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PREVALENCE AND INTENSITY OF GEOHELMINTHS AMONG PRIMARY SCHOOL CHILDREN AND RELATED FACTORS IN TEMEKE DISTRICT, DAR ES SALAAM.

BY

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ABSTRACT

A cross sectional study was carried out between February and March 1998 in Temeke district. The aim was to determine the prevalence and intensity of soil transmitted helminths among primary school children aged 6 to 18 years and related factors.

A simple random sampling method was used to select one primary school whereby all school children in that school were supposed to participate in this study. Out of 350 school children of that school, 290 school children participated in the study while the remaining 60 children did not participate for some reasons. Stool samples were collected and processed by modified Kato-Katz method to determine the egg count. All children found with soil transmitted helminths were treated with Albendazole and post-chemotherapy stools were collected over 48 hours and 72 hours to recover the expelled worms. The soil samples were taken from different places and processed by Baermann techniques to determine the ova and filariform larva of soil transmitted helminths. Questinnaires were administered to school children and teachers to asses their hygiene and awareness of the geohelminths. Data were analysed using SSPS and EPI-Info software.

Results showed that soil transmitted helminths are a health problem to school children. The overall prevalence of *A. lumbricoides* was 4.1% with a mean egg count of 192 eggs per gramme of faeces and a mean worm burden of 4 worms per

child. The overall prevalence of hookworm was 22.4% with a mean egg count of 183 eggs per gramme of faeces and the mean worm burden of 13 worms per child. The overall prevalence of *T. trichiura* was 0.7% and that of *S. stercolaris* together with *E. vermicularis* was 1.7%. The results of soil samples showed that 45% of 60 samples were found with geohelminths. Hand washing behaviour and wearing of shoes had no association with the infection.

It was concluded that although each school child knew at least one mode of transmission of soil transmitted helminths and prevention, the problem still remain in school children because they are living with the risk factors of infection. Therefore, it is recommended that the relevant authorities should have to find some mechanism of reducing the geohelminths infection. It is also recommended to treat all school children during deworming programme without mind they are infected or not infected with geohelminths.

DECLARATION

I, Anastasia Martini Tarimo, declare that this Dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar degree or any other degree award.

Signature .....

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DEDICATION

To my beloved husband **Rogers**

And

Children **William** and **Helen**

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LIST OF ABBREVIATIONS

EPG:	Eggs per gramme of faeces
IPH:	Institute of Public Health
SPSS/PC:	Statistical Package for Social Sciences for Personal Computer.
WHO:	World Health Organization

1.0 **INTRODUCTION:**

Geohelminths are intestinal nematodes whose part of their development takes place outside the body of the host (Manson, 1987). These organisms make soil their intermediate host before they infect the individual. The geohelminths include *Trichuris trichiura, Enterobius vermicularis, Ascaris lumbricoides, Toxocara canis, Strongyloides stercoralis,* and hookworm (*Ancylostoma duodenale* and *Necator americanus*). Among these worms *T. trichiura, A. lumbricoides* and hookworm often occur together in the same community and in the same person. In developing countries where hygienic conditions, sanitation and socio-economic status are poor, children are mostly affected.

Infection is acquired through ingesting food contaminated with the infective stage of *A. lumbricoides* and *T. trichiura*. Infection by hookworm is through skin penetration for *N. americanus,* while *A. duodenale* infects human beings equally successfully by percutaneous, oral, transmammary and probably transplacental routes (Manson, 1987).

Geohelminths are wide spread globally. They are found in tropical and sub-tropical areas of Asia, Central and South America, Europe, Africa and North America. In these areas, prevalence varies according to the hygienic conditions and socio-economic status of the area.

In Tanzania, the socio-economic condition of most of the people is low, therefore the problem of geohelminths cannot be escaped. Furthermore, many Tanzanians migrate from rural areas to urban areas to find better life. The result of this migration is high

population in the towns due to migrant population and high birth rates. The consequences of high population in one area is the shortage of social facilities and services like water, overcrowding of school children in classrooms and inadequate latrine facilities in most schools (Mwaluko, 1991). The problem of overcrowding and lack of proper latrine facilities make the school children defeacate sometimes around the school compound, and if the child is infected with geohelminths, he/she will contaminate the soil around the school area. Also the overflow of latrines do the same to the soil. The infected individual will produce a large number of eggs depending on the sex of the adult geohelminth. If this individual habours a large number of females, the number of eggs excreted in the soil may be high. On the other hand, if the individual harbours a large number of males, the number of eggs excreted in the soil may be low or there may be no eggs excreted in the faeces. The habit of school children playing barefooted or eating without washing hands makes them vulnerable to infection. Therefore soil contaminated with geohelminths eggs infects people especially children by mouth from contaminated fingers and through skin penetration for hookworm *(N. americanus*). From that infection the severity of the disease will depend on the intensity of the infection by adult worms. For example a child with 50 or more *A. lumbricoides* is much more likely to be ill than one with 5 worms (Hall, 1993). From those problems of geohelminths, it was thought better to study to what extent individuals are infected and how they were at risk of infection.

Therefore the aim of the study was to investigate the intensity of geohelminths by egg count and worm expulsion in school children and to determine the level of soil pollution by geohelminths in Temeke district, Dar es Salaam.

2.0 REVIEW OF LITERATURE:

2.1 SITUATION OF GEOHELMINTHS WORLDWIDE:

The geohelminths live in the intestine of the host, and they are major parasitic infections throughout the world. *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms (*Ancylostoma duodenale* and *Necator americanus*) are the common helminths infection which affect more than one billion people particularly children in developing countries (Hadju, 1995). Compared to other parasitic infections worldwide, *Ascaris* infection ranks fourth, *Trichuris* ranks seventh and hookworm ranks ninth (Pawlowski, 1984). But this morbidity rate may be underestimated since many cases occur continually in conjunction with increasing urbanisation in most developing countries (Crompton, 1993).

Nematode infection and particularly hookworm infection is associated with stunting of physical growth (Bundy, 1994). Ascariasis was the cause of paediatric intestinal obstruction in 5% to 35% of all cases in children in a comparison of studies conducted throughout tropical countries (Pawlowski, 1989). Rectal prolapse due to trichuriasis occurs in nearly 4% of children in West Indies (Bundy, 1989). Furthermore, it is reported that about 32% of the people in Africa are infected with *Ascaris lumbricoides* with one in 50 harboring heavy infections (Crompton, 1987). In 1987, WHO estimated that there might be some 3.5 million cases per year of clinical diseases associated with nematode infection worldwide. The severity of most infections is related to worm burden (Stephenson, 1987; Bundy, 1989; Lwambo, 1992). In developing countries, intense

infection occurs mostly in children who are living in poor hygienic conditions. Severe infection of hookworm and *Trichuris trichiura* is associated with stunting of linear growth, but this stunting can be reversed by antihelminths (Stephenson, 1990; Thein, 1991). Stunted children with moderate burden of *Trichuris trichiura* can exhibit a catch up growth rate after treatment which may be twice than the expected mean growth velocity for their age (Cooper, 1990 and 1992). The observation suggests that, moderate intensity of geohelminths have a serious effect on physical development of children (Stephenson, 1990). Many studies, reviewed reported that there is an association between each infection and protein-energy malnutrition or anaemia (Stephenson, 1987; Stephenson,1990). Furthermore there are some studies from many countries which show that treatment for geohelminths may improve productivity and health (Crompton 1989). Thus improvement in health can result in improving the physical fitness and capacity to work; hence increased productivity.

Soil contamination with geohelminths eggs or ova worldwide is a problem. This is due to the fact that, areas where soil is mostly contaminated with geohelminths, the problem is endemic. A study done in Jamaica showed that, households which had

high levels of geohelminthic infection had high density of eggs of helminths in the soil (Wong, 1990). Also the study of soil pollution done in Swahlunto and Serpong (Ismid, 1980) and Surabaya in Indonesia (Uga, 1995) showed the same results.

2.2 SITUATION OF GEOHELMINTHS IN TANZANIA:

The effect of intestinal helminths was seen in Tanzania since colonial government (Kihamia, 1977). The first report of intestinal helminths was published in Tanga in 1917 by the civil medical services which showed that geohelminths are prevalent in Tanzania. Since that time (1917) and the subsequent years, the civil medical services continued to give information in the annual report of geohelminths. This information was summarised by Kihamia in 1977 when he studied the rate of intestinal helminths in four communities in the Kilimanjaro region. Furthermore, the annual report from the Ministry of Health (1970 - 1971) revealed that intestinal parasites (nematodes) are endemic in Tanzania. According to the report of the Ministry of Health (1973 -1976) ancylostomiasis was the sixth and ascariasis was the 12th most frequent cause of admission in both government and voluntary agency hospitals in Tanzania (Reviewed by Makuka 1994). Also Macpherson, 1991 revealed that geohelminths are widely distributed in Tanzania. Persons infected by more than one species are potentially at risk of morbidity associated with each infection. These worms interfere with the individuals nutritional status and ultimately make him/her more susceptible to other diseases. Ascariasis can cause malnutrition, pneumonitis, allergic reactions and abdominal complications especially when individuals habour a large number of adult worms. The severely infected person can get economic loss in case of adults. In school children, the affected pupil can fail to attend classes regularly (Gbakima, 1994). When a pupil has a large number of *Ascaris* and she/he vomits them in class, or around the school compound, fellow pupils tend to laugh at him/her. This behaviour can result into psychological problems in the affected pupil.

Ascariasis and trichuriasis are most prevalent in hilly regions (Kihamia, 1977) and hookworm in the coast area. *A. lumbricoides* adult female lives for about 1 to 2 years and has a production rate of about 134,000 to 360,000 eggs per day in a period of about 300 days. Consequently a large number of eggs of *A. lumbricoides* are discharged into the environment daily and leads to extensive soil pollution.

The excreted eggs or larva in the soil may develop into an infective stage in one to several weeks. This infective stage of worms in the soil will infect individuals and re-infect them continuously and the area will become an endemic area of geohelminths. The defaecation habits of the people in an area influence the pollution of the soil of that area. Soil pollution will occur when the wormy person defaecates on open place, in bush areas, behind the house or around latrines and pollute the soil (Ismid, 1980). The overuse of latrine in most parts of the Dar es Salaam city due to the large population increase makes the latrine to flood mostly during the rain season. The excreta discharged into the area causes soil contamination and hence favours transmission of the disease. *Ascaris* infection occurs in all age groups. It is most prevalent in the 5 to 9 years group of pre-school and young children, who are more frequently exposed to contaminated soil than adults. School children are also exposed because most of their daytime, they are in school compounds which are sometimes polluted by worm eggs. In a school compound where hygienic conditions of latrines are poor, soil pollution is a rule and this tends to increase the rate of transmission. Soil pollution with geohelminths depends upon use of latrine and the method of excreta disposal. In excreta, the ova of *Ascaris* can persist in open pit latrines for a period of six months and in buried pit latrine for 10 to 13 months.

Thus, the habit of defaecating under trees or other place and not in a toilet tends to facilitate the process of soil pollution by geohelminths, which need investigation in Tanzania.

In Tanzania, assessment of geohelminths prevalence and soil pollution is important. This assessment can be done through stool examination. The number of eggs per gramme of faeces gives a measure of intensity of infection indirectly. Worm expulsion studies provide a direct assessment of the intensity of worms and the ability of antihelminths to expel worms. Stool examination for eggs of nematodes provides an assessment of intensity of the infection. A study done in West Bengal, Asia shows that the egg count method can act as an indirect measure of worm burden and this differs from one individual to another (Anderson, 1985). Counting the number of worms is the direct measure of infection. Furthermore it is assumed that, the individuals who harbour large number of female worms are the ones who excrete large numbers of eggs. It has been reported in literature that male worm have been found in only 3.3% of 1820 children studied (David, 1952). Purnel (1967) in his investigation on intestinal helminths in pupils in Mwanza town graded the intensity of infection as shown in Table 1.

Table 1. Categorization of intensity of infection due to intestinal parasites in school children at Mwanza, 1967:

Infection	Light	Moderate	Heavy
Hookworm	0 -100 epg	101 - 500 epg	500 + epg
Trichuris	0 - 100 epg	101 - 1000 epg	1001 + epg
Ascaris	0 - 100 epg	101 - 1000 epg	1001 + epg

Source: Purnel, 1967

Based on his study, the intensity of infection was assessed by egg count in school children. What was missing in his study was grading of intensity of worms per person. Those individuals with a high intensity of worms are the ones who need medical attention. If medical attention was not taken, Ascariasis may result in fatal illness due to intestinal obstruction. Necatoriasis can cause anaemia and trichuriasis is associated with chronic dysentery and rectal prolapse (Manson, 1987). The indirect consequences of geohelminths are the psychological problems and economic loss due to hospitalisation and expenses for buying medicines.

2.3 EPIDEMIOLOGY OF SOIL TRANSMMITED HELMINTHS

Eggs of *A. lumbricoides* develops best in shady damp soil and it is a family infection since soil around the house may be seeded regularly from the faeces of small children who play on infected soil and infect others and reinfect themselves. Prevalence and intensity occurs in all age groups and sex but is highest among children (Manson, 1987).

In areas where faeces is used as agricultural fertilisers infection is common in agricultural workers. In overcrowded towns and non-industrial societies with poor hygienic conditions prevalence may be higher in urban areas than rural communities (Manson 1987).

The only reservoir of infection of *A. duodenale* and *N. americanus* is man. *A. duodenale* infect man orally whereas *N. americanus* is through cutaneous route. Cutaneous infection with hookworm occurs in the field especially for people who work in vegetable farms and upland rice fields (Suzuki, 1980) and those walking barefoot. Also use of night soil as a fertiliser increases the risk of infection (Suzuki, 1980). It is most prevalent in coast areas (Beaver, 1953).

Trichuris trichiura is a human infection whereas *T. suis* is a pig infection which can also infect man. *T. trichiura* is a common infection in areas of high rainfall, high humidity, dense shade and poor sanitation. The greatest prevalence is in primary school age who pollute the soil around the house and who develop heavy worm burdens (Manson 1987). *Trichuris* infection is often associated with *Ascaris* and *Toxocara* the epidemiology of which are similar.

Geohelminths can be controlled through chemotherapy in school children, proper disposal of excreta, personal hygiene and every one to work in order to raise the socio-economic status. Also health education can be used as a control measure. Through education people will know how to put their surroundings clean. They will use their toilets properly and will know the importance of wearing shoes, and wash hands before

eating and after using a toilet. This control measure can work if the prevalence is known. In order to know the intensity of infection, one should not rely only on egg count per gramme of faeces, but also on counting the number of worms expelled after treatment.

3.0 STATEMENT OF RESEARCH PROBLEM

Geohelminthiasis in Tanzania is a public health problem. It is the infection which is neglected by some communities, until the infected person starts passing worms in faeces or vomit. Several studies done in some places in the country a few years ago showed that geohelminths are highly prevalent in Tanzania. Kihamia, (1977) studied intestinal parasites in Kilimanjaro region and found that, the prevalence of *A. lumbricodes* was 27.8%, *T. trichiura* 23.1% and hookworm 3.8%. Another study done in Pare district found that, the prevalence of *A. lumbricoides* was 5.8% and that of hookworm 16.4% (Senkoro, 1978). Killewo, (1991) in their study of pattern of *Ascaris* and hookworm infection in Temeke district found that, the prevalence of *A. lumbricoides* and hookworm were 4% and 7.1% respectively. Another study done in Kinondoni district for pre-school children showed that, the prevalence of *A. lumbricoides, T. trichiura* and hookworm was 4.9%, 3% and 14% respectively (Makuka, 1994).

Soil transmitted helminths can affect individuals health in several ways. Hookworm can stunt the growth of an individual and cause anaemia while ascariasis is associated with intestinal obstruction and trichuriasis can cause rectal prolapsed.

What matters for some one to be seriously sick are the number of worms and not the

number of eggs present in the individual. In all the studies cited above, the prevalence and intensity of infection was determined by egg excretion of the study subjects. The eggs, which come out, depend very much on the development stage of the parasite and the sexes available in the individual. If the individual harbours more males than female it means few eggs will come out with faeces even though the individual is severely affected. These individuals need antihelminths so that the worms can be expelled out and counted to show the level of intensity of geohelminths and severity of the infection. This gap of knowledge which shows intensity of geohelminths by worm expulsion needs to be filled. On the other hand all the previous authors above in their studies did not include the aspect of environmental contamination of soil by faeces. This information of soil pollution is important due to the fact that, it indicates the extent to which the residents are at risk of acquiring parasitic infection. Geohelminths use soil as their reservoir and develop to infective stage ready for infection. Thus the information for soil pollution is important in case of parasitic transmission.

The prevalence of geohelminths in Temeke, can no longer be used in control measure / intervention because it is more than ten years behind time. There are some changes, which have taken place in the area since 1985, including population increase due to migration and birth rate, which cause severe shortage of necessary facilities like water, overuse of latrines, overcrowding of school classes and poverty. Since 1985 the number of hospitals were increased. Also cost sharing in health services may be a problem, the individual might fail to get some money to buy drugs for treating the worms, and there is an introduction of broad-spectrum antihelminths with increasing cost. Therefore the problem may have increased or decreased in recent years suggesting the need for further

investigation.

3.1 RATIONALE OF THE STUDY

The study was conducted due to the fact that, there was no other study on worm expulsion and study of soil pollution by geohelminths in the area. The study on worm expulsion shows the ability of the antihelminths to expel worms. Also the study on soil pollution by geohelmiths shows how the individuals are at risk of acquiring geohelminths infection and mostly school children.

The study have shown that not only children found with geohelminths eggs expel worms when treated but also some school children found with no geohelmiths eggs expel worms when treated. Therefore this study will help the heath programme managers not to treat only those found with geohelminths eggs but to treat all children especially school children.

Treating infected individuals with geohelmiths reduces the rate of infection to the victim and others and also reduces soil pollution by the geohelminths. Also this study will help the public health programme managers to know how much manpower is required and cost of antihelminths needed for deworming and implementation of simple method of controlling parasitic transmission.

4.0 OBJECTIVES:

4.1 BROAD OBJECTIVE:

The broad objective of the study was to determine the prevalence and intensity of geohelminths by egg count and worm expulsion in primary school children and related factors at Temeke District in Dar es Salaam so as to suggest appropriate control measures.

4.2 SPECIFIC OBJECTIVES:

1) To determine the proportion of primary school children infected with geohelminths and the type of species.
2) To determine the intensity of geohelminths by egg count and worm expulsion in primary school children.
3) To determine the level of soil contamination by geohelminths in the study area.
4) To asses the hygienic conditions of the school children

5. METHODOLOGY:

5.1 DESCRIPTION OF THE STUDY SITE:

The study was conducted in Temeke district which is one of the three districts of Dar es Salaam. The other districts are Ilala and Kinondoni. According to the population census

of 1988, the district had a population of 405,753, of whom males were 212,366 and females 193,387 (Bureau of statistics 1988). In 1997 the district was projected to have a population of 590,406 of whom males were 309,008 and females 281,394 based on annual rate of population growth of 4.3% in Dar es Salaam (Bureau of Statistics 1988).

The district has 16 administrative Wards (Figure 1), which include Kigamboni, Vijibweni, Kibada, Kisarawe II, Somangira, Kimbiji, Mbagala, Chamazi, Yombo Vituka, Charambe, Toangama, Miburani, Temeke fourteen, Keko, Mtoni and Kurasini. The Ward selected for the study was Kigamboni and Kibugumo Primary School participated in the study.

Dar es Salaam weather is hot and humid throughout the year, average rainfall is about 1000 mm and monthly average temperature is 26^0C. The soils are generally sandy and porous but patches of clay, stone and rocks may also be found. The indigenous tribes are Wazaramo, Wamatumbi and Wandengereko. The majority of the city population is mainly drawn from tribes of upcountry regions who migrate to the city to seek employment or participate in commercial activities. The main activities of the indigenous people are fishing, subsistence farming (e.g. vegetables), small businesses and others are employed in various organisations. All these conditions and activities are found in Temeke District.

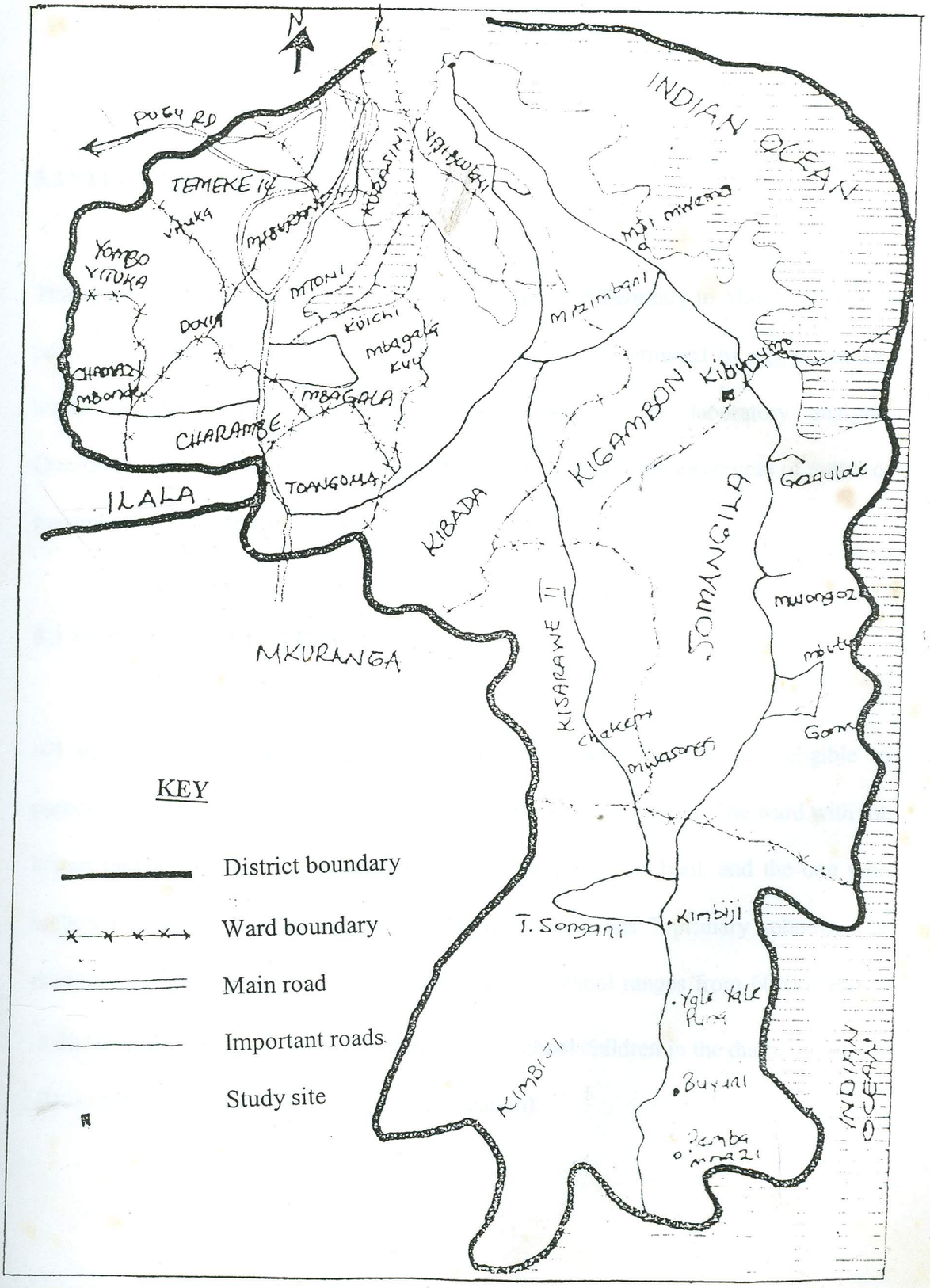


FIG 1. SKETCH MAP OF TEMEKE DISTRICT TO SHOW STUDY SITE.

5.2 STUDY DESIGN:

This was a cross-sectional study which was conducted in February to March 1998. The prevalence of geohelminths infection, and intensity was determined by egg count and worm expulsion. Soil contamination was investigated by laboratory analysis. Questionnaires were used on the pupils and teachers to assess the awareness of routes of transmission of soil transmitted helminths.

5.3 TARGET POPULATION:

All primary school children who are living in Temeke District were eligible to participate in the study. There are fifty primary schools in the district. The ward with the lowest number of schools is Mtoni, which has one primary school, and the one with highest number of primary schools is Miburani which has 7 primary schools. The number of primary school children enrolled in each school ranges from 60 (lowest) to 5,555 (highest) school children. Total number of school children in the district is 74,409. (District Education Officer, person communication).

5.4 STUDY POPULATION:

All pupils in the selected primary school in Temeke district numbering 350 participated in the study.

5.5 SAMPLE SIZE ESTIMATION:

The minimum sample size of the school children required for the study was obtained by using the formula below (Kirkwood, 1988)

$$n = \frac{Z_\alpha^2 P(1-P)}{e^2}$$

n: = Is the required sample size.

Z: = The standard normal deviation that corresponds to the (1 - $\propto$) x 100%; Confidence interval for the estimate of P.

P: = Is the expected proportion (in percentage) of people with the geohelminths. Previous proportion was 7.1% (Killewo, 1991)

1 - P: = Proportion of school children with no geohelminths.

e: = Is the desired precision (i.e. margin bound of error on P) which is set at 0.03 or at 3%.

Hence: $n = \frac{1.96^2 \times 0.071 \times 0.929}{(0.03)^2}$

= 281 + 10% of non response

= 309 x 3 (for each age stratum)

= 927

Therefore the actual required sample size was 927 school children, but due to research fund problems, the sample size of 350 school children were chosen to represent these sample size.

5.6 SAMPLING TECHNIQUE:

The schools of Temeke district, which have enrolled 300-500 school children, were listed. Then by using labelled cards of each school, the cards were shuffled and random selection of one of them was done. One primary school was chosen to participate in the study. Kibugumo Primary school, which is located in Kigamboni Ward, was selected. The school has an enrolment of 350 school children. The technique was chosen due to ethical consideration that every child found infected was treated, taking into account that funds were limited. That school had less school attendance, hence, I succeeded to take the sample of 290 school children. The other remaining sixty schoolchildren did not attend school all the time of the research. The cause of their absenteeism is most of them are drop out but they are still in list of the school attendance.

5.7 LOGISTICS AND PROCEDURES:

The study was carried out smoothly after the formalities were followed. The formalities

included getting the research permit from the Institute of Public Health

(IPH), City Council, District Education Officer and the Head Teacher of the primary school whose school was chosen to participate in the study.

5.8 MATERIALS REQUIRED FOR THE STUDY:

The materials included drugs (Albendazole) and laboratory reagents whose technical details and their use are given under Appendices B. Other requirements were: bucket, gloves, stool containers, glass slides, malachite green, normal saline, 10% formalin, applicator and detto soap.

5.9 MANPOWER:

The study team comprised of 4 research assistants. Two assistants were trained on how to administer the questionnaire and also to collect specimens, and the other 2 were qualified laboratory technicians who did laboratory procedures in addition to the researcher.

5.10 PILOT STUDY:

A pre-test of the questionnaire was conducted in one of the Kinondoni primary schools. The pre-test helped to modify and correct the questions in the questionnaires and also to train the research assistants.

5.11 DATA COLLECTION:

This was done after the researcher had been introduced to the District Education Officer by a letter of introduction from the Regional Commissioners' office. The other arrangements of getting the required school were done by the investigator under the help of the District Commissioners' office.

The District Education Officer made available the list of all schools in his district. Then the school was selected by the sampling method described above. The Head Teacher of the selected school was informed about the researcher's visit and the respective date. The school was visited by the research team. Interviews were conducted among the study population of the school selected. The questionnaires summarize the pupils' awareness about the geohelminths, the modes of transmission, signs of infection and preventive measures.

The questionnaires were developed in English Version and later translated into Kiswahili Version by a translator. During the time of interviewing the questionnaires used were the Kiswahili Version because most of the people use Kiswahili. The type of questions were open and closed ended types of questions. The questionnaire for teachers was self-administered while the researcher and her assistants administered the questionnaire for school children.

Research assistants were trained on how to use questionnaires before data collection.

This took place in one randomly chosen primary school. Each questionnaire consisted of 22 questions and each questionnaire required about half an hour to administer. Each day the investigators were expected to interview 50 school children so as to cope with the collection of stool specimens for worm identification.

The researcher with her team was introduced to the school children by the Head Teacher of the selected school. After the introduction the researcher explained to them the purpose of her visit to the school. The Head Teacher of the selected school informed the villagers in the area that there was a researcher in her school so that the parents could allow their children to bring stool specimen. Each primary school child in the selected school was asked to participate in the study. Each one was provided with a numbered container and was required to provide stool specimen for examination. These containers were numbered according to the questionnaire's sheet. For the standard one and two children their brothers and sisters were called and given all the information needed for stool collection. The researcher recommended for the stool specimen to be collected only in the morning before 9 o'clock so that there was enough time to transport the specimen to the IPH laboratory for parasitological examination. The researcher had one school child who was deaf and could not speak, therefore, the information to her was translated by her friend. Egg count during stool examination was done using Kato-Katz method (Appendix B). Children found with helminths ova after stool examination were treated with Albendazole and were provided with a plastic bag container to provide faeces after 48 and 72 hours for the purpose of counting the number of worms expelled, also those containers were labelled. Also the standard one and two pupils were given the same assistance as in the case of stool collection. The post treatment faeces were transported to

the IPH laboratory. In the IPH laboratory the faeces were preserved in 10% formaline solution because it took a long time to count the number of worms expelled (See appendix C). The 10% formaline helps to fix the parasite hence, preserve its morphology (Cheersbrough, 1987).

The soil for geohelminths identification was taken randomly from some homes of school children, playground, around school latrine, areas near the school, bush and behind the classes (in general the surrounding area of the school). The soil samples were carried to the laboratory for investigation using Baerman technique. More detailed description of this technique is indicated under appendix D. The cleanliness of the school latrine was observed each day during the study time by the researcher with her assistants. Around the school latrine there was no scattered faeces except in the bush areas near the school.

Data for interview and the questionnaire was processed using compatible desktop computer after data collection. EPI Info version 6 and SPSS/PC were used to carry out the analysis. The whole process involved entering information in a computer in relation to geohelminthic infection. Such data was checked and cleaned before analysis to get results. Such data was intended to give results of geohelminths infection, prevalence, intensity, awareness of infection, transmission, prevention and the results of soil pollution by geohelminths. Tables were created to answer the research questions and the results were expected to be significant when the P- value was equal or less than 0.05.

5.12 ETHICAL CONSIDARATION

After getting the permission for carrying out the study in the area, the informed consent from the individuals were obtained after discussion and explain to them what study was all about and advantages of the study. The results from the laboratory investigation obtained from the specimen were communicated to the subjects if he/she wanted to be treated, otherwise those individuals who did not want to be treated were not forced.

6.0 THE VARIABLES:

6.1 INDEPENDENT VARIABLES:

-Age

-Sex

-Availability of school latrine

-Awareness of the disease

-Availability of shoes to each school children

-Presence of geohelminths eggs/larvae in the soil

-Availability of latrine at home

-Awareness of washing hands after visiting the latrine and before eating

6.2 DEPENDENT VARIABLES:

-Presence of geohelminths

-Intensity of geohelminths: 0-100, 101-500, more than five hundred eggs per

gramme of faeces

-Intensity of geohelminths: 1-5, 6-10, more than ten worms per child.

7.0. LIMITATION OF THE STUDY:

1) The source of research funds was the Ministry of Science, Technology and Higher Education. But this fund was not enough to carry out a study of a larger sample size, therefore only one primary school participated in the study, which sometimes did not represent the whole target group.

2) The investigation needed a respondent to bring the faeces after treatment, but some refused to be treated and this required compasation of non response; as a result non response was 4.8%.

3) There was probably some worm loss during sieving and in collection from the washed residues

4) The soils were collected and examined for geohelminths eggs after heavy rain, this rain might have affected the results because the upper soil was washed away by that rain.

8.0 RESULTS

8.1 Distribution of Study Population in General

A total of 290 school children of one primary school aged 6 to 18 years old participated in this study. Of those 290 school children 49% (142) were males while 51% (148) were females. These school children were interviewed and examined for the geohelminths infection. The school had only 6 teachers and out of them, 50% (3) were males and 50% (3) were females. Table 2 shows the distribution of the school children by age and their place of residence.

8.2 Prevalence of Geohelminths

8.2.1 Prevalence of *A. lumbricoides*

The overall prevalence of *Ascaris lumbricoides* was 4.1% with the highest age specific prevalence rate of 5% being observed in age 10 to 13 years old (Table 3). A total of 12 school children were infected by *A. lumbricoides* and of those 6 were males and 6 were females. There was no significant difference of prevalence between male and female school children (Chi-square = 0.01, df =1 p = 0.94) (Table 4).

Table 2: Distribution of study population by age, sex and village of residence.

Age Group	Kibugumo		Gezaulole		Other Places		Total	
	Number	%	Number	%	Number	%	Number	%
6-9	26	15.1	10	15.6	10	19.2	46	15.9
10-13	85	49.4	27	42.2	28	53.8	140	48.6
14+	60	35.5	25	42.2	13	26.9	102	35.0
Total	172	59.7	64	22.2	52	18.0	288	10040

Chi-square = 3.19 df = 2 P-value = 0.5

NB: Two school children did not know their place of residence

Table 3: Prevalence of *A. lumbricoides* by age group

Age Group	Total Examined	Positives	
		Number	Prevalence (%)
6 - 9	48	2	4.2
10 - 13	140	7	5.0
14 +	102	3	3.0
Total	290	12	4.1

Chi-square = 0.63 df = 2 P-value = 0.73

Table 4: Prevalence of *A. lumbricoides* by sex.

Sex	Total examined		Infected	
	Number	%	Number	%
Males	142	49	6	4.2
Females	148	51	6	4.1
Total	290	100.0	12	4.1

There was no significant difference between male and female prevalence in school children (chi- square = 0.01 df = 1 p value = 0.94)

8.2.2 Prevalence of Hookworms

The overall prevalence rate for hookworm was 22.4%. The least infected age group being 14-17 years by having a prevalence of 20% (Table 5). The total number of school children infected with hookworm was 65 (22.5%). Of those 65 school children infected 48% (31) were males while 52% (34) were females.

Table 5: Prevalence of hookworm infection by age group

Age Group	Total	Positives	
	Number Examined	Number	%
6-9	48	12	25.0
10-13	140	32	22.9
14+	102	21	20.5
Total	290	65	22.4

The overall prevalence of hookworm was 22.4%. The least infected age group being aged 14-17 by having a prevalence of 20%.

Chi-square =0.40 df = 2 P-value = 0.82

8.2.3 Prevalence of *T. trichiura* and Other Geohelminths

The prevalence rate for *Trichuris trichiura* was 0.7%. Two school children were found with *T. Trichiura* and all were males. The prevalence rate for *Strongyloides stercolaris* and *Enterobius vermicularis* together was 1.7%. Five school children were found with these parasites.

Multiple infection was not common but 1.7% (5) of school children were found with double infection of hookworm and *S. stercolaris*. *Ascaris* and hookworm were found in 1% (3) of the school children.

8.3 Intensity of Infection by Geohelminths

8.3.1 Intensity of Infection as Expressed by Egg Count of Geohelminths

The intensity of *A. lumbricoides* was fair with 25% (3) of the 12 infected cases falling under light category, and 75% (9) of them under moderate category. The highest egg count in this population was 432 eggs per gramme of faeces while the lowest egg count was 72 eggs with the mean egg count 192 eggs per gram of faeces in males and 164 in females. The intensity of hookworm ranged from light to heavy infection. Among the infected cases with hookworm 16.9% (11) had light infection, 78.5% (51) had moderate infection and 4.6% had heavy infection. The highest egg count in hookworm was 744 eggs per gramme of faeces while the

lowest egg count was 72 eggs per gramme of faeces with a mean egg count of 187 in males and 180 in females. Two school children were infected with *T. trichiura* one with moderate and the other one with heavy infection. Infected cases for *Enterobius vermicularis* and *S. stercolaris* was moderate in both cases.

8.3.2 Intensity of Infection as Expressed by Worm Explusion of Geohelminths

The intensity of worm expulsion in *A.lumbricoides* ranged from light to moderate. Out of 11 children expelling worms 63.6% (7) had light worm expulsion while 34.4% (4) had moderate worm explusion. There was no one found with heavy worm expulsion in *A. lumbricoides*. The rate of worm expulsion ranged from 2 worms per child to 8 worms. The mean worm count per child was 4. The intensity of worm expulsion in hookworm ranged from light to heavy. Sixteen point nine percent (13) of school children had light worm expulsion, 48% (37) had moderate worm expulsion and 35.1% (27) had heavy worm expulsion. The mean worm count was 13 worms per child. Fourteen point three percent (11) of school children expelled a mixture of hookworms and *Ascaris lumbricoides.* Intensity of *Trichuris trichiura* was not found because the infected individuals did not expel worms. Intensity of *Enterobius vermicularis* by worm expulsion was light in 50% (2) of school children and heavy in 25% (1) of school children. *S stercolaris* was not seen.

8.4 Results of the Soil Pollution by Geohelminths

The results of soil pollution by geohelminths ova showed that areas around school latrines are most polluted than other areas as Table 6 shows next page. The cleanlinnes of the school latrine during the time of study was fair but the latrine wall had no shelter or windows.

Table 6: Examination of soil for Geohelmnths in the study area.

Place	Number of Soil Sample Taken	Positives	
		Number	Percentage
Some homes of school children	30	14	46.7
From play ground	5	1	20.0
Around school latrine	5	3	60.0
Behind school classes	10	2	20.0
Near school areas	10	5	50.0
Total	60	27	45.0

The 45% of the soil samples examined were found with geohelminths ova.

8.5 Hygienic Conditions of School Children

8.5.1 Hand Washing Behaviour of School Children

Of the 290 school children asked on their behaviour of washing hands before eating and after using a toilets, 95.9% (278) said that they washed but out of those 27.7% (77) were infected and 72.3% (201) were not infected. Among those not washing hands 25% (3) out of 12 were infected while 75% (9) were not infected. This difference between the two groups was not significant (Chi-square = 0.04 df = 1 and p value = 0.838) (Table 7).

8.5.2 Distribution of the study population by who told them to wash hands.

Among the three groups of parents, teachers and friends, large prorpotion of parents (75.2%) told their children to wash hands. Teachers were 22% and friends 2.8%.

Table 7: Washing hands habit and infection in school children.

	Infected		Not infected		Total	
	Number	**%**	**Number**	**%**	**Number**	**%**
Washing hands yes	77	27.7	201	72.3	278	95.9
Washing hands no	3	25.0	9	75.0	12	4.1
Total	80	27.6	210	72.4	290	100.0

Chi-square = 0.04 df = 1 p value = 0.83.

There is no association of washing hands habit and infection.

8.5.3 Association of Wearing Shoes and Infection in the Study Population

Analysis was done to determine if there was an association of wearing shoes and infection. Of the 290 school children examined 60.7% (176) had shoes among whom 25.6% (45) had geohelminthic infection compared to 39.3% (114)who had no shoes of whom 30.7% (35) had infection. There was no statistical significant difference between those two groups (Chi-square = 0.9 df = 1 and p value = 0.34) (Table 8).

8.5.4 Distribution of study population by wearing or not wearing shoes after school hours.

The 44.8% (130) of the school children did not wear shoes after school hours as shown in Table 9. The reason for them not to wear shoes were in the discussion.

8.5.5 Proportion of homes of school children with or without latrine in their village they come from.

Latrine coverage was generally high with 94.8% (273) of the homes having a latrine (Table 10). Although this coverage was high the majority of them provide no privacy and encourage fly breeding.

Table 8: Association of wearing shoes habit and infection in school children.

Character	Total		Infected	
	Number	%	Number	%
Wearing shoes yes	176	60.7	45	25.6
Wearing shoes no	114	39.3	35	30.7
Total	290	100.0	80	27.6

Chi-square = 0.9 df = 1 P value = 0.34

Table 9: Distribution of study population by wearing or not wearing shoes after school hours.

Age group	Wearing shoes		Not wearing shoes		Total	
	Number	%	Number	%	Number	%
6-9	20	41.7	28	58.3	48	16.6
10-13	78	55.7	62	42.3	140	48.3
14+	62	60.8	40	39.2	102	35.2
Total	160	55.2	130	44.8	290	100.0

Table 10: Proportion of homes of school children with or without latrine in their village they came from.

Home	Kibugumo		Gezaulole		Other Places		Total	
	Number	%	Number	%	Number	%	Number	%
With Latrine	163	94.8	62	96.9	48	92.3	273	94.8
Without Latrine	9	5.2	2	3.1	4	7.7	15	5.2
Total	172	59.7	64	22.2	52	18.1	288	100

8.6. Awareness of the respondent to geohelminths

The majority of the school children (69%) are not aware of what is geohelminths and the remaining 31% (90) of school children were aware of them (Table 18). There was no significant difference between the two groups of those knowing and those not knowing in all age groups (chi-square = 1.42 df =3 p value = 0.70) Table 11.

8.6.1 Awareness of the Mode of Geohelminths Infection

Analysis was done to assess if the respondents knew at least one mode of geohelminths infection. Ninety four point eight percent (275) of the respondents knew at least one mode of geohelminths infection. They said that infection is through eating contaminated food with faeces, eating without washing hands, through walking barefooted, and a few did not know any mode of infection (Table 12). The analysis of comparison of awareness of infection was done between males and females. There was a statistical significant difference between these two groups in knowing the modes of geohelminths infection (chi-square = 6.1 df = 1 and p value = 0.01) (Table 13).

Table 11: Awareness of the respondent to know about geohelminths by age group.

Age Group	Who know		Who did not know		Total	
	Number	%	Number	%	Number	%
6 - 9	18	20.0	30	15.0	48	16.6
10 - 13	40	44.4	100	50.0	140	48.3
14 +	32	35.5	70	35.0	102	35.2
Total	90	31.0	200	69.0	290	100

Chi-square = 1.34 df = 2 p - value = 0.51.

Table 12: Awareness of the respondent of at least one mode of geohelminths infection by age group.

	Response by age group							
Mode of Infection	**Age 6 - 9**		**Age 10 - 13**		**Age 14 +**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
At least know one mode	39	81.3	134	95.7	102	100	275	94.8
Did not know	9	18.8	6	4.4	0	0.0	15	5.2
Total	48	16.6	140	48.3	98	33.8	290	100.0

Chi-square = 23.83 df = 2 P-value = 0.00

Table 13: Awareness of the respondent of at least one mode of geohelminths infection by sex.

Infection Mode	Male		Female		Total	
	Number	%	Number	%	Number	%
At least know one mode	130	95.6	145	98.0	175	94.8
Did not know	12	8.5	3	2.0	15	5.2
Total	142	49.0	148	51.0	290	100.0

Chi-square = 6.1 df = 1 P value = 0.01

8.6.2 Awareness of the Signs of Geohelminths Infection

Analysis was done to asses if the respondents in the study population were aware with geohelminths. Sixty two point six percent (179) were not aware with the signs of geohelminths infection in all age groups while 37.4% were aware with the signs of infection (Table 14). The signs which they said includes stomach-ache, vomiting, loosing appetite and mulitple signs.

Table 14: Proportion of study population who know at least one sign of geohelminthic infection by age group.

	Age group in years							
Signs	**Age 6-9**		**Age 10-13**		**Age 14 +**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Know at least one sign	13	27.1	56	40	38	38.8	107	37.4
Did not know	35	72.8	84	60.0	60	61.2	179	62.6
Total	48	16.8	140	49.0	98	34.2	286	100.0

Chi-square = 2.67 df = 2 P-value = 0.26

8.6.3 Awareness on the Transmission Mode of Geohelminths

Analysis was done by questionnaire to asses if the respondents knew how the transmission of geohelminths took place. Seventy two point four percent of the population knew at least one transmission mode of geohelmints. They believe that transmission is by defaecating in open places or by contaminating food or water by faeces. Twenty seven point four percent (80) of the study population did not knew the transmission mode. Among the age group as you go higher the age, the awareness of the transmission mode increases as shown in Table 15 (chi-square = 8.44 df = 2 P value = 0.01). There was no statistically significant difference between male and female school children in the awareness of geohelminths transmission (chi-square = 0.14 df = 1 P value =0.71) Table 16.

Table 15: Awareness of the respondent of at least one mode of geohelminthic transmission by group.

Response by age group								
Mode of transmission	**Age 6-9**		**Age 10-13**		**Age 14 +**		**Total**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Know at least one mode	30	62.5	96	68.6	84	82.4	210	72.4
They did not know	18	37.5	44	31.4	18	18.4	80	27.6
Total	48	16.6	140	48.3	98	33.8	290	100

Chi-square = 8.44 df = 2 P-value = 0.01

Table 16: Awareness of the respondents of at least one mode of geohelminthic transmission by sex.

Mode of Transmission	Male		Female		Total	
	Number	%	Number	%	Number	%
At least know one mode	111	78.2	113	76.4	224	77.2
They did not know	31	47.0	35	53.0	66	22.8
Total	142	49.0	148	51.0	290	100.0

Chi-square = 0.14 df = 1 P-value = 0.71

8.6.4. Awareness of the Preventive Measure of Geohelminths

Analysis was done to asses the awareness of geohelminthic prevention. Of the 290 school children, 94.8% knew at least one mode of geohelminths preventive measure wihle 5.2% (15) did not know any preventive measure (Table 17). They believe that prevention were through wearing shoes, boiling drinking water,improving personal hygiene, proper use of toilets and through multiple methods. There was statistical significant difference between male and female school children in knowing the mode of geohelminths prevention (chi-square = 6.1 df = 1 p value =0.01). Table 18.

Table 17: Awareness of the respondent of at least one mode of geohelminthic prevention by age group.

Mode	Response age group							
	6-9		10-13		14 +		Total	
	No.	%	No.	%	No.	%	No.	%
At least know one mode	39	81.3	134	95.7	102	100.0	275	94.8
Did not know	9	18.8	6	4.30	0	0.0	15	5.2
Total	48	16.6	140	48.3	98	33.8	290	100.0

Chi-square = 23.83 df = 2 P-value = 0.00

Table 18: Awareness of the respondent of at least one mode of prevention by sex.

Mode	Male		Female		Total	
	Number	%	Number	%	Number	%
At least know one mode	130	95.5	145	98	275	94.8
Did not know	12	8.5	3	2.0	15	5.2
Total	142	49.0	148	51.0	290	100

Chi-square = 6.1 df = 1 P value = 0.01

8.6.5 Awareness of teachers to Geohelminthic Infection

Teachers were given some questions if they knew geohelminths and examples of them. Thirty three point three percent (2) of the teachers are not aware of what are geohelminths and even the examples. All the teachers knew the signs of geohelminths and how to help school children of those signs. Also 33.3% (2) of the teachers said that the school latrine does not satisfy the children use because the latrines walls had no shelter and there are no windows for ventilation. Sixty six point seven percent (4) of the teachers did not give any comment.

9.0 DISCUSSION

The methodology used in this study has both merits and demerits. The method used of choosing one primary school sometimes has bias. This is because one school does not represent the characteristics of all the schools in Temeke District. Also this study was a cross-sectional study which gives the characteristics of the disease at that particular time. Also it provides the prevalence of the disease at one time and not for any other time. Furthermore using a questionnaire was a problem because asking a person some questions the person may answer correctly or incorrectly. Despite all these problems the researcher managed to get useful information reflecting actual situation of the magnitude of geohelminths in the study area. In general, these results can be used in Dar es Salaam region as a whole and other places within the country. This is because most of the schools in our country have the same or nearly the same condition as the studied school and the school children themselves had the same habit when they are hungry and see something to eat.

The results show that geohelminths are a public health problem among the study population. Among 290 school children examined for geohelminthic infection 80 (27.6%) were found infected with several species. The overall prevalence rate for *A. lumbricoides* was 4.1%, hookworm was 22.4%, *T.trichiura* 0.7% and *S. stercolaris* with *E. vermicularis* together had a prevalence of 1.7%. The prevalence of multiple infection for *A. lumbricoides* and hookworm was 1% and that of hookworm and *S. stercolaris* was 1.7%.

The prevalence rate of *A. lumbricoides* was not different from that found by Killewo (1991) who conducted a study in Temeke in 1985 and found a prevalence of 4%. Also these prevalence rates were not different from those found previously by Makuka (1994) in pre-school children in Kinondoni district who found a prevalence of 4.9%. Finding the same prevalence of about 4% since 1985 in Temeke district is suprising when factors which favour transmission are considered. The factors include increase of urban population since 1985 when the study was conducted, an introduction of cost sharing in hospital facilities, overcrowding of school classes by pupils and poverty. On the other hand with all these problems the prevalence has remained the same probably due to the fact that there was an introduction of broad-spectrum anthelminths. Furthermore the results were affected by a long dry period followed by heavy rain and floods during which the study was undertaken. The long dry season did not support the geohelminths ova in the soil and also the heavy rain which followed that period washed away some ova or filariform larva of geohelminths species. Therefore, the prevalence remained the same. The prevalence rate of *T. trichiura* and *S. stercolaris* together with that of *E. vermicularis* was low. The infection of *A. lumbricoides* and *T. trichiura* had been reported to have similar distribution and epidemiological characteristics (Kihamia, 1977). The sand soils of the study area did not support the ova or filariform larva of *A. lumbricoides, T. Trichiura, S. stercolaris and E. vermicularis*. This is so because dry sandy soils kill the ova before reaching the infective stage while a loose soil with moderate shade favour their survival (Belding, 1952).

The sandy soil favour the hookworm survival compared to other geohelminthic species. So the prevalence of hookworm was higher than other species of geohelminthic. The prevalence of hookworm of 22.4% in this study was much higher than that found by Killewo of 7.1% in Temeke district when he conducted the study in 1985 and that of pre-school children found by Makuka in 1994 of 14% in Kinondoni district. This difference in prevalence may be due to the fact that the population increase leads to overuse of latrine and this leads them to overflow. The overflow of the latrine lead to soil pollution and cause school children to easily come in contact with faecal material during playing and hence become infected. This is supported by the observation that some of the city septic tanks overflow and one such example was when one primary school in the city was closed due to the school being surrounded by waste water from septic tanks (Head Teacher, personal communication)

There was no significant difference in the prevalence of *A. lumbricoides* among males and females. This was probably because the sexes were exposed to the same factors of acquiring infection. The most infected age group with *A. lumbricoides* was the age group 10-13 years while the least infected age group was 18 years and above which actually had no infected individuals. Ten to thirteen years of age were more affected probably because they were more exposed to the contaminated materials than others. This age group is the one which is most active and they play and walk bare footed in most of the time.

The prevalence rate of hookworm was higher among all age groups. It was over 20%. This occurred because all the age groups in the study area shared the same environmental condition, that of sandy soil in the area. There was no significant difference in the prevalence of hookworm between males and females. The prevalence of *T. trichiura, S. stercolaris* and *E. vermicularis* was so small that to compare them by sex was difficult. The prevalence of hookworm was higher than the other species of geohelminths in the study area. This was supported by another author (Macpherson, 1991) that hookworm especially *A. duodenale* is prevalent on the coast of Tanzania. It was also said (Beaver, 1953) that hookworm in the coastal area especially *N. americanus* has a capacity to yield 46,000 larvae for six to eight days after inoculation. This support the general view that open sandy soils of the coast areas provide ideal condition for the development of rapid migration of infective stage larvae. From the observation the coast soils are sandy, therefore, hookworm is prevalent along the coast area of Tanzania.

The intensity of infection was assessed indirectly by counting the number of eggs per gramme of faeces. From the assessment the study population infected with *A. lumbricoides* fell under light category and moderate category (Purnell, 1967). Twenty five percent (3) of cases fell under light category while 75% (9) of cases fell under moderate category. The highest egg count was 432 eggs per gramme of faeces while the lowest egg count was 72 eggs per gramme of faeces with mean egg count of 192 in males and 164 in females. In all cases of *A. lumbricoides* infection there was no

one found with heavy infection, therefore, the majority of the infected cases remained asymptomatic. These asymptomatic individuals remain untreated and they continue to pollute the soil if they defaecate out of latrine, hence making the area endemic with reinfection becoming a continuous process.

Furthermore, the intensity of hookworm was also assessed by counting the number of eggs per gramme of faeces. The intensity of infection ranged from light to heavy infection. Seventeen percent (11) of the individuals had light infection, 78.5% (51) had moderate infection and 4.6% (3) had heavy infection. Among the age groups, the age group 10 - 13 had all categories of light, moderate and heavy infection. Twenty five percent (8) had light infection 65.6% (21) had moderate infection and 9.4% (3) had heavy infection. The highest egg count in hookworm was 744 eggs per gramme of faeces while the lowest was 72 eggs per gramme of faeces with a mean egg count of 187 eggs per gramme of faeces in males and 180 eggs per gramme of faeces in females. The probable reason for the age group 10-13 having a high intensity of hookworm might be due to increased exposure. Most of the time this age group was observed to be barefooted and indulged in games such as rolling on the ground in the school compound which was often polluted with geohelminths ova. Also the school children used the same defecation site in their large numbers and this exposed them to the risk of geohelminthic infection. Furthermore the school did not provide lunch for the school children, therefore, most of the school children bought something to eat and they shared among each other and often ate without washing hands, hence getting infected . This is so because all children were asked if the school provided lunch for

them, where 89% said no. During lunch time they bought roasted cassava and ate. These reasons might be applicable to the other species of geohelminths as well. The intensity of *T. trichiura* was moderate.

Judging from the intensity of infection by worm expulsion, the infected individual with *A. lumbricoides* fell under light and moderate categories. The light category consisted of 63.6% of those infected with *A. lumbricoides* and moderate category consisted of 36.4% of the infected individuals. The age group 6-9 had only light worm expulsion while the age group 10-13 had both light and moderate worm expulsion. There was no significant difference in the rate of *A. lumbricoides* expulsion between males and females. The smallest number of *A. lumbricoides* expulsion was 2 while the highest number expelled was 8 worms. The mean worm expulsion per child was 4.

The intensity of hookworm expulsion ranged from light to heavy expulsion. Seventeen percent (13) school children fell under light category, 48% (37) fell under moderate category and 35% (27) fell under heavy worm expulsion. The smallest number of hookworm expelled by a school child was 4 while the highest number was 115 hookworms. The mean hookworm expulsion was 13 worms per child. A study on adult hookworm expulsion after antihelminthic administration was also reported by Gnana (1993) in India. They stated that the average hookworm burden was 1.25 hookworms per child which was less than the present study of 13 worms per child. This variation could be related to differences in the study population and different

climate (one group from Asian continent and the other from Africa). Also some of the children whose stool was shown to have no geohelminths were administered with antihelminths and they expelled worms. This indicated that even if the individual was not shown to have geohelminthic ova in the stool, given antihelminths the infection will appear directly. This shows that may be during stool examination the examiner did not detect them or the part of stool taken did not have eggs. So given antihelminthic the infection was detected. Also it was said that (Belding, 1952) the individuals who fell under light category will show no symptom, those under moderate category will show slight symptom and those under heavier category show the symptoms of infection. Therefore the administration of antihelminthic is so important because it reduces the individuals risk of infection.

Furthermore the results of soil samples taken showed that ova and filariform larvae for geohelminths were present in the soil. Among the 60 samples of soil examined, 45% (27) of the samples were shown to be contaminated with geohelminths. The soil samples were taken from different places. The most contaminated area was around the school latrine with 60% showing geohelminths filariform larvae, while the least contaminated areas were open areas and behind school classes. The area around school latrine was contaminated due to the fact that the school had only one latrine which was not enough to satisfy the needs of the school children and this led them to defaecate around the latrine or others had a habit of defaecating out of the latrine. Other school children feared the latrine and went to defaecate near the school area (bushy) and that was why areas around the school were found with 50% of soil

samples being contaminated with geohelminths ova. Soil samples taken from some homes of school children were also shown to be contaminated with geohelminths. Forty seven percent (14) of the 30 samples taken were found with geohelminths filariform. From the results of soil pollution within homes of school children it meant not only the school area was polluted but also other areas such as homes were contaminated. The playing ground and the area behind school classes were less polluted compared to other places. This might probably be due to school children being afraid of defaecating on playing ground or around classes because the other children might see them. It could also be due to heavy rains which washed away the eggs or the long drought which killed the geohelminths eggs. This was supported by Beaver (1953) that the long drought period kills the filariform or ova of geohelminths. The related study of soil pollution with geohelminths was done in Jamaica (Wong, 1990) and Indonesia (Ismid, 1980; Uga, 1995). It showed that areas where people had no latrines and defaecated in garden, soil pollution was usually present. Those results could be compared to that of the present study whereby geohelminths were found around the latrine and the area around school where there were shaded trees. The contaminated soil increase the risk of infection of geohelminths in the study area.

The present study showed that the habit of children of washing hands before eating and after toilet had no association with geohelminths infection. Most of the infected children said that they washed hands before eating and toilet but most of them were infected. The infection to the children was probably due to washing hands in the same

container. Also in that area water is a scarce resource which can lead them to share washing water. However the investigator thought that these results were affected by the answers of the children because each question they were asked they just answered yes. Also areas around their school was surrounded by trees of fruit. The children usually went there to pick fruits and ate them without washing hands. About 75.2% (215) of the school children said that it was their parents who told them to wash hands, 22% (63) said it was their teachers and 2.8% (8) said it was friends. The habit of washing hands was a dream to a school child when he/she was hungry and saw something to eat. He/she would just pick and eat without remembering to wash hands. From the habit of eating without washing hands the individuals might be infected with *A. lumbricoides, S. stercolaris, Enterobius vermicularis* and *Ancylostoma duedenale* (Manson, 1987).

Wearing shoes had no association with geohelminthic infection. Among 80 school children who were infected 56.3% (45) of them said that they had a habit of wearing shoes most of the time. From the results, it was seen that even if a child wore shoes he/she was still infected especially with hookworm species *Necator americanus* which penetrate the skin (Manson, 1987). Most of the school children shoes to them meant open shoes (sandals) (personal observation). Furthermore some school children did not wear shoes due to a number of reasons such as, some children had no shoes, other said that it was their habit not to wear shoes, others gave other reasons like time of playing and others did not respond to that question for their own reasons.

The latrine coverage in the homes of school children in the study area was very high. Although this coverage was high, the soils of the area were polluted with geohelminths. This meant that the latrines were not of good quality which could be used by the user comfortably. Lucas, (1990) gives a quality of a good latrine which includes the following; no handling of fresh faeces, no contamination of the surface soil, no contamination of surface or underground water, excreta inaccessible to flies or animal, no unpleasant odours, simple and inexpensive in construction and operation and culturally acceptable to the community. Most of the latrines in the study area did not posses these qualities. Most of the latrine walls were built by coconut leaves and had no shelter, therefore, did not provide privacy hence someone could decide to defaecate in the bushy areas where he/she could be more comfortable.

Most of the study population were not aware with geohelminths. The awareness of geohelminths was not a problem for school children alone but also their teachers. Thirty three percent (2) of teachers out of six in the study school were not able to mention a single example of geohelminths. They said geohelminths were equivalent to tapeworm which was caused by eating improperly cooked meat. On the mode of geohelminths infection, they believe that infection was through eating food contaminated with faeces, eating without washing hands, walking barefoot and others said it was caused by multiple methods. A few did not know any mode of transmission of geohelminths. In all age groups at least each child knew a single mode of infection and this was because in the school there was a session of health in each class from standard one up to standard seven. There was a significant difference

between males and females in knowing mode of geohelminths infection.

Regarding awareness on how geohelminths are transmitted from one individual to another, 36.6% (106) of the study population said it was through defaecation out of latrine. This meant that the soil would be polluted and the individual get the infection through soiled fingers if contaminated with the geohelminths ova or ate without washing hands. Also the hookworm larva in the soil especially *Necator americanus* penetrate the skin for those walking barefooted (Manson, 1987). Thirty six percent (104) said transmission was through food or water contaminated with geohelminths ova when consumed without heating or boiling drinking water. Twenty eight percent of school children did not know any mode of geohelminths transmission. The awareness of geohelminths was high among school children of higher age of above 17 years old. There was no significant difference in awareness of the mode of geohelminths transmission among the sexes.

On the modes of prevention most of the study population knew a preventive measure according to age group as well as according to sex. Although each one knew at least one preventive measure, geohelminths infection was still a problem in the study area. This was because the factors which favoured transmission were there which exposed them to a greater risk of infection. There was significant difference in the awareness of the mode of geohelminths prevention among males and females.

Due to the fact that geohelmenthic infection is a problem to that area, there are some

health consequences of it. The geohelminths affect the physical development of the children in general (Stephenson, 1990). Ascariasis can cause malnutrition, pneumonitis, allergic reaction and abdominal complication for heavy infected individuals (Manson,1987). Hookworm can result in anaemia. If the school children get infected and experience those complications their school attendance will be poor as well as the school performance.

10.0 CONCLUSIONS

In this study it was found that geohelminths were a public health problem especially among school children in Temeke district. The prevalence of soil transmitted helminths was 27.6% with species of hookworm, *A. lumbricoides, T. trichiura, S. stercolaris* and *E. vermicularis*.

The intensity of geohelminths infection was assessed indirectly by egg counting and directly by counting the number of expelled worms. Intensity of infection by egg count shows that some of the school children have light infection, some have moderate infection and others are heavily infected. Intensity by worm expulsion shows the same result as egg count but some individuals were found to have no geohelminths eggs but when given antihelminths they expelled worms.

The soils in the study area was contaminated by geohelminths eggs. Soils around the school area and homes of school children were contaminated and this makes the school children to live with the risk factor of infection.

The hygienic conditions of school children was fairly well, with some school children having shoes and others having no shoes and most of them considered shoes to be open sandals. Although each individual in the study population knew at least one mode of geohelminths transmission and prevention, geohelminths remained a problem among school children. This was because there were risk

factors for geohelminths infection. Those factors include polluted soil, school children sharing same defaecating site, school children walking barefooted, therefore, the school children were at great risk of getting geohelminths infection.

11. RECOMMENDATIONS

1. Study shows that the prevalence of geohelminths especially hookwormS were high in the study area, therefore, there is a need for relevant authorities to find some mechanism of reducing them.
2. Study shows that those school children found negative with geohelminths were given antihelminths and they expel worms, therefore, it is recommended to treat all school children without mind if they are infected or not during deworming programme.
3. Soils in the study area was found polluted with geohelmiths in this study, therefore, it is recommended that every one in that area to have at least one pair of shoes and knowing the meaning of washing hands so that to reduce the risk of infection especially with hookworm.

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