10.2)	1		
Family size(4-5)	10(23.3)	33 (16.8)	1.80(0.47, 6.94)	0.39	1.80 (0.47, 6.94)
Family size(6-10)	12(7.7)	144 (22.3)	3.64 (1.45, 9.13)	0.006*	3.64 (1.45, 9.13)**
Wealth index(richest)	4(9.1)	40 (20.3)	1		
Wealth index(rich)	3(5.8)	41 (20.8)	0.61 (0.13, 2.90)	0.54	
Wealth index(medium)	1(2.6)	37 (18.8)	0.27 (0.03, 2.5)	0.25*	
Wealth index(poor)	10(22.7)	42 (21.3)	2.94 (0.85, 10.23)	0.09*	
Wealth index(poorest)	7(16.0)	37 (18.8)	1.90 (0.51, 7.00)	0.34	
Hand washing habit BE and AD (no)	11(22.5)	38(19.3)	3.29 (1.38, 7.81)	0.007*	
Hand washing habit BE and AD (yes)	14(8.1)	159(80.7)	1		
Exposed(yes)	9(12.3)	65(33.0)	0.87 (0.37, 2.08)	0.76	
Exposed(no)	16(10.8)	132(67.0)	1		

Note **Statically significant association in multivariate analysis (p. value <0.05)

*Statically significant association in bivariate analysis (p. value <0.25)

Unmarked: not significant

6. DISCUSSIONS

The overall prevalence of malnutrition among STH infected and non-infected primary school children in Shashogo District was found to be 12.2% and 10.8%, respectively. The prevalence of malnutrition i.e. those with malnutrition is found to be higher in infected than non-infected children and this difference was not significant among these children. Nutritional status of children's with STH infections and without STH infections were relatively similarly; but this is inconsistence to the study conducted in Dale, Ethiopia shows infection with Trichuris trichura was significantly associated with stunting.

Generally nutritional status of most children was within healthy parameters but a few cases of stunting 12(5.4%), thinness 19(8.6%) and underweight1(0.9%) were observed. Of the children who were stunted and thin, boys accounted for 46% and 58% of the cases, respectively. Overall, of 222 children, 25 (11.3%) had at least a form of nutritional deficit. The present study however showed a relatively low prevalence of malnutrition comparable to the report from the study conducted in primary school children in Dale (25), Addis Ababa (31%) Ethiopia (28) and higher than the WHO/2007 international reference standards (29). But this study similar with the study done in school-age children in Honduras (10.3%) (16). The possible reason might be that treatment of asymptomatic intestinal helminth infection improved nutritional status of the children.

Regarding the associated factors, multivariate analysis showed that having large family size (>5) was the predictors of malnutrition among primary school children. Accordingly, those respondents having large family size (>5) were 3.6 times more likely to have malnutrition as compared to respondents having small family size. This finding similar with the study done in Fogera district Northwest Ethiopia larger family size (6–8) was significantly associated with undernutrition (30). This shows more number of family sizes could have put children at higher risk for malnutrition and this could be because of imbalance between family size and resource.
Hence, positive significant relationship between family size and prevalence of malnutrition could be explained by the fact that the family pot is shared among a large number of people in the household, thus inadequate dietary intake by children for a prolonged period and eventually the manifestation of chronic malnutrition.

7. LIMITATION OF THE STUDY

This study is limited to students in grades 1–6 and those who were present in school. Students absent due to illness or other circumstances were not included. For stool sample examination Formalin-ether concentration and Kato-katz technique is better to increase accuracy of the result. However, to my knowledge this article is the first of its type to look the relationship between STH and nutritional status among school children in Ethiopia.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Basing on the findings of this study, the following conclusions can be made:

- ✓ Children's who exposed for STH infection had somewhat higher risk of developing malnutrition when compared to non-exposed.
- ✓ Households with large family size are associated with observed prevalence of malnutrition among primary school children in Shashogo district, so that appropriate control measures like child care, health information about child nutrition could be needed.
- ✓ Since the prevalence of malnutrition was not negligible in this population, elimination of helminthes infections among school children can play a major role in improvement of the children's nutritional status.

8.2 RECOMMENDATIONS

For the School:

- ✓ establish regular hygiene and sanitation program/behavioral change communication
- ✓ establish hygiene and sanitation club at school.
- ✓ work in collaboration with town health office on STH de-worming program

For district health office:

- ✓Strengthen the screening and de-warming program in the school age children.
- ✓provide/facilitate health information about STH and its impact on child malnutrition to the community.

For health posts;

- ✓ conduct regular community sensitization and malnutrition screening program among in school children
- ✓ strengthen and expand school and community-based programs that prevent the spread of STH infections.

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ANNEXES

Appendix I: Information sheet and Informed consent

I. Information sheet

Greeting: Good morning/afternoon

My name is----------I am from Jimma University Department of Epidemiology and working a research on Correlation of STH infections and nutritional status among primary school children in Shashogo District. This study aims to determine the correlation/association between STH infection and nutritional status of the child. I would like to ask you a few questions which take 10-15 minutes.

I would very much appreciate your participation in this survey. This information will help us to determine the STH infections and their association with nutritional status which leads to the program planers and government officials can apply evidence based interventions.
You are selected randomly to be participant of this study if you give me consent after you have understood the following information sheet:

Rights of participants: Participating and not participation is the full right and participants can stop for participating in the study at any time. They can also skip any question which they want to respond. They can ask any question which is not clear for them.

Confidentiality: Any information forwarded will be kept private and her/his name will not specified.

II. Informed consent

I have read this form or it has been read to me in the language I comprehend and understand all conditions stated above. Therefore, willingness to participate in this study.
1)Yes -------2) No ---------- signature----------
If yes, continue with the questions.
Date of interview in Ethiopian Calendar ----------/----------/-------

Time stated---------- Time completed ----------

Study area: - woreda/ 1.Town---------- 2.kebele----------3.house number----- -----

Name of Interviewer----------

Name of Principal investigator: BIRHANU SEYOUM;
Address: Tell: 0913489627 Email: birhanuseyoum@gmail.com
Name of institution: Jimma university college of Health Science IRB
Address: jimma, Ethiopia

Appendix II: Stool Examination Format

District_____ Kebele _____ Name of the school_____

Sr. No	Name of the children	Age	Sex	Grade	Laboratory result*	Remark
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

*0=Negative; 1=*Ascaris lumbricoides;* 2=*Trichuris trichiura;* 3=Hook worm; 4=1+2; 5=1+3; 6=2+3; 7=1+2+3; 8=Others

**0--Neg; 1--A.lum; 2--TT; 3--HW; 4--A.lum & TT; 5--A.lum &HW; 6--TT&HW; 7--A.lum, TT&HW; 8--Others

Name and signature of the Laboratory technician _____Date____/____/____

Appendix III: English version questionnaire

Part I: Socio-demographic data

Identification number_____ Name of the student_____ Date_____/_____/2016

Sr. No	Questions	Possible response	Skip to
1	Residence	Urban------1 Rural-------0	
2	Sex of the child	Male--------1 Female-----0	
3	Age of the child	_____ years	
4	Grade of the child	_____	
5	Household size/How many persons live in your house?(Family size)	_____number	
6	Is your father alive?	Yes------1 No-------2	If no, skip to # 9
7	If the answer for Q no 6 is yes what is the educational status of the father?	1.Cannot read and write 2.Can read and write 3.Primary school (1-8) 4.Secondary school (9-12) 5.Diploma 6.Degree and above	
8	If the answer for Q no 6 is yes what is your father's occupation?	1. Farmer 2.Employed 3.Merchant 4.Daily laborers 5.Other (specify: _____)	
9	Is your mother alive?	Yes-----1 No------0	If no, skip to # 12
10	If the answer for Q no 9 is yes what is the educational status of the mother?	1.Cannot read and write 2.Can read and write 3.Primary school (1-8) 4.Secondary school (9-12) 5.Diploma 6.Degree and above	
11	If the answer for Q no 9 is yes what is your mother's occupation?	1.House wife's 2.Employed 3.Merchant 4.Daily laborers 5.Other(specify: _____)	
12	Religion	1.Protestant 2.Orthodox 3.Catholic 4.Muslim 5.Other(specify:_____)	
13	Ethnicity	1.Hadiya 2. Kembeta 3. Silte 4. Other(specify:_____)	

Part II. Household wealth index identification questionnaires

House hold wealth. (Rural/Urban). **Now I will ask you about some fixed assets that your households have.**			
Does the household has any of the following properties.(**circle**)		Yes-----1 No------0	
1	Functioning radio/tape recorder/CD player		
2	Functioning television		
3	Stove(gas/kerosene/electric)		
4	Motorcycle		
5	Cart/Gari		
6	Watch(hand /wall)		
7	Mobile phone		
8	Plough		
9	Sofa		
10	Spring mattress		
11	Foam/sponge mattress		
12	Generator		
13	Milling		
14	Water pump		
	Does the Household has the following animals?	Yes-----1 No-------0	How many?
15	Oxen		
16	Cows		
17	Horse /mules		
18	Goats /cheeps		
19	Chicken		
20	Donkey		

Variable	Yes -----1 No------0	**Variable**	Yes-----1 No-------0
21.Drinking water source		**25.Main floor material**	
1.Tap water		Earth/ sand	
2.Well water		Dung	
3.River or Spring		Wood planks	
4.Rain water		Cement	
5.Others---(more than one answer is possible)		**26. Exterior Walls materials**	
22. Type of toilet facility		Wood with mud	
No facility/ bush/ field		Bricks	
Traditional pit latrine		Others	
Improved ventilated pit latrine		**27. Cooking fuel**	
Flush toilet		Dung	
23. Electricity		Firewood	
24. Roof material		Charcoal	
Wood/ mud		Coal	
Thatch/leaf		Kerosene	
Iron sheet		Biogas	
Cement		Natural gas	
		Electricity	

Part III. Sanitation and hygiene related factors

1	Main drinking water source (check one for main source)	1.Tap water 2.Well water 3.River or Spring 4.Rain water 5.Others----------(more than one answer is possible)	
2	Is functional latrine available in your house/compound?	Yes-----1 No------0	
3	Does the child have a habit of hand washing with soap?	Yes-----1 No------0	If no, skip to # 5
4	The answer for Q no 3 is yes when does he wash?(Do not read)	1.before meal 2.after meal 3.after toilet always 4.aftertoilet sometimes 5.others specify	
5	Habit of wearing shoe	1.always 2.sometimes 3.not at all	

Part IV. Anthropometric measurements of the student

Weight _____. ___ kg,

Height _____ . ___ cm

Thank you very much!

Appendix IV : Hadiyigna version questioner

Baxxanchi III: Suu'm xa'michcha

Ijaaj I: Minaadaphi naqaashsha

Inkiinno'i xigo _____ Losaanchi summa _____Balla ____/____/2016

Xigo	Xa'michcha	Iheena xanoo dabachcha	Urakka'a higimma
1	Heechchi beyyo	Beero'o-------1 Hax uulla------0	
2	Ciilichchi albachcha	Gooncho-------1 Landichcho----0	
3	Ciilichchi umura	_____	
4	Ciilichchi baxxanchi gabala	_____	
5	Abaroos dutooma	_____	
6	Kiyyan foor hee'a?	Eeya yookko------1 Bee'e----------0	Beelas utta xig 9 hige
7	Xa'michchi loh(6) dabachchi yookki yitlas, kiyyan losa'nissa maha labookko?	1.Qanannaa'imma kitaabimma xanooyyo 2.Qanannaa'imma kitaabimma xanookko 3.Luxx gaba'l losano(1-8) 4.La'm gaba'l losano(9-12) 5.Dipiloomma 6.Digire'e gabalaa shiqqeena	
8	Lohiq(6) xa'michchi dabachchi yookko yitlas kiyyan bax maha?	1.Abuullaancho 2.Adi'l baxancho 3.Daddaraancho 4.Balli baxancho 5.Mullek yoolas kure:_____	
9	Kiyyumma foor hee'la'a?	Eeyya yoo------1 Bee'e----------0	Beelas utta xig 12 hige
10	Xa'michchi honso(9) dabachchi eeyya yookki yitlas, kiyyummi losa'n gabal maha labookko?	1.Qanannaa'imma kitabimma xantamoyyo 2.Qanannaa'imma kitabimma xantamo 3.Luxx gaba'l losano(1-8) 4.La'm gaba'l losano(9-12) 5.Dipiloomma 6.yuuniveersite'i gabalaa shiqqeena	
11	Xa'michchi honsina(9) eeyya yo'o yitlas kiyyum bax maha?	1.Mi'n baxoo ooso li'isimma 2.Adi'l baxaanchotte 3.Daddaraanohotte 4.Balli baxaanchotte 5.Mullek yoolas kure: _____	
12	Amma'nat	1.Amma'naancho 2.Oortodokisa 3.Kaatolika 4.Isilaancho 5.Mullek yooles kure:_____	
13	Giichcho	1.Hadiyyichcho 2.Kambaatichcho 3.Silxekichcho 4.Mullek yoolas kure _____	

Ijaaj II. Abaroosina yoo amaxxa moo'oo suu'm xa'michcha

Abaroos amaxxa.(Hax uulla) **Kaba abaroosina yookkii mikke'oo bee'i amaxxa moo'oo xa'michcha xa'moommo.**			
Abaroosina awwonaa yoo amaxxi hee'aa?		Eeyya yookko-----1 Bee'e----------0	
1	Baxoo raadoona/Teepa sagara inkiiraancho		
2	Baxoo Televizhiina		
3	Buttaa gaaza/koronte'e		
4	Doqdoqe'e		
5	Faraxxi shafe'i gaare'e		
6	sa'aat/Gorte'ik/angik		
7	Moobaayi'l silka		
8	Abuulli maarasha/kado'o		
9	Soofa'a		
10	Isipiring firaasha		
11	Ispoonj firaasha/fuutto'i firaasha		
12	Jenereeteera		
13	Hurbaata liittoo koronte'e		
14	Boomb(winziiro'i wo'o)		
Abaroosina woroon yoo diinat yoonihe?		Eeyya yookko----1 Bee'e----------0	Mee'o?
15	Mirgo'uwwa		
16	Saayya		
17	Farashsho/Baquchcho		
18	Fella'a/Gereebba		
19	Antabaa'a		
20	Hallichcho		

Hasamoo luwwa	Eeyya yookko--1 Bee'e----------0	**Hasamoo luwwa**	Eeyya yookko--1 Bee'e----------0
21.Aggi wo'i siidamo beyyo		**Min gax bamu luwwa moo'ookeeno**	
Xeen wo'o		Buchcha/shashshara	
Bare/qoqobba/dambala		Oreeti maragimma	
Daajje		Diqamu haqinnette	
Daado bu'o		Simintoo	
Hinakko'i bare		**Mi'n illichchi baxamu luwwa**	
Axisamaakko bu'o		Haqqa/hara	
Axisamaakko bare		Huqqa/shashsha/bura'a	
Gatt mi'n qashii toohcho siidamo boomb wo'o		Qorqoro'o	
Qashi woro siidamo boomb/winiziiro'i wo'o		Siminto'o	
Mi'n woro siidamo boomb wo'o		**Hurbaata sarakkam luwwa**	
Shu'm mine moo'oo'isa		Koboota	
Shu'm mi'n bee'e/haqqi woro/haraar biira		Haqqiinne(gii'l haqqa)	

Kora'i shu'm min yookko		Kassala	
Danaam hafachchi aago/firo shu'm min yokko		Meneraala	
Siminto'i baxamaakko shu'm lasage wo'o dunakkamok yokko		Naafixxa	
Koronte'i caakka		Baayyo gaasa	
Gorte'i baxamu luwwa		Uumo'o siidamo gaasa	
Haqqine harinnette		Koronte'e	
Xuuba			

3. Baxxanchi III. Hegeeqeka gaqi muccuroo'm qedda moo'ookeeno.

1	Agi wo'i siidamoo beyyo	1.Boomb(winiziiro'i) wo'o 2.Bare siidamo wo'o 3.Daajje te'im bu'o 4.Xeen siidamoo wo'o 5.Mullek yoolas kure_____	
2	Ki'n mi'n qash(ooxxi) woro awwaado uwwoo shu'm min hee'aanihe?	Eeyya yookko--------1 Bee'e----------0	
3	Ciil hundi ammanem ixx anga saamun aansha'imma losaa?	Eeyya yookko-------1 Bee'e----------0	Aansha'oo beelas utta xig 5 hige
4	Xa'michchi 3na dabachchi eeyya yitlas hink ammane aansha'ookko?	1.Hurbaaxxi illage 2.Hurbaaxxi lasage 3.Shu'm lasage 4.Mat mataare shu'm lasage 5.mullek yoolas kure _____	
5	Kobe'e issa'immi losano	1.Hundammanem 2.Mat mataare 3.Hore'em issa'ooyyo	

Baxxanchi IV. Losaanchi orachchi qaxooma keenimma

Guurato_____._____kg ,

Uullichcha _____._____ cm

Araqa Galaxxommo!