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# Prevalence and factors associated with Intestinal Parasitic Infections among People living along the shores of Lake Kijanebalora, Rakai District Uganda

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## ABSTRACT

**Background**: Intestinal parasitic infections can lead to various diseases like amoebiasis, giardiasis, and helimithiasis. People living or working near lake shores in Uganda are at a high risk to a variety of intestinal parasitic infections due to constant contact with contaminated water and poor sanitation. This study was carried out to determine the prevalence and factors associated with intestinal parasitic infections among people living along the shores of Lake Kijanebalora in Kasula Parish, Rakai District.

**Methods:** A cross sectional community survey was carried out between May 2019 and June 2019 in the villages along the shores of Lake Kijanebalora in Kasula Parish, Kyalulangira Sub County, Rakai District. Participants were chosen from randomly selected households within the study area and stratified into three age categories namely under-fives, 5-14 years and those 15 years or older. The proportion of the study sample represented by each age-group corresponded with estimated age-specific distribution of the population of Kasula Parish. Participant stool samples were collected and analyzed by microscopy to identify and characterize intestinal parasitic infections. Data on socio demographic and economic characteristics, hygiene and sanitation behavior and practices were collected using a questionnaire. Fisher's exact test was employed to determine if differences in prevalence across age categories considered in the study were significant. Logistic regression analysis was employed to identify factors statistically associated with intestinal parasitic infections.

**Results:** Three hundred fourteen (314) participants were studied. The overall prevalence of intestinal parasitic infection was 66.6% [61.3%-71.8%]. Age-specific prevalence were 69.4% for children under 5 years, 67.4% for children between 5-14 years and 65.1% for adults aged 15 or older. Among the infected participants, 64.1% had protozoa infections only, 20.6% had helminthes infections only, while 15.3% had a combination of helminthes and protozoa infections. Nine species of intestinal parasites were identified of which *Entamoeba* *histolytica/dispar* was the most prevalent at 40.2%, followed by *Ascaris lumbricoides* at 35.4% and *Cryptosporidium* spices at 22.0%. Twenty-three percent of infected individuals had multiple infections and 45.4% had high or very high degree of infection. The high prevalence of intestinal parasitic infections among people living along the shores of lake Kijanebalora in Kasula Parish, Rakai District was statistically associated with community members practice of open defecation (aOR:3.28[1.85-5.80]) and eating of raw foods, (aOR:2.44[1.22-4.91]). Having short finger nails (aOR:0.56[0.33-0.97]), going for medical checkup voluntarily (aOR:0.33[0.13-0.85]) and purifying drinking water (aOR:0.34[0.16-0.74]) may reduce one's risk of acquiring intestinal parasitic infections.

**Conclusion**: In the study setting, the prevalence of intestinal parasitic infections is high and protozoa infections are very common. Community members practice of open defecation, eating of raw foods and long finger nails are risk factors for intestinal parasitic infections. Community sensitization about prevention by Health authorities in the area, inclusion of anti intestinal protozoan treatments into the current de worming strategy, as well as extending the de worming strategy by the Ministry of health Uganda to include adults, are recommended.

## 1. Introduction

Intestinal parasitic infections cause a great burden of morbidity and mortality as they lead to various diseases like amoebiasis, giardiasis, and helimithiasis among others all of which are considered to be neglected tropical diseases(Utzinger J, 2012).These diseases are dangerous to human life as they are associated with life threatening conditions such as anemia, diarrhea, abdominal pain, fever, rectal prolapse, nausea, anorexia, constipation and intestinal obstruction among others (Ministry of health Uganda, 2016). The parasites can also invade various vital body organs like the liver, brain, lungs and others potentially damaging them (Burton J.Bogitsh, 2012).

Globally over three billion people are infected with one or more types of intestinal parasites. Soil transmitted helminthes alone affect more than 24% of the world's population(WHO, 2018). Two hundred million people worldwide were estimated to be infected by *Giardia lamblia* (Utzinger J, 2012). More than four hundred million people worldwide are suffering from disease caused by intestinal parasite (WHO, 2018). Protozoan infections like giardiasis and amoebiasis are very significant, where by an estimated 100,000 deaths worldwide were attributable to *Entamoeba histolytica* amoebiasis alone ranking fourth in the most fatal parasitic related diseases Utzinger J, 2012). In Africa, the general continental prevalence may not be known. However, studies done in different countries, indicate a high prevalence. For example in Nigeria 86.2% of school children, had intestinal parasitic infections, of which 39.1% had mixed infection (Vincent P. Gyang etal, 2017). In Kenya, 33.4% of HIV infected people are also infected with intestinal parasites (Fredrick Wabwile Wanyama, 2014), while in Tanzania, 57.1% of the population in Mwanza are infected of which protozoa are responsible for 20.5% of the infections (H.D. Mazigo, 2010). In Uganda, current reports describing the prevalence of all intestinal parasitic infections are scarce.This can be attributed to the narrow scope of studies which focus mainly on Schistosomiasis or soil transmitted helminthes (Cara Kamenka & Fenwick, 2003),and the age group of children (Moses Adriko, 2018). Although children and pregnant women are considered to be most at risk groups, non-pregnant adults and the elderly are also susceptible to infection and can act as a source of active transmission in the community. Also there is no active regular surveillance system for the trends of all intestinal parasitic infections in the Uganda and demographic health surveys, which are Uganda's source of health indicator statistics do not generate data about intestinal parasitic infections (Uganda Bureau of statstics, 2016). Limited availability of current data results into poor perception of the burden of intestinal parasitic infections in the community among decision and policy makers. This can hinder designing of appropriate prevention and control strategies, yet without wide coverage of prevention and control strategies, intestinal parasitic infections continue contributing to a great burden of morbidity and mortality which affects the health and well being of people in the area.

Several ways exists through which intestinal parasitic infections are transmitted. They include fecal oral route whereby a person is infected either directly or indirectly through taking in infective fecal matter in contaminated food, water or by use of contaminated hands(Monica Cheesbrough, 2009). Transmission can also occur when man ingests in the fresh of an infected definitive or an intermediate host which upon action by gastric juices, free larvae are released which attach on the mucosa membrane, mature into adult forms while others enter circulation and then disseminated into the whole body where they form cysts in various body parts including the brain(Monica Cheesbrough, 2009).Upon open defecation by an infected person, ova can develop into *Rhabditform* larvae, like for the case of hookworms, or some *Rhabditform* larvae for the case of *Strongyloides* live freely in the environment, develop into *Filariform* larvae (infective larvae) which can infect humans by penetrating the human skin and then enters the human circulation and via the heart, lung, and esophagus, finally enters the intestines where they mature from (Peter L.Chiodini, 2001).

Intestinal parasitic infections majorly persist in developing countries especially in the tropical and subtropical regions (Burton J.Bogitsh, 2012), with populations living or working near lake shores being identified as a high risk group for a variety of intestinal parasitic infections (Cara Kamenka & Fenwick, 2003). This is attributed to several factors which pose a risk to the population, for example poverty, lack of access to adequate clean and safe water as well as poor hygiene and sanitation practices, for example people characterized by irregular hand washing with soap and water, improper use of toilets or people practicing open defecation, sharing accommodation with animals, and coming into contact with contaminated environment without protective gears (Utzinger J, 2012). Dietary habits like eating of raw foods also can expose one to a risk of intestinal parasitic infections through the fecal oral route because chances of one eating infective stages of parasites are high (Baye Sitotaw, 2019). Poor health care seeking behaviors, sex, level of education, literacy levels, and occupation also can influence intestinal parasitic infections(Burton J.Bogitsh, 2012).Age is another factor, and people of all age groups are susceptible to these infections, however preschool and school going children as well pregnant women plus women of child bearing age are at greater risk compared to others (WHO, 2018). It is estimated that over 267 million pre-school and over 568 school age children around the world, live in areas where intestinal parasitic infections are intensively transmitted (WHO, 2018).

## MATERIALS AND METHODS

### 2.1 Background of the study area

Kasula Parish is found in Kyalulangira sub-county, Rakai District, in the Southern part of Central Uganda. The Parish is about 12 km South West of Rakai District headquarters along the Southern shores of Lake Kijanebalora in Kyalulangira sub-county. Rakai District headquarter is about 20km from Kyotera town along Kyotera, Rakai, Kibaale road. Kasula Parish is made up of fourteen villages and out of these, five are along the shores of Lake Kijanebalora and these include, Kamoma A, Ntebezadungu, buligi, Kalugu and Ntovu. It has a projected population of about 8420 people, of these 3873 are people under 15 years of age,1490 are children under 5 years, and 1701 are women of child bearing age . Crop and livestock farming as well as fishing are the main economic activities of people in the area much as other activities such as trade are also done (Moses, 2018).

### 2.2 Study design

A cross sectional community survey of intestinal parasitic infections and associated factors was carried out between May 2019 and June 2019. It took place in the villages that are along the shores of Lake Kijanebalora in Kasula parish, Kyalulangira Sub County, Rakai district. It involved 314 participants. Stratified by age group (56 children under 5 years, 89 children aged 5-14 years and 169 people aged 15 years and above), based on the estimated age distribution and population size of Kasula parish.

### 2.3 Sampling and sample selection

A household sampling frame was created from village health team (VHT) registers of each of the five villages in Kasula Parish that are along the shores of Lake Kijanebalora. Over a three-weeks period, all households in each village were listed with the help of VHT members and a single list of all households in the study area was made. Each household was assigned a unique identification number. After the sampling frame was ready, the principal investigator with assistance of two VHTs from Kasula Parish wrote identification number of each of 998 households in the sampling frame on small pieces of paper. The small papers each containing a single household number were placed into a single wide box and then mixed well. The principal investigator while his eyes closed picked one paper at a time until 125 households were selected. The determination of 125 households was based on the assumption that if at least a mother, father and a child from a selected household gave consent, the required sample size would be achieved. All persons within the selected households were legible to participate in the study if their age category was not yet filled up, they gave consent and were not in any similar or intervention study against intestinal parasitic infections at the time of enrolment. Participants were assigned with unique identification numbers which were beginning with the household number followed by personal number. This number was written on a paper, given to a participant, to ease identification during the process of giving feedback. The unique participant number was also written on the questionnaire, the stool container, laboratory data collection form and consent form to ease identification of participants. Identification numbers for the selected households were marked on respective houses after interviewing participants so as to ease the identification of these households during the process of giving feedback on results from stool analysis.

### 2.4 Inclusion criteria

A person was included into the study if he or she was a resident at any of the villages that are along the shores of lake Kijanebalora in Kasula Parish and is a member of a randomly selected household. In addition, eligible participants were asked to show consent first by signing a consent form. For individuals below 18 years, the guardian was asked to sign an ascent form on their behalf. Persons under 18 years who were considered emancipated minors like those heading households consented for themselves.



### 2.5 Exclusion criteria

People involved in any other similar study, or a study that administers interventions to address intestinal parasitic infections at the time of enrollment. Also any person who failed to produce a stool sample was excluded.

### 2.6 Data collection methods

#### 2.6.1 Key study variables

The primary outcome variable was intestinal parasitic infections. It was assessed by analyzing participants' stool samples and reported as positive in case any intestinal parasitic feature was found or negative in case no intestinal parasitic feature was found. In addition, the frequency of occurrence of each intestinal parasite type and species found was determined. This was done by detailed examination of positive samples to clearly identify and record the type and species. Also the degree of infection was determined by establishing the parasite density in the positive stool samples. Exposure variables assessed included personal hygiene factors like, washing of hands with soap and water, use of protective footwear, use of hand protective ware while on agricultural work, latrine use, sharing accommodation with animals, length of finger nails, and shaking hands. Community variables, like type of water source, accessibility of to public toilets, type of community (Landing site vs. Agricultural) were recorded by the use of a questionnaire. The questionnaire was used also to collect data on social demographic factors like age, sex, education level and literacy. Participants who were 10 years or older were subjected to a simple literacy test. Those below 10 years, their care takers were assessed instead. This was done by requesting a participant to read a simple massage typed on a card in Luganda or Runyankole or English which are the mostly spoken languages in the area.This was followed by observing if the participant was able to write his or her name properly on the consent form. A participant was considered literate if he or she was able to write his or her name properly on the consent form and was able to read whole or part of the sentence on the literacy testing card. If the participant could only read or write or couldn't both read and write, was considered illiterate. Results of this test were recorded into the questionnaire. Data on economic variables**,** like occupation and contact with organic manure and dietary practices, like eating raw foods and safety of drinking water was also collected. Treatment factors, like history of de worming and health care seeking behaviors were also assessed by the questionnaire. Participants below 10 years were helped by their guardians to answer the questions where they could not answer. The questionnaire was translated into Luganda language which is the major language spoken in the area.

**2.7 Stool sample collection**

After the interview, each participant was asked to provide a single stool sample for laboratory analysis to determine the presence or absence of intestinal parasitic infections. A clean stool sample collection container, labeled with a participant's details, and a toilet paper was provided, instructed on how to collect the best stool sample. On return, the container was inspected to establish if the right sample was place and adequate. A smear was made from the sample on a well labeled slide while still in the field in case the sample was diarrheic/watery, or semi formed. The smear was allowed to air dry fixed with methanol and slide placed into a slides box. Then the stool containers were placed in a cool box without ice packs, and then transported to Kyalulangira HCIII laboratory for analysis. The transportation of samples from the field could be made before one hour elapsed after collection using the study sample transporter. Each participant was provided with a piece of soap and requested to get water for hand washing.

**2.8 Stool analysis methods used**

Stool analysis involved five methods which included, direct wet preparation technique, formal ether concentration technique, modified Zn technique, modified rapid fields staining technique, and modified fields staining technique. Direct wet preparation, method, was done on all samples to detect and observe the presence of motile parasites, ova, cysts, blood ad pus cells in stool. For all negative samples at this stage, formal ether concentration method was employed so as to increase chances of detecting parasites. For semi formed and unformed stool samples, modified rapid fields staining technique was done to increase on chances of detecting intestinal protozoa so as to rule chances of missing them in wet preparation due to death or loss of motility. For watery stool samples only, modified fields staining technique was done to detect the presence of *Microsporidia* species. Modified Zn staining technique was done on all stool samples to detect the presence of *Cryptosporidium* and *Cyclospora oocysts*.

## 2.9 Reporting laboratory results

Results were reported into a laboratory data collection form. Each participant was identified by his or her study number. Appearance of the sample was reported as either formed, semi formed, watery/unformed or diarheic, bloody or mucoid. Microscopy results were reported as positive, in case any intestinal parasitic feature was found or negative when no intestinal parasitic feature seen. For positive samples, we went ahead to identify the species and type of the parasite seen. The degree of intestinal parasitic infection was determined by counting the number of larvae, egg/cyst/oocysts or trophozites found in the entire preparation and grade it as follows: low when 1-10 per preparation, moderate, 11-20 per preparation, high 21-40 per preparation and very high when > 40 per preparation (Monica Cheesbrough, 2009).

## 2.10 Data processing and analysis

A data set was created by entering data from the questionnaires and the laboratory data collection forms into Microsoft office excel 2007 spread sheet, coded and imported into STATA Version 12 for analysis. The prevalence of intestinal parasitic infection was established by expressing number of positive samples as a percentage of all the samples analyzed. The frequency of occurrence of each type and species of intestinal parasitic infections was established by expressing the number of a particular type or species seen, as a percentage of the entire infected number of participants. Prevalence data is presented in tables as a general percentage and also as percentages for each intestinal parasite types and species. A general description of the prevalence of intestinal parasitic infections, followed by description of patterns of intestinal parasitic infections based on age categories, was done. Bivariate logistic regression analysis was done to obtain crude odds ratios. Multvariate logistic regressions analysis was employed to rule out confounding and effect modifying factors so as to establish factors statistically associated with intestinal parasitic infections. Fisher's exact test was used to establish significance of differences in prevalence across age groups. Odds ratios were used as a measure of association. Odds ratio below one indicated a protective association, one indicated no association, while above one indicated risk factors. P-values (levels of significance) were used to determine the statistical significance of the association using 0.05 as the decision threshold.

## 2.11 Limitations of the study

The study was cross-sectional. Causal interpretation of risk factors identified can't be made for example there is no knowledge of whether open defecation occurred first before intestinal parasitic infections or having intestinal parasitic infections makes people to defecate in open.

The study was liable to self reporting and recall bias as participants could have given false information for example reporting use of a water purification method, yet in actual sense they do not, or reporting not practicing open defecation yet in reality it is their routine practice.

Pre-testing of data collection tools especially the questionnaire was not done prior to data collection. Field experience revealed that overall quality was good, however some participants had difficulty differentiating between sandals/slippers and open shoes.

Transporting of samples to the analysis laboratory at Kyalulangira HCIII within one hour of collection was hectic and challenging, however our study sample transporter was committed. To avoid missing trophozoites of intestinal protozoan parasites due to death or loss of mortality, a smear to be used for Rapid Modified Fields Staining Technique was made from each fresh semi formed and diarrheic or watery sample immediately after collection while still in the field.

All members of selected households were eligible to participate in the study. Since behaviors tend to cluster in households, this may have reduced the effective sample size for analysis of relationships.

## 2.12 Ethical consideration

A research proposal was submitted to the Faculty of Medicine Research Committee for scientific review and the Research Ethics Committee of Mbarara University of Science and Technology which approved of the study protocol. Authorization to carry out the study in the area was obtained from Rakai District Health office while the in-charge of Kyalulangira Health Center III, provided clearance for laboratory analysis of stool samples in this facility. The objectives of the study were explained to study participants or their guardians and written consent was obtained when they signed a consent form. Eligible participants were interviewed from a selected private place at home to ensure privacy and were informed about potential discomforts that could arise out of the stool collection procedures.

## 2.13 **Quality assurance**

The questionnaire, laboratory data collection form, consent forms, all other involved study tools and the proposal were approved by the Faculty of Medicine research committee and the Research and Ethics Committee of Mbarara University of Science and Technology. All the reagents, materials and equipment used to analyze stool samples were assembled and quality control tests were done on them using samples of a known composition to ensure that they are standard and can give accurate results. For example the microscope used in the study, was used to read an already known stool sample preparation containing high (20-40) *Ascaris lumbricoides* ova as a positive control and a stool sample that contained no intestinal parasitic feature as a negative control. The ova were seen in the positive control and none in the negative control. The machine was declared fit for use. The stool quality control samples were preserved stool samples of known composition obtained from Kyalulangira HCIII laboratory. Daily maintenance activities were done on the equipments and always whenever required and maintenance logs were update. Laboratory technician and Assistant involved in the study were trained first in the Standard Operating Procedures of stool analysis to be followed and assessed for competence using known prepared stool samples from Kyalulangira HCIII, by the Principle investigator. They worked on them following Standard Operating Procedures, of each of the test to be involved, and they reported results. Afterwards, he identified gaps and addressed them accordingly. The final conclusion made was that they were fit to carry out study activities. Every tenth study sample was read by two laboratory professionals of whom the Principle investigator was inclusive to ensure that results given are accurate and reliable. In case of a disagreement a third reader was involved to act as a tie breaker and in this case the previous batch of ten samples would be re-read by two laboratory professionals in the presence of the tie breaker to ensure that results are accurate. Each of the participants' microscopy results reported was reviewed by a second laboratory professional to ensure completeness of the laboratory data collection form.

All research assistants were trained on the study protocol before data collection began. The questionnaire was translated into Luganda language which is the main local language in the area before data collection began and the interviewer always had a copy of this during data collection. The principle investigator always checked laboratory data collection forms before a day’s work to ensure their completeness. Before leaving a house hold the study team would check the questionnaire to ensure that it is completed well. The data set was checked for completeness by running the codebook command of STATA version 12 software and any missing data identified was rectified where possible.

## 3.0 RESULTS

**Table1: Socio-demographic characteristics participants**

| CHARACTERISTICS | FREQUENCY (n) | PERCENTAGE (%) |
|---|---|---|
| **Age (years)** | | |
| Under five | 56 | 18.0 |
| 5-14 years | 89 | 28.0 |
| 15 years and above | 169 | 54.0 |
| **Sex** | | |
| Male | 129 | 41.1 |
| Female | 185 | 58.9 |
| **Education level** | | |
| Never went to school | 80 | 25.5 |
| Primary | 221 | 70.4 |
| Ordinary secondary | 13 | 4.1 |
| **Literacy** | | |
| Able to read and write | 192 | 61.1 |
| Un able to read and write | 122 | 38.9 |
| **House hold location in the community** | | |
| Landing site community | 214 | 68.1 |
| Agricultural community | 100 | 31.9 |

The study involved 314 participants residing in Kasula Parish in villages along the shores of Lake Kijanebalora, Rakai District. Of these, 56 (18.0%) were children under five years, 89 (28.0%) were children between five and 14 years while 169 (54.0%) were adults aged fifteen years or older. More females (58.9%) were recruited into the study compared to males (41.1%). Majority attained a primary level education (70.4%), while a few (4.1%) had ordinary secondary education. The highest percentage of participants (61.7%) could read and write. Most of the sampled households (68.1%) were from landing site community, while only 31.9% were from agricultural community.

**Table2: Personal hygiene and other characteristics of participants**

| CHARACTERISTICS | FREQUENCY (n) | PERCENTAGE (%) |
|---|---|---|
| Washing hands with water and soap before eating food | 120 | 38.2 |
| Use some form of foot protective wear | 144 | 45.9 |
| Use hand protective wear (gloves) | 8 | 2.5 |
| Community members practice open defecation | 200 | 63.7 |
| Currently rearing animals in the house hold | 285 | 90.8 |
| Ever shared accommodation with any animal in past one months | 50 | 15.9 |
| Shaken hands while greeting others in past 24 hrs | 172 | 54.8 |
| Have Long finger nails | 139 | 44.3 |
| **Household water source** | | |
| Open dam | 65 | 20.7 |
| Lake | 231 | 73.6 |
| Open dug fountain well | 18 | 5.7 |
| Used a public toilet in past one month | 189 | 60.2 |
| At least have an employment | 138 | 44.0 |
| Contact with organic manure | 149 | 47.5 |
| Eating raw food | 262 | 83.4 |
| Purify drinking water | 237 | 75.5 |
| Ever gone for voluntary medical checkup in past one year | 25 | 08.0 |
| Taken de worming drugs in past one year | 145 | 46.2 |



Less than 40% of participants washed their hands with soap before eating food, 45.9% used a form of foot protective wear, while only 2.5% used hand protective wear and yet 54.8% had long finger nails (see Table 2). The majority of community members (63.7%) practiced open defecation. Sixty percent reported using a public toilet in the previous one month, 47.5% reported contact with organic manure and 15.9% had shared accommodation with any animals in the previous one month. Rearing of animals was common and reported by 90.8% of the participants. The Lake (73.6%) and dams (20.7%) were the main sources of water for households. The majority of participants (83.4%) were eating raw foods. Less than 50% had taken de worming drugs in the past one-year period, while very few (8.0%) had voluntarily gone for medical checkup in the past one year.

**Table3: Prevalence and patterns of intestinal parasitic infections**

| | Age group(years) | | | Overall | P-value |
|---|---|---|---|---|---|
| | **Under 5 n(%)** | **5-14 n(%)** | **15 or older n(%)** | **All ages n(%)** | |
| ***Prevalence of intestinal parasitic infections*** | 39(69.4) | 60(67.4) | 110(65.1) | 209(66.6) | 0.826 |
| ***Types of intestinal parasitic infection*** | **n=39** | **n=60** | **n=110** | **n=209** | |
| Protozoa, only | 32(82.1) | 34(56.6) | 68(61.8) | 134(64.1) | 0.052 |
| Helminthes ,only | 7(17.9) | 13(21.7) | 23(20.9) | 43(20.6) | 0.950 |
| Protozoa and helminthes | 0(0) | 13(21.7) | 19(17.3) | 32(15.3) | 0.003* |
| ***Intestinal parasitic infections species **** | **n=39** | **n=60** | **n=110** | **n=209** | |
| *Entamoeba histolytica/dispar* | 14(35.9) | 31(51.7) | 39(35.5) | 84(40.2) | 0.127 |
| *Ascaris lumbricoides* | 7(17.9) | 26(43.3) | 41(37.3) | 74(35.4) | 0.060 |
| *Cryptosporidium species* | 9(23.1) | 17(28.3) | 20(18.2) | 46(22.0) | |
| *Entamoeba coli* | 3(7.7) | 5(8.3) | 19(17.3) | 27(12.9) | |
| *Giardia lamblia* | 8(20.5) | 3(5.0) | 8(7.3) | 19(9.1) | |
| *Cyclospora species* | 0(0) | 1(1.7) | 8(7.3) | 9(4.3) | |
| *Hookworm* | 0(0) | 0(0) | 4(3.6) | 4(1.9) | |
| *Isospora belli* | 0(0) | 1(1.7) | 1(0.9) | 2(1.0) | |
| *Idoamoebabuetschlii* | 0(0) | 1(1.7) | 1(0.9) | 2(1.0) | |
| **Multiple species infections** | 3(7.7) | 16(26.7) | 30(27.3) | 49(23.4) | 0.007* |
| ***Triple spices infections*** | 0(0) | 2(12.5) | 6(20.0) | 8(16.3) | 0.257 |
| ***Double species infections*** | 3(100) | 14(87.5) | 24(80.0) | 41(83.7) | 0.039* |
| ***Degree of infection*** | **n=39** | **n=60** | **n=110** | **n=209** | |
| Low | 19(48.7) | 12(20) | 54(49.1) | 85(40.6) | 0.002* |
| Moderate | 9(23.0) | 9(15.0) | 12(10.9) | 30(14.4) | 0.140 |
| High | 10(25.6) | 19(31.7) | 26(23.6) | 55(26.3) | 0.468 |
| Very high | 1(2.7) | 20(33.3) | 18(16.4) | 39(18.7) | 0.001* |

*Column percentages are higher than 100% because some participants had multiple species infections.* Indicates significant P-values*

The overall prevalence of intestinal parasitic infections among people living along the shores of Lake Kijanebalora in Kasula Parish was 66.6% [61.3%-71.8%]. Age specific prevalence indicated a higher prevalence (69.4%) among children under five years, followed by children aged five to fourteen years at 67.4% and people aged fifteen and above last at 65.1%. However, on applying a Fisher's exact test, the obtained P-value is 0.826 which is far above 0.05 indicating that the difference is non significant. Among the infected participants, 64.1% had protozoa infections only, 20.6% had helminthes infections only, while 15.3% had a combination of helminthes and protozoa infections. Within infected participants, protozoa infections only, prevailed highest in children below five years (82.1%). The p-value for the trend was 0.052, suggesting a lack of evidence that protozoa infections reduced significantly with increasing age of participants. The frequency of helminthes infections only, was similar across age-groups (p-value=0.950). About 18% of children under five years had helminthes infections only, compared to 21.7% among people aged five to fourteen and 20.9% among those age 15 years or older. A combination of protozoa and helminthes infections was observed among children aged five to fourteen years (21.7%) and among people aged fifteen or older (17.3%). None of the under-five children in the study had evidence of mixed intestinal parasitic infections. Thus, the significant difference in frequency of mixed infections observed (p-value=0.003) was between children under-five years and other age-groups. Indicating that children under five years not likely to be diagnosed with a combination of protozoa and helminthes infections as compared to those in the other age groups. Infections by species of intestinal parasites among infected participants were identified. Overall, 23.4% of infected participants had multiple species infections. Multiple species infections were lowest in children under five years (7.7%) compared to 26.7% in children aged five to fourteen years and 27.3% in persons age 15 years or older (p-value=0.007). Nine species of intestinal parasitic infections were identified in the study of which *Entamoeba histolytica/dispar* was the most prevalent at 40.2%, followed by *Ascaris lumbricoides* at 35.4%, *Cryptosporidium* species ranked third at 22.0%, while *Entamoeba coli* presented fourth at 12.9%. 9.1% had *Giardia lamblia*, 4.3% were infected by *Cyclospora* species, 1.9% for Hookworms, while *Isosporabelli* and *Idoamoebabuetschlii* both equally prevailed at 1.0%. *Giardia lamblia* was more common in children under five years (20.5%) than other age groups (p-value=0.027).

**Table 4: Details of triple and double intestinal parasitic infection species**

| | Under 5 n (%) | 5-14 n (%) | 15 or older n (%) | All ages n (%) |
|---|---|---|---|---|
| ***Triple spices infections*** | n=0 | n=2 | n=6 | n=8 |
| *Entamoebahistolytica/dispar+Cyclospora* species+*Isospora belli* | 0(0) | 0(0) | 1(16.7) | 1(12.5) |
| *Entamoebahistolytica/dispar+Cryptosporidium* species+*Giardialamblia* | 0(0) | 0(0) | 1(16.7) | 1(12.5) |
| *Entamoebahistolytica/dispar+Cryptosporidium* species+*Ascaris lumbricoides* | 0(0) | 2(100) | 1(16.7) | 3(37.5) |
| *Entamoeba histolytica/dispar+ Giardialamblia+Ascaris lumbricoides* | 0(0) | 0(0) | 1(16.7) | 1(12.5) |
| *Entamoebahistolytica/dispar+Isospora belli+Idoamoeba buetschlli* | 0(0) | 0(0) | 1(16.7)) | 1(12.5) |
| *Ascarislumbricoides+Giardia lamblia+Cryptosporidium* species | 0(0) | 0(0) | 1(16.7)) | 1(12.5) |
| ***Double species infections*** | **n=3** | **n=14** | **n=24** | **n=41** |
| *Entamoeba histolytica/dispar+ Ascaris lumbricoides* | 0(0) | 2 3(14.3) | 5(20.8) | 7 (17.1) |
| *Entamoebahistolytica/dispar+ Cryptosporidium* species | 0(0) | 3(21.4) | 0(0) | 3(7.3) |
| *Entamoeba histolytica/dispar+ Entamoeba coli* | 0(0) | 0(0) | 2(8.3) | 2(4.9) |
| *Entamoeba histolytica/dispar+ Cyclospora* species | 0(0) | 1(7.1) | 2(8.3) | 3(7.3) |
| *Ascaris lumbricoides+Cryptosporidium* species | 0(0) | 6(42.9) | 6(25.0) | 12(29.3) |
| *Ascaris lumbricoides+Giardia lamblia* | 0(0) | 1(7.1) | 1(4.2) | 2(7.3) |
| *Ascaris lumbricoides+Cyclospora* species | 0(0) | 0(0) | 2(8.3) | 2(4.9) |
| *Ascaris lumbricoides+Entamoeba coli* | 0(0) | 0(0) | 2(8.3) | 2(4.9) |
| *Ascaris lumbricoides+Hookworms* | 0(0) | 0(0) | 2(8.3) | 2(4.9) |
| *Entamoebacoli+Cryptosporidium* species | 1(33.3) | 0(0) | 0(0) | 1(2.4) |
| *Entamoebacoli+Idoamoeba buetschlii* | 0(0) | 0(0) | 1(4.2) | 1(2.4) |
| *Gardialamblia+Cryptosporidium* species | 2(66.7) | 1(7.1) | 0(0) | 3(4.9) |
| *Hook worm+Crptosporidium* species | 0(0) | 0(0) | 1(4.2) | 1(2.4) |

Of the 49 participants with multiple species infections, 41 (83.7%) had double infections while 8 (16.3%) had triple infections. Only three children under five years (6.1%) had double infections and none (0.0%) had triple species infection. Among participants infected with triple species, a combination of *Entamoeba histolytica/dispar+ Cryptosporidium* spices+*Ascaris lumbricoides* was the most common. 3(37.5%)of the participants had a combination of *Entamoeba histolytica/dispar+ Cryptosporidium* spices+*Ascaris lumbricoides*, two of whom were children between 5 and fourteen years while one was aged fifteen or older (Table 4). Among participants with double species infections, a combination of *Ascaris lumbricoides+Cryptosporidium* species was more common and occurred equally in participants aged 5 to 14 years and those 15 years or older.

Majority of the infected participants had low degree of infection (40.6%). The frequency of low degree of infection was similar between children under five years (49.1%) and persons 15 years or older (48.7%) but significantly lower (20.0%) in children aged five to fourteen years (p-value 0.002). Forty five percent of infected persons had high to very high degree of infection. The frequency of high to very high degree of infection was highest in children five to fourteen years (65%) followed by adults 15 years or older (40.0%).

**Table 5: Bivariate and multivariate analysis of factors associated with intestinal parasitic infections**

**Outcome** = Intestinal parasitic infection

**Main exposure**= Community members practice open defecation

| | | | Bivariate analysis | | Multivariate analysis | |
|---|---|---|---|---|---|---|
| **VARIABLE** | **Infected n(%)** | **Not infected n(%)** | **COR[95%CI]** | **P-value** | **AOR[95%CI]** | **P-value** |
| Community members practice open defecation | 153(73.2) | 47(44.8) | 3.37[2.06-5.51] | 0.000* | 3.28[1.85-5.8] | 0.000* |
| **Age** | | | | | | |
| <5years(**ref**) | 39(18.7) | 17(16.2) | | | | |
| 5yrs-14 years | 60(28.7) | 29(27.6) | 0.90[0.44-1.86] | 0.779 | 0.55[0.23-1.33] | 0.187 |
| ≥15years | 110(52.6) | 59(56.2) | 0.81[0.42- 1.56] | 0.533 | 0.80[0.36-1.78] | 0.582 |
| **Sex(ref: Male)** | | | | | | |
| Male | 82(39.2) | 48(45.7) | | | | |
| Female | 127(60.8) | 58(55.3) | 1.26[0.78-2.02] | 0.348 | 1.43[0.82-2.49] | 0.206 |
| Washing hands with water and soap | 70(33.5) | 50(47.6) | 0.55[0.34-0.89] | 0.016* | 0.89[0.52-1.53] | 0.672 |
| **Length of finger nails(ref: Long)** | | | | | | |
| Long | 105(50.2) | 34(32.4) | | | | |
| Short | 104(49.8) | 71(67.1) | 0.47[0.29-0.77] | 0.003* | 0.56[0.33-0.97] | 0.040* |
| Accessibility of a public toilet | 125(59.8) | 66(62.9) | 0.88[0.54-1.42] | 0.602 | 0.67[0.36-1.25] | 0.211 |
| **House hold location in the community(ref:** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Agricultural community)**<br>Landing site community<br>Agricultural community | 137(65.6)<br>72(34.4) | 77(73.3)<br>28(26.4) | 0.69[0.41-1.16] | 0.164 | 0.73[0.41-1.29] | 0.280 |
| Use some form of foot protective wear | 94(45.0) | 50(47.6) | 0.83[0.58-1.19] | 0.309 | 1.15[0.74-1.80] | 0.537 |
| Eating raw food | 181(86.7) | 81(77.1) | 1.92[1.05-3.51] | 0.035* | 2.44[1.22-4.91] | 0.012* |
| Use a form of water purification method | 142(67.9) | 95(90.5) | 0.22[0.11-0.46] | 0.000* | 0.34[0.16-0.74] | 0.007* |
| Ever gone for voluntary medical check in the past one year | 13(6.2) | 12(11.4) | 0.51[0.23-1.17] | 0.113 | 0.33[0.13-0.85] | 0.022* |
| Ever taken de worming drugs in the past one year | 106(50.7) | 45(42.9) | 1.37[0.86-2.20] | 0.189 | 1.33[0.68-2.62] | 0.408 |

***NOTE**: COR, crude odds ratio, AOR, adjusted odds ratio, CI, confidence interval, ref, reference category. *Significant at p<0.05.*

Bivariate and multivariable analysis of factors associated with intestinal parasitic infections revealed that community members practice of open defecation and eating raw foods had significantly higher odds of intestinal parasitic infections among people living along the shores of lake Kijanebalora in Kasula Parish, Rakai District. In the multivariable analysis, the odds of intestinal parasitic infections in persons who reported community practice of open defecation were more than three times compared to those who did not report open defecation (aOR=3.28; 95%CI: 1.85-5.80]. Similarly, the odds of intestinal parasitic infections in persons who reported eating raw food were twice as high as high the odds in persons who did not eat raw foods (aOR=2.44; 95%CI: 1.22-4.91). Short finger nails, use of any form of water purification and going for voluntary medical checkup were protective against intestinal parasitic infections with adjusted odds ratios of 0.56, 0.34, and 0.33 respectively. Washing of hands with water and soap before eating food was non significant after multivariate analysis and therefore not associated with intestinal parasitic infections.

## 4.0 Discussion

In this study we found that 66.6% [61.3%-71.8%] of the people living along the shores of Lake Kijanebalora in Kasula parish, Rakai District were infected with intestinal parasitic infections.

This is high compared to that reported in most studies conducted in areas along lake shores for example 57.1% was reported among patients attending medical services at Bugando medical center in Mwanza north western Tanzania an area that is along the southern shores of lake Victoria.(H.D. Mazigo, 2010).

In the study setting, the prevalence of intestinal parasitic infections was high in all age-groups. This finding is in inconsistent with the World health organization report (WHO, 2018), in which children are identified as the most at risk group for intestinal parasitic infection. The prevalence of children being similar to that of adults can be attributed to the reduced risk of children as they are de wormed periodically during child days plus.

Protozoa infections only were the most prevalent type of intestinal parasitic infections among infected people at 64.1% compared to helminthes infections only at 20.6% and a combination of helminthes and protozoa at 15.3%. The results are consistent with other studies carried out in other parts of the world, for example in Saudi Arabia, where protozoa infections only were also reported high at 33.8%, compared to helminthes infections only at 3.8%, and a combination of protozoa and helminthes at 7.2%.(Omar Hassen Amer1, 2015)

In this study none of the children under five years had a combination of protozoa and helminthes infections yet it occurred in children who were five to fourteen years and adults 15 years or older. The results suggest that children under five years in the study setting are not likely to be infected by a combination of helminthes and protozoa. However, no studies reporting similar results have been found.



A variety of intestinal parasitic infections were identified. *Entamoeba histolytica/dispar* was the most prevalent species followed by *Ascaris lumbricoides* at 40.2 and 35.4% respectively. Our findings on intestinal parasitic species differ from results reported more than 10 years ago in Northern Uganda where *Strongyloides* were the most prevalent at 12.8%, followed by *Schistosoma mansoni* at 9.6% (Mote, 2005). In our study, the prevalence of *Giardia lamblia* was significantly high in children under five years compared to other age-groups. Therefore *Giardia lamblia* infection is more likely to be found in children under five years, followed by adults compared to children between five and fourteen years. However in a study among children under the age of 5 years attending the Debre Birhan referral hospital, North Shoa, Ethiopia *Giardia lamblia* infection was reported to be high in this age group without comparison to other age categories (Telanesh Zemene, 2018).

Our study shows that children under five years are less likely to suffer from multiple species infections compared to other age groups and they are not likely to have triple species combinations. Children aged 5-14 years are more likely to have double species combinations compared to other age categories, however no studies reporting similar results have been found.

40.6% of the people with intestinal parasitic infections had low degree of infection. This indicates that they can freely live with these parasites without causing much harm to them and therefore not seeking for treatment and end up continuously transmitting them which makes prevention and control difficult. On the other had people with a very high degree of infection (18.7%) need immediate treatment for intestinal parasitic infections.

Based on this study, community member's practice of open defecation is a significant risk factor for intestinal parasitic infections where people in this community have 3.28 chances of being infected. This is consistent with other studies in Africa, for example in Ethiopia 3.40 odds of infections among communities practicing open defecation are reported (Habtamu Sewunet Mekonnen, 2019). This indicates that these people are living in a community heavily contaminated by infective stages of intestinal parasites which increases their chances of becoming infected. Eating raw foods also can expose one to intestinal parasitic infections where by a person practicing it has 2.44 chances of becoming infected. Similar results have been reported by Baye stataw in Ethiopia. (Baye Sitotaw, 2019). This could be due to the fact that raw foods are more likely to be contaminated by infective stages of intestinal parasites and when ingested an infection can occur easily.

Having shorter finger nails can reduce ones chances of becoming infected by intestinal parasites, a factor that is supported by other studies. Azmeraw Asires and colleagues found a protective association among Food Handlers at Prison, East and West Gojjam, Ethiopia who had short finger nails(Azmeraw Asires, 2019).Those purifying water for drinking are also less likely to become infected compared to those who do not. In Cambodia studies have indicated significant association between drinking unpurified water and increased risk of infections with intestinal parasites like Heminolepsis nana (Chien-Wei Liao, 2017). The protective association among people drinking purified water can be attributed to destruction of infective stages of intestinal parasites by water purification methods which make water safe for human consumption and hence reduce on exposure. Going for medical checkup voluntarily also shows protection against intestinal parasitic infections, and this could be that at voluntary medical checkup people get more health information through health education sessions by health workers especially for protection against diseases including intestinal parasitic infections. This is similar to findings of Edosa Kebede among food handlers in Wollo University students cafeteria, North East Ethiopia (Edosa Kebede, 2019).

## 5.0 Conclusions

The prevalence of intestinal parasitic infections reported among people living along the shores of lake Kijanebalora in Kasula parish, Rakai district is high and almost the same across age groups.

Protozoan infections are very common in this setting.

Community members practice of open defecation and eating of raw foods are risk factors for intestinal parasitic infections whereas, shorter finger nails, purification of drinking water and going for medical checkup voluntarily are protective against intestinal parasitic infections in this community.

Combinations of protozoa and helminthes infections exist in this community with some people having more than one type or species of intestinal parasites. *Entamoeba histolytica/dispar* is the most prevalent species followed by *Ascaris lumbricoides* and *Cryptosporidium* species.

## 6.0 Recommendations

Based on results of this study, leaders and health authorities in the area should put in place measures to prevent and control the practice of open defecation. These may include community sensitization about the dangers of open defecation, enforcing each house hold to possess a pit latrine, construction and maintenance of public pit latrines at landing sites, among others.

Community health sensitization meetings should be held continuously to educate people about good hygienic practices that have been identified as protective against intestinal parasitic infections, for example keeping finger nails short, purifying water for drinking, and voluntarily going for medical checkup.

Clinicians in health facilities within the area should routinely request for stool analysis tests such that most of the infected people attending services at health facilities can be diagnosed and get proper treatment.

In addition to the de worming strategy for children below fifteen years, the Ministry of Health Uganda, should design a de worming program for adults above fifteen years because the study has indicated that they are also susceptible to infections and without proper prevention and control strategies, they can be a source of active transmission in the community.

The Ministry of Health Uganda should include and emphasize administration of anti-intestinal protozoan drugs during the mass administration of de worming drugs so as to control intestinal protozoa infection.

## REFERENCIES

Abraar Karan, G. B. C., Alison Galvani. (2012). The Influence of Poverty and Culture on the Transmission of Parasitic Infections in Rural Nicaraguan Villages. [Research Article]. *Journal of Parasitology Research, 2012*.

Azmeraw Asires, M. W., and Alemayehu Reta. (2019). Prevalence and Associated Factors of Intestinal Parasitic Infections among Food Handlers at Prison, East and West Gojjam, Ethiopia. *Advances in Medicine, Volume 2019*.

Betty.R Kirkwood, J. A. C. S. (2003). Essential medical statstics. In V. P. Fiona Goodgame, Karen Moore (Series Ed.) Vol. 2. K. moore (Ed.) (pp. 413 - 424).

Burton J.Bogitsh, C. E. C., Thomas N.Oeltmann,. (2012). Human Parasitology

Cara Kamenka, A., & Fenwick, R. S., Howard Thompson, Narcis Kabatereine. (2003). Action Aganist Worms. *PPC News Letter*(3), 1-6.

Chien-Wei Liao, K.-C. C., 4 I-Chen Chiang,1 Po-Ching Cheng,1,2,3 Ting-Wu Chuang,1,2,3 Juo-Han Kuo,1 Yun-Hung Tu,1 and Chia-Kwung Fan1,2. (2017). Prevalence and Risk Factors for Intestinal Parasitic Infection in Schoolchildren in Battambang, Cambodia. *The American journal of Tropical Medicine and Hygien*.

Dennis Adu-Gyasi , K. P. A., Margaret T. Frempong , Dennis Konadu Gyasi ,Louisa Fatahiya Iddrisu , Love Ankrah , David Dosoo , Elisha Adeniji , Oscar Agyei ,Stephaney Gyaase , Seeba Amenga-Etego , Ben Gyan , Seth Owusu-Agyei. (2018). Epidemiology of soil transmitted Helminth infections in the middle-belt ofGhana, Africa. [Parasite Epidemiology and Control]. *Parasite Epidemiology and Control, 1*, 4-10.

Edosa Kebede, A. S. S. A. (2019). Prevalence and associated risk factors of intestinal parasitic infections among asymptomatic food handlers in Wollo University student's cafeteria, Northeastern Ethiopia. *BMC Research Notes*.

Edward. Buzigi. (2015). Prevalence of Intestinal Parasites and Its association with severe accute malnutrition related diarrhoea. *Journal of Biology,agriculiture and health care, 5*.

Fredrick Wabwile Wanyama, A. M. W., Elijah Oyoo-Okoth. (2014). Pre-Disposing Factors Contributing to the Prevalence of Intestinal Parasitic Infections (IPI) among the HIV/AIDS Patients in Bungoma County, Kenya. [International Journal of Science and Research (IJSR)]. *International Journal of Science and Research (IJSR), 1*, 628-629.

Girum Tadesse. (2005). The prevalence of intestinal helminthic infections and associated risk factors among school children in Babile town, eastern Ethiopia. [Original article]. *Ethiop.J.Health Dev.*

H.D. Mazigo, E. E. A., M. Zinga, E. Bahemana, L.L. Mnyone, E.J. Kweka, J. heukelbach. ( 2010). Prevalence of intestinal parasitic infections among patients attending Bugando Medical Centre in Mwanza, north westernTanzania. [Tanzania Journal of Health Research]. *Tanzania Journal of Health Research, 12*, 3-5.

Habtamu Sewunet Mekonnen, D. T. E. (2019). Prevalence and factors associated with intestinal parasites among under-five children attending Woreta Health Center, Northwest Ethiopia. *BMC Infectious Diseases*.

Ibrahim Ntulume, J. T., Adamu Almustapha Aliero, Barugahare John Banson. (2017). Prevalence of intestinal protozoan infections and the associated risk factors among children in Bushenyi district, western Uganda

[Journal of tropical diseases and health]. *Tropical diseases and health, 23*.

Kolaczinski, J. H. (2006). Neglected tropical diseases and their contral in Uganda Vol. 1. N. B. K. Ambrose W. Onapa, Richard Ndyomugyenyi,Abbas S. L. Kakembo,Simon Brooker, (Ed.) *Situation analysis and needs assesment of neglected diseases and their contral in Uganda* (pp. 7-13).

L. Naing, T. W., B.N. Rusli, et al. (2006). Practical Issues in Calculating the Sample Size for Prevalence Studies. *Archives of Orofacial Sciences*, 9.

Liza Nyantekyi, M. L., Girmay Medhin, Abebe Animut, Konjit Tadesse, Chanda Macias, Abraham, & Degarege, B. E. (2014). Community awareness of intestinal parasites and the prevalence of infection among community members of rural Abaye Deneba area,

Ethiopia. [Asian Pacific Journal of Tropical Biomedicine]. *Asian Pacific Journal of Tropical Biomedicine*.

Ministry of health Uganda. (2016). Uganda clinical guidelines National guidelines for the managment of common conditions, Vol. 1. Health (Ed.) (pp. 177-187,386-391).

Monica Cheesbrough. (2009). District Laboratory Practice in Tropical Countries Vol. Part 1. M. Cheesbrough (Ed.) (pp. 191-208,298-299).

Moses Adriko, B. T., Moses Arinaitwe, Narcis B. Kabatereine, Mariam Nanyunja, Edridah M. Tukahebwa (2018). Impact of a national deworming campaign on the prevalence of soil-transmitted helminthiasis in Uganda (2004-2016). *medicine journal, 2*.

Moses, N. (2018). *Catchment area of kyalulangira HCIII*. Projected population of kasula parish. Records. Kyalulangira HCIII. Kyalulangira HCIII.

Mote, K. E. M., B. and Kisakye, J.J.M,. (2005). Prevalence of intestinal parasites among school children in Moyo district,Uganda. [Health Policy and Development Journal]. *Health Policy and Development Journal, 3*.

Omar Hassen Amer1, I. M. A., Najoua Al Sadok Haouas,. (2015). Prevalence of intestinal parasite infections among patients in local public hospitals of Hail, Northwestern Saudi Arabia. *Asian Pacific Journal of Tropical Medicine*.

Peter L.Chiodini, A. H. M., David W.Manser,. (2001). Atlas of medical helminthology and protozoology. In T. horne (Series Ed.) Vol. one. T. horne (Ed.) (pp. 3-79).

Sirintip Boonjaraspinyo, T. B., Butsara Kaewsamut, Nuttapon Ekobol, Porntip Laummaunwai,Ratchadawan Aukkanimart, Nadchanan Wonkchalee, Amornrat Juasook, Pranee Sriraj,. (2013). A Cross-Sectional Study on Intestinal Parasitic Infections in Rural Communities, Northeast Thailand. *Korean J Parasitol*. doi: 10.3347/kjp.2013.51.6.727

Telanesh Zemene, M. B. S. (2018). Prevalence of intestinal parasitic infections in children under the age of 5 years attending the Debre Birhan referral hospital, North Shoa ,Ethiopia *BMC Research Notes*.

Uganda Bureau of statstics. (2016). *Uganda Demographic and Health Surveys*. Kampala.

Utzinger J, B. S., Knopp S, Blum J, Neumayr AL, Keiser J, et al. (2012). Neglected tropical diseases: diagnosis, clinical management, treatment and control. . *Swiss Med Wkly., 142*.

Vincent P. Gyang etal, T.-W. C., Chien-Wei Liao ,Yueh-Lun Lee , Olaoluwa P. Akinwale , Akwaowo Orok ,Olusola Ajibaye , Ajayi J.Babasola , Po-Ching Cheng ,Chia-Mei Chou , Ying-Chieh Huang , Pasaiko Sonk. (2017). Intestinal parasitic infections: Current status and associated risk factors among school aged children in an archetypal African urban slum in Nigeria. [Journal of Microbiology, Immunology and Infection]. *1*, 3-5.

WHO. (2012). Bench Aids for the diagonosis of intestinal parasites.

WHO. (2018). Key facts on soil-transmitted helminthes infections.

Manual of basic techniques for a health laboratory (2003).

Yirgalem G/hiwot, A. D., Berhanu Erko,. (2014). Prevalence of Intestinal Parasitic Infections among Children under Five Years of Age with Emphasis on Schistosoma mansoni in Wonji ShoaSugarEstate,Ethiopia. [journal]. *PLoS ONE, 1*.