SOIL-TRANSMITTED HELMINTHS AND THEIR RELATED FACTORS IN PRE-SCHOOL CHILDREN IN SELECTED AREAS OF KINONDONI DISTRICT, DAR ES SALAAM.

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ABSTRACT

A community-based cross-sectional study was conducted in Kinondoni district from Mid - October 1992 to Mid - January 1993. Kibamba and Kunduchi wards were randomly selected from a list of five wards which constitute the peri-urban portion of the district. The two wards are administratively divided into seven villages out of which five were randomly selected for the study. Due to constraints of funds this study was limited to the two mentioned wards only. The primary aim of the study was to determine the prevalence rates of infection with soil-transmitted helminths among pre-school children aged between 2 - 6 years and the possible impact of infection on their nutritional status. The study involved 508 pre-school children aged 2 - 6 years who had their anthropometric measurements taken for analysis of their nutritional status. The children were also stool examined for geohelminths. The study further involved a house to house inspection visit of 339 households selected for the study. The visits at household level aimed at taking anthropometric measurements on the children, collection of stool specimens, latrine inspection and to conduct interviews on adult respondents. In each household visited, one adult respondent was interviewed on the source of

infection, mode of transmission, preventive and control measures against geohelminths. Using the Kato-Katz modified thick-smear technique, the overall prevalence rate of hookworm was found to be 14% and was the most prevalent geohelminth in the district. The prevalence rates of the other geohelminths were 4.9% for Ascaris lumbricoides, 3% for Trichuris trichiura and 1% for Strongyloides stercoralis. The study further revealed that, 204 (40.2%) of the children studied had poor nutritional status. In summary, this study established the following findings:

1. The problem of soil-transmitted helminths among pre-school children in the district is substantial while malnutrition is rampant.

2. There was a highly significant association between geohelminthiasis and malnutrition. However, since this was a cross-sectional study, it was not possible to establish the causal relationship.

3. The majority of the population in the district has a low level of perception on geohelminths.

4. Latrine coverage at household level is still quite unsatisfactory as 51 (15%) out of 339 households had no latrines while 38 (13.2%) households had latrines which were unfit for use.

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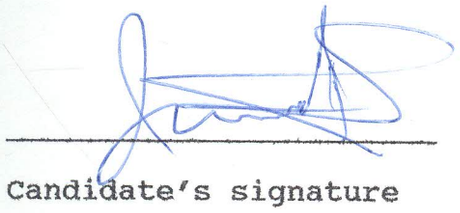
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DECLARATION

I hereby declare solemnly that not the whole or part of this dissertation has ever been submitted for a degree in any other University and that it is a result of my original work.



Candidate's signature

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INTRODUCTION

1.1. General Consideration

The word "helminth" in Greek means "worm". Although the term originally referred to intestinal worms, it is more usually interpreted to include both parasitic and free-living species of roundworms (Beaver et al; 1984). The term roundworm includes not only true roundworms or nematodes (Phylum: Nematoda) but also "hair snakes" (Phylum: Nematomorpha). Based on the mode of transmission, helminths can be classified into the following five groups (WHO, 1964):.

Contagious or Faecal-borne Helminths:

Eggs or larvae of such worms become infective soon after being passed or deposited at the anus and are therefore transmissible directly from person to person, e.g. Enterobius vermicularis.

Soil-transmitted Helminths (or Geohelminths):

The infective stages of worms included in this group are reached only after a period of embryonation in the soil e.g. Ascaris lumbricoides, Trichuris trichiura and hookworms.

Vector-borne Helminths:

The infective stages develop in arthropod intermediate hosts which transmit the infection during their act of biting, e.g. Onchocerca volvulus.

Snail-transmitted Helminths:

The infective stages develop in the snail intermediate hosts after partial development in the snail, e.g. Trematodes.

Food-animal-transmitted Helminths:

The infective stages develop in animals whose flesh is an important item of food for man, e.g. Taenia species. From the standpoint of their overall prevalence and influence on individual health, the most important geohelminths are: Ascaris lumbricoides, Linnaeus, 1758; Trichuris trichiura, (Linnaeus, 1771), Stiles, 1901; Necator americanus (Stiles, 1902) Stiles, 1903 and Ancylostoma duodenale (Dubini, 1843) (Creplin, 1845). An additional species less widely distributed and less restricted to soil transmission is Strongyloides stercoralis (Bavay, 1877) Stiles and Hassall, 1902. Other species also soil-transmitted and which to a lesser extent contribute to the morbidity of communities are the ascarids of dogs - Toxocara canis (Werner, 1782) Johnston, 1916; the trichurids of dogs - Trichuris vulpis (Froelich,, 1789) and a common helminth of rats - Capillaria hepatica (Bancroft, 1893), Travasos 1915. In the life-cycle of geohelminths, through faecal contamination, stages which are not yet infective gain access into the soil where development to the infective stage can take

place. The soil also provides protection for the infective stage for a period during which it may get into contact with a suitable individual whom it may enter by mouth (Ascaris lumbricoides, Trichuris trichiura), or by skin penetration (Necator americanus, Ancylostoma duodenale). Therefore, the soil serves these parasites as an intermediate host (Beaver, 1961).

Fundamentally, the endemicity of the soil-transmitted helminths depends upon the presence of infected individuals, habitual faecal contamination of the soil, a favourable soil environment (temperature, moisture, soil-texture) for the development of the infective stages and frequent contact between infective soil and uninfected individuals. The importance of soil-transmitted helminths was not internationally considered as a disease group until late in 1963 when a WHO Expert Committee on helminthiases was convened in Rio de Janeiro in Brazil to review the problems raised by geohelminths (WHO, 1964). Until then, only private or national efforts were being directed towards one or the other of the geohelminth infections. Apparently, there is a rapid increase of population in urban areas of the developing world which has been growing so rapidly since in 1950 (Sawaya et al, 1990).

The number of persons living in urban areas in the developing world has increased from almost 400 million in 1960 to about 1500 million in 1990 (Sawaya et al, 1990). This rapid increase in urban population of the developing world is not accompanied by economic and social development. Such a trend leads to creation of over-crowded shanty-towns with rudimentary sanitary and other social facilities. Definitely, such slum-dwellers are quite exposed to the burden of intestinal parasitic diseases due to the existing favourable conditions for transmission. It is estimated that about one-third of the population in cities of the developing countries live in slums and shanty-towns (Crompton and Savioli, 1993). It is further estimated that by the year 2000 this figure will grow to 2200 million people and that by the year 2025 about 57% of the population in developing countries will be in urban areas (Crompton and Savioli, 1993).

1.2 The Global situation of Geohelminths

The soil-transmitted helminths are prevalent in many parts of the world and especially so in the tropical and sub-tropical countries. Geohelminths are endemic in many parts of Africa, the Middle East, the Americas and in the Caribbean (WHO, 1964). Ascariasis is one of the commonest and most widespread human infections

worldwide. The current global estimates of geohelminth infections are 1000 million infected by Ascaris, 900 million with hookworms and 500 million with Trichuris (WHO, 1991). However, despite geohelminth control improvements in a number of countries such as Japan and the Republic of Korea, WHO is concerned in that the global trend is such that these infections remain the most prevalent, especially among the poorer population groups of the developing world. The global distribution pattern of geohelminths varies from one species to another, although not quite so between Ascaris and Trichuris.

1.3 Epidemiology of Geohelminths in Tanzania.

There is no doubt that intestinal parasites are widespread in Tanzania. The annual hospital figures from most hospitals in the country (1970 - 1971) reveal that intestinal parasites particularly geohelminths are endemic. According to a report of the Ministry of Health (1973 - 1976), ancylostomiasis was the sixth and ascariasis the twelfth most frequent causes of admission to both Government and Voluntary Agency hospitals of Tanzania Mainland. Up to date, ancylostomiasis and iron deficiency anaemia are among the top-ten causes of admission to Government and Voluntary Agency hospitals on Tanzania Mainland (Ministry of Health, 1973-1976).

Unfortunately, these hospital figures do not reflect the true prevalence value of the intestinal parasites in question due to their incomplete and biased source. However, the figures show the magnitude of the problem which is quite serious particularly in terms of morbidity. According to a WHO (1967) Expert Committee on the control of ascariasis, morbidity and mortality reflect only a small portion of the impact of geohelminths on the health of the people. About 80% of Tanzanians live in rural areas with poor water supply and hygienically unacceptable excreta disposal facilities. In such prevailing sanitary conditions, indiscriminate defaecation with consequent soil contamination with intestinal parasites is the rule. Although many parasites do occur in Tanzania, it is the intestinal helminths, and particularly the geohelminths, which are of much public health concern. The extent to which intestinal parasitic infection contributes to malnutrition has not been fully determined. Several studies of children infected with parasites such as Ascaris, Giardia, Trichuris, and hookworm have demonstrated growth reduction, malabsorption of nutrients, and damage of intestinal mucosa (Sawaya et al; 1990). Some workers are less convinced of the importance of the effect of parasites on nutritional status. Loewenson et al. (1986) found

strong association between Giardia infection and undernutrition, wasting and stunting, but found no evidence of an association between helminth infection and undernutrition.

Other authors noted a close association between intestinal parasitism and malnutrition, but observed that factors other than parasitism, such as social class and hygiene were more important (Sawaya et al. 1990). This study will among other things investigate the possible association between parasitic infection and malnutrition in pre-school children in Kinondoni district.

2. RATIONALE OF THE STUDY

The true picture of soil-transmitted helminths in Tanzania as regards their prevalence and intensity of infection still remains inadequately studied. Most of the available data on intestinal helminths in general are hospital based but which do not reflect the true picture of the situation in the general population due to their incompleteness and bias. Not much has been done in the direction of community-based surveys country-wide which is scientifically more meaningful in obtaining valuable data on these silent killers of mankind. The influx of migrants from upcountry regions to Dar es Salaam region has reached unproportional

rates regarding the necessary social amenities being provided by the city authorities. These include proper housing, safe and adequate water supply, schools, health care units and sanitary installations. As a result quite a good section of the city residents end up living in crowded squatter areas without proper hygienic means of human excreta disposal, domestic waste water disposal coupled with poor water supply. All these factors create favourable conditions for the spread of soil-transmitted helminths. Despite all these facts, Dar es Salaam region remains improperly surveyed in this respect. So far, no community-based study has been carried out in Kinondoni district to find out how serious the problem of geohelminthiasis is in young children especially when taking it into consideration that the impact of intestinal worm infection on the nutritional status and health in general is strongly expressed in this age group. The rationale for carrying out this study is therefore to collect the necessary information which will be utilised in the prevention and control of soil-transmitted helminths in the district.

3. OBJECTIVES

3.1 Broad Objective

To determine people's perception, the magnitude of infection and the related factors of soil-transmitted helminths among pre-school children in selected areas of Kinondoni district.

3.2. Specific Objectives

1. To determine the prevalence of soil-transmitted helminths in children aged 2-6 years.
2. To determine the intensity of infection with soil-transmitted helminths in children aged 2-6 years.
3. To determine the prevalence of malnutrition in children aged 2-6 years and its relationship to geohelminthiasis.
4. To determine the household latrine coverage and the quality of the latrines.
5. To determine people's perception on soil-transmitted helminths.

4. LITERATURE REVIEW

In the following literature review an effort is made to review the available information on soil-transmitted helminths with particular reference to Tanzania. The review of literature provides evidence that during the

colonial era in the then Tanganyika Territory both the German and British Medical personnel admitted that intestinal parasites and particularly geohelminths were widespread. The information further reveals that few surveys were carried out in various areas and communities of the country such as in institutions like schools, hospitals and also in villages. However, it has not been possible to conclude with certainty the overall incidence of infection with soil-transmitted helminths among the general population in the country because most of the studies done so far have been hospital-based whose procedure is rather biased and incomplete.

4.1 **Morbidity and Mortality due to Geohelminths**:

The impact of geohelminths on human health is quite enormous and even though their direct effects on growth achievement, nutritional status and health are difficult to measure, there is no doubt that infection with soil-transmitted helminths adversely affects growth, intellectual velocity and work capacity of the infected individuals (WHO, 1964, 1981). The World Health Organisation (WHO, 1967) summarized the morbidity of ascariasis as follows:-

1. Allergic action of the adults and larvae.

   a) Substances from adult worms:

Allergic phenomena among laboratory workers

b) Substances from the larvae:

i. Cutaneous signs: urticaria, erythematous lesions

ii. Blood oesinophilia

iii. Loffler's syndrome

c) Associated infections:

i. Complications due to Strongyloides stercoralis and Escherichia coli

ii. Cryptogenetic and malignant oesinophilia

iii. Cutaneous, ophthalmic and visceral larva migrans due to migration of the larvae.

2. Action of the adults on the intestinal tract.

a) Nutritional disorders and enterocolitis of the diarrhoeal type.

b) Surgical complications:

i. Intestinal sub-occlusions and occlusion caused by mass of Ascaris leading to e.g. intussusception (in children), volvulus, hernial strangulation (penetration of Ascaris into the loop involved).

ii. Acute mesenteric adenitis

iii. Penetration into the appendicular lumen or into intestinal diverticulum.

iv. Post-operative troubles due to movement of Ascaris lumbricoides (Colic, peritonitis, fistula)

3. Wandering of adult worms:

   a) From mouth, nose, lacrimal fossa or through eustachian tube to the middle ear.

   b) Through glottis (glottal oedema) to trachea or bronchi.

   c) Into bile ducts causing obstructive jaundice, gall-stones, cholangitis, liver abscess.

   d) Into pancreatic duct which may result into acute haemorrhagic or purulent pancreatitis.

   e) Migration across tissue walls from intestine to peritoneal cavity and elsewhere.

Although the mortality rate due to ascariasis appears to be low, the absolute number of deaths due to it is quite high in relation to other infections because of its high prevalence (WHO, 1967). The morbidity statistics of ascariasis are ill-defined, but the high prevalence again means that many people are ill and many more are at risk of infection (WHO, 1967). Latham (1991), is of the opinion that well over 2,000 million people worldwide are carrying the burden of worms.

Latham (1991) further states that, Ascaris lumbricoides is the most prevalent worm and is estimated to infect 1,200 million individuals which constitutes about one-fifth of the world's population. He summarises his statement by estimating the prevalence of human

hookworms at 800 million people and 600 million for Trichuris trichiura. The author sadly concludes that until recently, geohelminth infections have been a neglected problem and attributes this to partly being due to the great emphasis which has been placed on survival, especially child survival, and less on the quality of life, health and productivity of those who survive.

Latham (1991), further observes that, the great majority of those with worms do not die directly from these infections but the quality of their lives is likely to be compromised. It has recently been strongly evidenced that ascariasis, especially when worm burdens are high, retards the normal growth of children and contributes to malnutrition (Latham, 1991). On the other hand gastrointestinal symptoms are difficult to delineate because of frequent intercurrent infections with other intestinal pathogens. Trichuriasis is probably not as widespread as ascariasis but the infection is more or less coexistent with ascariasis. Trichuriasis causes very significant morbidity mainly in the form of severe dysentery and mainly affecting the health of small children (Beaver, 1961, Latham, 1991). Sawaya et al., (1990) studied the association between intestinal parasitic infections and malnutrition in pre-school children in the city of Sao

Paulo, Brazil. Higher risks of malnutrition were found in children aged more than 2 years infected with Ascaris, Trichuris or with more than three different parasites. Barnett Cline (1991), emphasizes the need to quantify the impact of intestinal helminths on human health and to understand the mechanisms behind their adverse effects. Owing to the relatively small bowel lumen in pre-school children, intestinal obstruction with ascarids is a common cause of surgical emergencies particularly in the developing world where children may acquire massive infection from playing in and ingesting dirt contaminated with infective eggs. The most important effect of age is its relationship to the probability of concurrent disease, particularly febrile illness. Ascarids are not attached to the intestinal mucosa and conditions such as febrile illness trigger off aberrant localization of worms with migration to extra-intestinal sites causing serious or fatal complications (Barnett Cline, 1991).

The morbidity due to hookworm infection is mainly manifested in the form of anaemia which if unchecked may ultimately lead to death. Bloodloss due to hookworm is not only caused by the worms sucking blood but also results mainly from minute mucosal lacerations at the site of worm attachment and reattachment.

Blackman (1962) in his studies in Dar es Salaam on cases of severe anaemia was convinced of the big role played by hookworm infection in the cause of anaemia especially in adults. Similar studies were carried out by Meredith and Eyakuze (1962), Nhonoli (1974) and all came up with the same views as those of Blackman (1962). Sturrock (1962/63) revealed that Ancylostoma duodenale species was associated with a more marked effect on the blood (anaemia) than was Necator americanus species (East African Institute for Medical Research Annual Report, 1963/63, p. 56 - 58).

4.2 Control Aspects of Geohelminths

Geohelminths are still highly prevalent in countries with poor socio-economic status and inadequate environmental sanitation, especially in African, Asian and Latin American countries.

Pawlawski, (1985) is of the opinion that, the control of intestinal worms by sanitary means alone is a slow process requiring a base of health education and socio-economic development. He alternatively suggests that chemotherapeutic control can be added to support the sanitary measures. Pawlawski (1985) concludes that eradication of geohelminths is quite difficult to attain except in isolated communities such as on small islands and mountainous areas and as such, the primary

aim should be to control the disease rather than to eradicate it. Stephenson (1991) is of the same opinion as she stresses that deworming can do a great deal to decrease malnutrition and improve overall health development and the quality of life of the children. Latham (1991) believes that large scale deworming is a strategy whose time has come which does not only benefit individuals but is also a public health measure. If large numbers of people, particularly children, are regularly dewormed in a community, then there will be reduced contamination of the environment. Drug therapy is a good entry point for community health programmes since intestinal worms and especially the large ascarids are viewed by the society as unwelcome. The greatest effect of ascariasis and trichuriasis probably occurs in children under 6 years of age whereas hookworm morbidity peaks up in the school age group (Latham, 1991).

Latham (1991) further suggests that if integrated into community - based health care programmes, anthelmintics can effectively reach the at-risk pre-school population and, at the same time, greatly enhance community acceptance of primary health care programmes. Other control aspects include giving health education to people with the aim of improving their perceptions on

geohelminths and also to encourage them in the construction and proper use of latrines at household level.

4.3 Prevalence of Geohelminths in Tanzania

The epidemiology of human intestinal parasites has not yet been widely studied in most parts of the developing world, Tanzania included. Due to this fact, the World Health Organisation (WHO, 1981) has recommended that more epidemiological surveys be carried out at national scale in all member states. Epidemiological surveys are therefore indispensable in this respect. The Ministry of Health has noted that the commonest and most important intestinal helminths throughout Tanzania are hookworms, Ascaris, Trichuris, and tapeworms (Annual Report 1970 - 1971). However, these worms are not uniformly distributed throughout the country due to climatic differences. As for the species of hookworm prevalent in Tanzania, only few studies have been carried out so far because the species identification requires special investigations such as the Harada-Mori technique (Kihamia, 1992). Sturrock, (1964) carried out a number of studies in several localities of the then Tanganyika to determine the mode of hookworm infection among the general population. All age groups were included as follows: 0-5 years, 6 - 9 years, 10 -

19 years, 20 - 39 years and 40 years and above. The studies showed that Necator americanus was more widespread in the country than was the case with Ancylostoma duodenale while mixed infections were not uncommon (Table 1).

Table 1: Distribution pattern of hookworm species in various parts of Tanzania (All age groups included)

Locality	N. Americanus	A. Duodenale	Mixed Infenctions	Author	Year
Tanga	61.3%	6.5%	32.3%	Sturrock	1964
Mwanza	39.5%	19.5%	41.0%	Sturrock	1965
Dodoma	93.8%	2.1%	4.1%	Sturrock	1966
D'Salaam	99.1%	0.9%	-	Rouland	1966
Tanga	50 - 70%	5 - 15%	15 - 45%	Annual Report	1970/ 1971
D'Salaam	100.0%	-	-	Parasit. Dept.	1985

Going retrospectively during the colonial rule, intestinal worms were found to be prevalent in the then Tanganyika Territory. Scott (1944) in his annual report showed a prevalence rate of 23% for hookworm infection among the general population in the territory. Sneath (1945) made an effort to compare the

number of cases of ancylostomiasis so far reported since 1940 and found it to increase year after year. Later on Mackenzie (1947) noted a slight decrease in the infection rate but observed a continued fatality rate of 5.77%. Mackenzie (1947) further noted that the African section of Dar es Salaam residents was being infected with hookworms than was free of it judging from the number found to be infected, though without clinical manifestations. Sneath (1948) commented on the unfortunate situation that the majority of patients with ancylostomiasis reported to hospitals while already in an advanced stage with severe anaemia.

Sneath (1948) went further and attributed the burden of sickness resulting from hookworm to many allied factors cited to be conducive to the spread of the disease. Amongst these allied factors were the environmental hygiene and sanitation level of the territory which was still far from satisfactory. It was commented that intestinal helminths were linked to low living standards coupled with poor personal and environmental hygiene. It was suggested that in order to deal effectively with intestinal parasites, it was necessary to improve the living standards (Tanganyika Annual Medical Report, 1953). Infections with intestinal worms were believed to be widespread and Pan-

territorial in Tanganyika though with varying prevalence rate from one province to another. Hookworm infection was observed to be widely prevalent in the territory but was particularly common along the coastal belt (Tanganyika Medical Report, 1955).

It was further noted that the control of hookworm would continue to be difficult until when the standards of environmental hygiene were raised. Starting in the year 1950, a number of epidemiological surveys in selected areas of Tanganyika were conducted. Trant (1950) did a survey on the Ukara island in Lake Victoria where she examined 191 stool specimens out of which 37 (19.4%) were found with Ascaris lumbricoides, 29 (15%) with Trichuris trichiura, 25 (13.1%) with hookworm and 17 (8.9%) with Strongyloides stercoralis. Trant (1950) recommended preventive measures to be achieved through health education so as to promote people's perceptions on the disease. Trant (1950) attempted a more extensive survey on the island involving 790 people. Stool examination revealed that 99.4% of the study group showed one or other intestinal helminth infection. Not even a single latrine was sighted by the researcher on the island. In another study on the same island by the East African Medical Survey team, among 785 islanders examined, high prevalence rates of Ascaris lumbricoides in adults

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(57%) and in children aged 6-15 years (50%) were recorded. Trant (1954) conducted a detailed study in three selected areas of Maruku, Gera and Nyakato in Bukoba district and found soil-transmitted helminths to be widespread with prevalence rates of between 18-59%. Similar studies were done in Kwimba but showed a low prevalence of ascariasis and trichuriasis while hookworm parasitism was found to be quite high (45%). The low prevalence in Ascaris lumbricoides and Trichuris trichiura was attributed to the dry arid sandy area which is unfavourable for the egg survival of the two species (Tanganyika Annual Medical Report, 1954). A number of surveys were conducted on primary school children in the districts of Mwanza, Singida and on the Ukara island. The studies disclosed a very high prevalence of about 70% for hookworm (Tanganyika Annual Medical Report, 1956/57). Sturrock (1961/62) commented on the high prevalence of hookworm infection in many parts of East Africa. For instance, of 216 students he examined at Mwanza Town Secondary School, 52.3% were infected by hookworm. Out of those 113 infected 27.4% were passing more than 100 eggs per gram of faeces while only 5.3% were passing more than 500 eggs per gram of faeces. The rest were passing less than 100 eggs per gram of faeces (East African Institute for Medical Research Annual Report, 1961/62, P. 36).

However, Purnell (1967) in his survey on intestinal helminths in pupils in Mwanza town, graded the intensity of infections as follows (Table 2).

Table 2: Categorisation of intensity of infection due to several intestinal parasites in school children at Mwanza.

INFECTION	LIGHT	MODERATE	HEAVY
Hookworm	0 - 100 epg	101 - 500 epg	501+ epg
Trichuris	0 - 100 epg	101 - 1000 epg	1001+ epg
Ascaris	0 - 100 epg	101 - 1000 epg	1001+ epg

But Smillie and Augustine (1926) in their study on the effect of varying intensities of hookworm infection on the physical condition of school children categorized the intensity of infection as follows:-

1 - 25 epg for very light
26 - 100 epg for light
101 - 500 epg for moderate
501 - 1000 epg for heavy
1001 + epg for very heavy

Sturrock (1962/63) conducted studies among populations in Mwanza in trying to determine the hookworm species responsible for infection. Test-tube cultures from 158

infected people showed that 96 (61%) were infected with N. americanus species, 25 (16%) with A. duodenale species, while the remaining 37 (23%) had mixed infections. The overall incidence of the infection due to N. americanus was 84% while that due to A. duodenale was 39% (Tanganyika Annual Medical Report, 1962/63). McCullough (1974) acknowledges that very few epidemiological surveys on intestinal parasites have been undertaken in the East African region. He attributes this fact to three major reasons:

Firstly, that until fairly recently, satisfactory drugs for the radical treatment or for mass deworming of intestinal worms were unknown. Secondly, the attention of the already over-worked physicians was centered on problems either genuinely more demanding or decidedly more dramatic. Thirdly, up-to-date the distribution of intestinal helminths such as Ascaris lumbricoides is largely focal with a low prevalence in the vast areas of scanty rainfall (<750 mm per annum) which make up more than two-thirds of the entire land surface in East Africa. In areas of high rainfall with clay soil and more dense population, the likelihood of Ascaris lumbricoides infection being more prevalent is quite high.

McCullough (1974) further observed that unplanned urbanization accelerates the spread of intestinal parasites particularly the geohelminths. He cites Mwanza town as a vivid example for showing high prevalence rates for Ascaris lumbricoides due to widespread slum areas. Bell (1956), recording medical and social findings in a hospital in Meru, Kenya, found that the greatest number of patients with ascariasis were in the age group of 1-4 years with a definite preponderance towards female children.

Buckley (1946) working in the Bangwealu area of the then Northern Rhodesia (now Zambia) recorded a significantly higher incidence of ascariasis in females than in males. But in a sharp contrast with most other findings elsewhere, he noted a slightly higher infection rate in adults than in children. The difference in prevalence rates between adults and children could be less marked in circumstances where transmission is less intense or where there has been effective treatment of the infected children who play a major role in the contamination of soil with geohelminth ova (WHO, 1967). In his survey on the incidence of hookworm infection in East Africa, Miller (1969) also agreed with other workers that the most common species was N. americanus whereas only 15% of the 1773 samples contained A. duodenale against 70% in

incidence for N. americanus. Senkoro (1978), in his survey on the prevalence of intestinal parasites in South Pare, found the overall prevalence for hookworm infection at 16.4%, ascariasis (13%), trichuriasis (5.8%) and strongyloidiasis (0.6%). As the literature shows, there is enough evidence to support the idea that intestinal worms, particularly geohelminths are prevalent in Tanzania.

Hookworm infection is most prevalent along the coastal belt of Tanzania (Tanganyika Medical Report, 1955; Sturrock,, 1964, 1966; Vaughan, 1973) while ascariasis and trichuriasis are more prevalent in the hilly regions with high rainfall (Kihamia, 1992).

Despite all the survey activities undertaken since the pre-independence era up to date, no data on pre-school children in coastal Tanzania on prevalence and intensity of geohelminth infection have been documented. Since the problem of geohelminths is thought to be more serious in children, the investigator has found it necessary to look into the matter in children rather than adults. Very few studies in the country on geohelminths have concentrated on the worm burden element. This gap of information has also prompted the investigator to study the intensity of infection in the study population.

Other gaps of knowledge intended to be filled by this study include: Knowing the level of perceptions among adults as regards the mode of transmission and prevention of geohelminths. Lastly, a better information on the latrine coverage rate and the quality of latrines will be sought through this study.

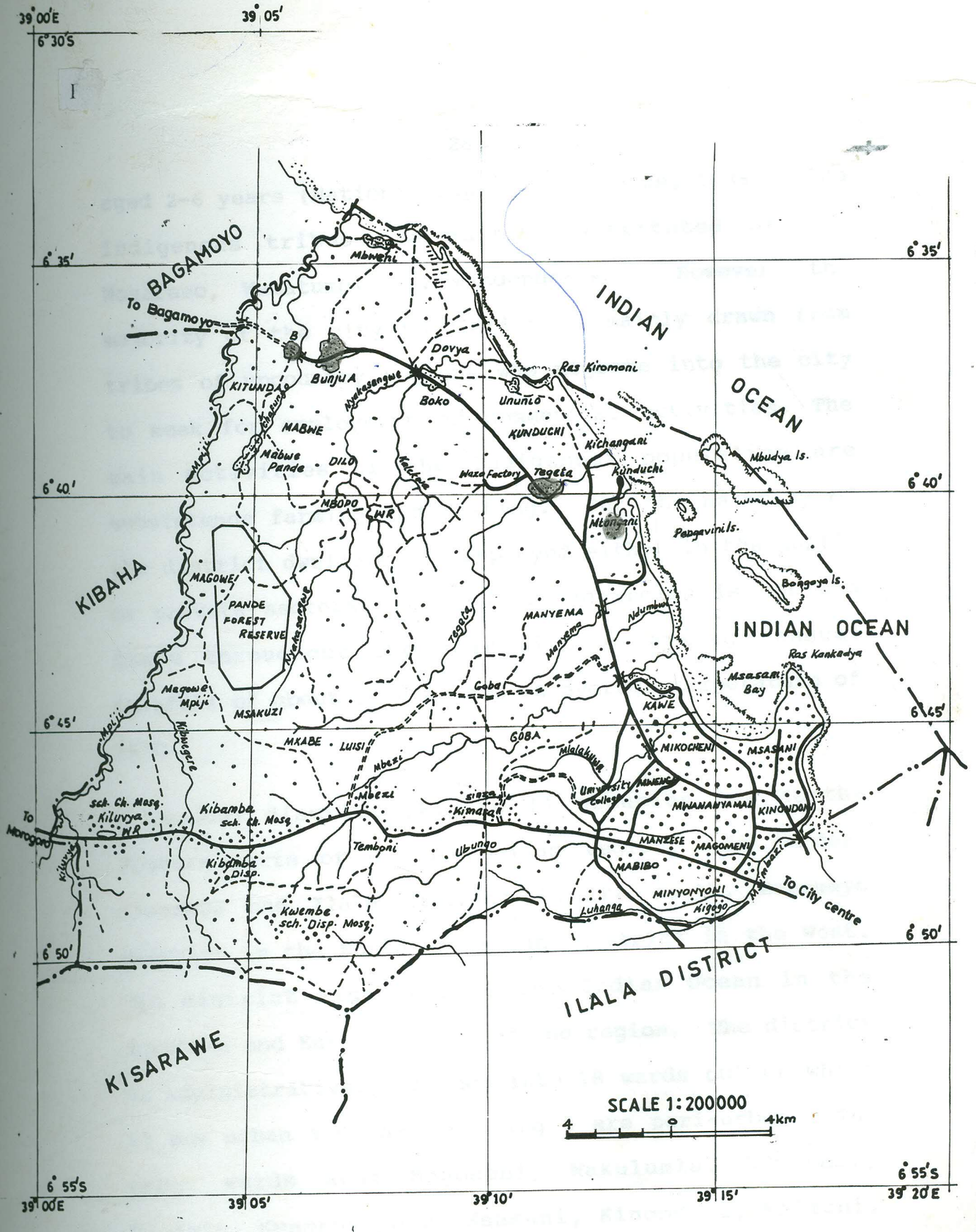
5. METHODOLOGY

5.1 Study Design

This was a cross-sectional study in which the prevalence and intensity of infection due to soil-transmitted helminths among pre-school children and their nutritional status were determined. Further, the study determined people's perception on geohelminths and also assessed latrine coverage in the visited households including their quality and usage in the prevention and control of geohelminths.

5.2 Description of the Study Area

Kinondoni district is one of the three districts constituting Dar es Salaam region (Figure 1). The other two districts are Ilala and Temeke. Dar es Salaam is the largest commercial centre in the country with an estimated population of 1.8 million people (National Population Census 1988). Kinondoni district has an estimated population of 621,389 people out of whom 83,346 are estimated to be pre-school children



KEY:

- Main Roads (bound surface)
- Reginal Boundaries
- District Boundaries
- Villages / Populated areas / Houses
- Roads (loose surface)
- Other tracks or Footpaths
- Rivers or Streams.
- Coast Line

aged 2-6 years (National Population Census, 1988). The indigenous tribes are mainly constituted of the Wazaramo, Wamatumbi and Wandengereko. However, the majority of the city population is mainly drawn from tribes of upcountry regions who migrate into the city to seek for employment or commercial activities. The main activities of the indigenous population are subsistence farming and fishing. But the majority of the district dwellers are employed either in the public or private sectors. Dar es Salaam region is hot and humid throughout the year with an average annual rainfall of about 1000 mm and an average temperature of 26^{o}C.

Kinondoni district (Figure 1) occupies the North-Western parts of Dar es Salaam region. It borders Kisarawe and Ilala district in the south, Bagamoyo district in the North and Kibaha district in the West. The district also borders the Indian Ocean in the Northern and Eastern parts of the region. The district is administratively divided into 18 wards out of which 13 are urban and the remaining 5 are peri-urban. The urban wards are: Magomeni, Makulumla, Ndugumbi, Tandale, Mwananyamala, Msasani, Kinondoni, Mzimuni, Kigogo, Mabibo, Manzese, Ubungo and Kawe. The peri-urban wards are Kibamba, Goba, Kunduchi, Mbweni and Bunju.

5.3 Selection of the Study Area

The study was conducted in selected areas of the peri-urban portion of the district which is constituted of five administrative wards namely Bunju, Goba, Kibamba, Kunduchi and Mbweni. Out of the five wards, two, namely Kibamba and Kunduchi were randomly selected for the study. The two selected wards had a total of seven villages out of which five were randomly selected for the study. The selected villages were Kibamba, Kiluvya, Kwembe and Mbezi in Kibamba ward and Mtongani village in Kunduchi ward.

5.4 Sample Size Determination

The minimum sample size of the pre-school children required for the study was determined using the statistical formula:

$$n = \frac{Z^2pq}{d^2}$$

Where:

n = The desired minimum sample size

Z = The standard normal deviation set at 1.96 which corresponds to the 5% significance level.

P = The proportion in the target population estimated to be infected with soil-transmitted helminths which in this case is estimated at 50% since the true prevalence in the district is not known.

q = 1-P

d = degree of accuracy desired to be set at the 0.05 or at 5%.

Thus computing:

$$n = \frac{(1.96)^2 \times 0.5 \times (1 - 0.5)}{(0.05)^2} = 383.92 = 384$$

Therefore the minimum sample size of the children required was 384. Five ten-cell leaders were randomly selected from each of the five selected villages for the study. This gave a total of 25 ten-cell leaders with a total of 339 households under their jurisdiction to be visited by the research team. The research team decided to visit all the 339 households in its house to house inspection tour so as to cover all the 25 ten-cell leaders selected for the study. The convenience sampling method was applied in achieving the minimum sample size of the respondents who participated in the interview. In this particular case, one adult household member who happened to be present at the time of the visit was included in the interview. Since 339 households were visited, the same number of adults were interviewed.

5.5 The Target Population

This included all children living in Kinondoni district.

5.6 The Study Population

This included all pre-school children aged 2-6 years present in the selected households for the study. As

a result, the minimum sample size of 384 was surpassed. Because of the mere fact that most children in Tanzania start schooling at the age of seven years, the term pre-school children in this study included all children aged not more than six years (or 83 months). There were a few children within this age range who had already started going to school and these were excluded from the study. The minimum age limit was two years as it is generally at this age that optimal conditions for acquiring intestinal worm infections particularly Ascaris and Trichuris are ripe.

5.7 Logistics and Procedures

For the study to be carried out successfully, certain formalities had to be accomplished. This included getting a research permit from the authority of the Institute of Public Health, Party and Government leaders both at district and ward levels.

5.7.1 Materials Required for the Study

This included drugs (Albendazole) and laboratory reagents whose technical details regarding their preparation is given under Appendix 12.7 .

5.7.2 Manpower

5.7.2.1 Field Work Personnel

This comprised of the researcher and two field assistants. The assistants were trained on how to administer the questionnaire and on how to take weights and heights of the children.

5.7.2.2 Laboratory personnel

One qualified Laboratory Technician was recruited for the laboratory procedures in addition to the researcher himself.

5.7.2.3 Data Collection

A formal letter to introduce the research team to the village governments was obtained from the ward secretary's office. All arrangements to get the required ten-cell leaders were done by the investigator under the help of the village governments. Each village government in the study area made available her list of the ten-cell leaders out of which five ten-cell leaders were randomly selected for the study. The selected ten-cell leaders were requested to inform all their respective heads of households about the researcher's visit and their respective dates of visits so that at least one senior household member could remain at home for the expected visit. House to house visits were made under the respective ten-cell leader's company.

Each household was visited by the whole research team. Interviews were conducted among adult members of the households. Only a single member from each household was interviewed. The questions that were asked summarized the people's perception on geohelminths such as source and route of infection and preventive measures. Information about excreta disposal of the people was also gathered including inspection of latrine facilities regarding availability and quality. Interviews were conducted privately while specimens were collected only in the morning before 9 o'clock. Properly labelled stool pots were given to the parents or guardians of the children soon after the interview and a full explanation on how and when to collect the stool specimens was given. The researcher recommended for the stool specimens to be collected only in the morning before 9 o'clock so that there was enough time to ship the specimen to the Institute of Public Health Laboratories for parasitological examination. After interviews in each household, the household latrine was inspected to find out not only if it was available or not but also to know if it sufficed for hygienic human excreta disposal. Registration of all children suitable for the study age-wise was done on specially designed forms (see Appendix 12.5).

After registration, the body weight and height of each child was taken and entered in the registration form (Appendix 12.5). Maternal and Child Health (MCH) cards, birth certificates or any other documents of relevance were referred to in the bid to know the exact age of the children. The body weight of each child aged 2-6 years was taken using a salter spring balance model 235 PBW with the scale measuring up to 25 kgs with increments of 100 grams. With this type of balance, the child hangs in a specially designed "bag".

The model is sturdy, compact, and easily transported, but need be callibrated at the start of each working session to be sure of its accuracy. For determination of the height of children, a wooden length-board measuring up to 130cm was used. The wooden length-board had an added advantage of being quite portable and easily applicable and allowed for the determination of the recumbent length (crown-heel length). Each child laid on the length-board which was itself placed on a flat surface. The head was positioned firmly against the fixed headboard, with the eyes looking vertically. The knees were extended, and the feet were flexed at right angles to the legs with the help of a sliding foot piece, a firm contact with the heels was established and the length read to the nearest 0.1cm.

5.8 **Assessment criteria used during household latrine inspection:**

1. "Good and clean" latrine is one which had:
   a) An intact floor preferably with a concrete slab.
   b) A latrine drop-hole not soiled with faeces round its edges and having a cover.
   c) A superstructure which provided adequate privacy.

2. "A satisfactory" latrine is one which had:
   a) An intact floor not necessarily concrete slab.
   b) A drop-hole with or without faeces around but with no cover.
   c) A superstructure which provided some privacy.

3. "A non-useful" latrine is one which had:
   a) A floor with cracks or holes.
   b) A drop-hole soiled with faeces around and without a cover.
   c) Pit full or almost full.
   d) No superstructure, or if present, provided no privacy at all.

5.9 **Assessment of Nutritional status**

All pre-school children included in the study had their anthropometric measurements taken for nutritional analysis. These included height (length), body weight

and mid-upper arm circumference (MUAC). Nutritional status was defined according to a combination of the classification of Gomez (1956) and Waterlow (1972). This procedure allowed maximum utilisation of anthropometric analysis and a more secure defination of the magnitude and degree of nutritional disorders. The nutritional status of the study population was determined and classified into normal, mildy malnourished, moderately malnourished and severely malnourished (According to Sawaya et al; (1990).

5.10 **Determination of any possible association between malnutrition and geohelminthiasis**

According to Sawaya et al; (1990) association was looked for between malnutrition and the presence of intestinal helminths as follows:

1. Identification of infected children with geohelminths.
2. Identification of a control group of non-infected children.
3. Identification of malnourished children.
4. Computation of the odds ratio (OR) for the subsequent development of malnutrition following infection with geohelminths

$$OR = \frac{a\ d}{b\ c}$$

Where:

a = Malnourished and infected

b = Malnourished and non-infected

c = Nutritionally normal and infected

d = Nutritionally normal and non-infected

5.11 The Questionnaire

Use of questionnaire was deemed more appropriate in assessing the level of awareness of the community members on geohelminths. A questionnaire form with 15 questions was developed in accordance with the researcher's own experience in relation to the problem as it exists in the general population. The questionnaire was developed in English but was also translated into a Swahili version. The interviews were conducted by the investigator himself using the Swahili version questionnaire.

5.12 Specimen Examination

Stool specimens were examined at the end of the week after completing the house-to house visits of some of the households under the responsibility of the selected ten-cell leaders in each village. The stool examination was done by the researcher himself in collaboration with a qualified Laboratory Technician. The stool specimens were stored in the Institute's laboratory refrigerator while the researcher employed

the "modified Kato thick smear technique" as described under Appendix 12.7. Specimens were considered negative for parasites after being examined both by the Laboratory Technician and the Principal Researcher himself. For specimen detected positive for parasites, egg counting was done using Kato-Katz technique to determine the intensity of infection.

5.13 Data processing

This was done by the researcher with the help of an experienced computer programmer. Data analysis was done by using the SPSS programme, in an IBM computer. The whole process involved entering information in relation to latrine inspection, stool examination, anthropometric measurements and the interview on adult respondents. Such information was intended to give detailed answers on latrine coverage at household level, prevalence and intensity of infection with geohelminths, nutritional status of the children and people's perception on geohelminths.

6. PROBLEMS ENCOUNTERED

The following are the major problems encountered during the course of the survey:

1. Transport

This was indeed a major problem as far as access to and from the research field was concerned. To

partly solve the problem, the researcher decided to stay within the research field by being provided with accommodation by the respective village governments. Stool specimens were being sent daily to the Institute of Public Health laboratories by one of the research assistants. This was being done by using public transport. The specimens were stored for parasitological examination at the end of the week when the investigator was back from the field. This prevailing situation undermined the possibility of examining the specimens on daily basis while still fresh since the investigator would not make it to and from the Institute daily to the field and yet be able to participate in the examination exercise of the specimens which was necessary.

2. <u>Research funds</u>

Due to constraints of funds, it was not possible to hire a vehicle to solve the transport problem. Again the same problem prevented the possibility of recruiting enough research assistants. Only a half of the estimated funds were made available for this study.

3. <u>Households location</u>

In most cases, the research team had to cover long distances as many households were quite far apart

in some areas. This apart from tiring the research team, caused delays in reaching such households.

4. Non-compliance

Some members of the selected households did not give heed to their ten-cell leaders' messages to remain at home in order to be met by the research team. This caused a lot of inconvenience to the research team which had to rearrange its schedule of work and therefore prolonged the period of stay in the study field. Fortunately, the response rate was in general satisfactory.

7. RESULTS

This study consisted of 508 pre-school children aged between 24 and 83 months who were examined for geohelminth infection and had their anthropometric measurements taken for analysis of their nutritional status. Also included were 339 adults who had their level of awareness on geohelminths tested through interviewing. Table 3 shows the distribution of the examined children by age, sex and villages of residence. Out of the 508 children 239 were boys while 269 were girls. Tables 4 - 8 show the overall prevalence rates for geohelminths in the surveyed villages. The overall prevalence rate for Ascaris lumbricoides was 4.9% with the highest age specific prevalence rate of 8% being observed in the three year olds (Table 4). A total of 25 children were infected with Ascaris lumbricoides and of these, 14 were boys while 11 were girls. The overall prevalence rate for Trichuris trichiura was 3% again with the highest age specific prevalence rate being observed in the three year age group. The total number of children infected with Trichuris trichiura was 15 and which comprised of 9 boys and 6 girls (Table 5). The overall prevalence rate for hookworm was found to be 14% with the highest age specific prevalence rate being recorded in the six year olds (Table 6). Out of those infected with hookworm, 34 were boys while 37 were girls (Table 6).

Strongyloides stercoralis was the least recorded geohelminth with a prevalence rate of 1% (Table 7). Out of the 508 children examined for geohelminths, 116 (22.8%) of them were found infected (Table 8) and the overall male to female ratio for infection was 1:1. The prevalence rates for Ascaris lumbricoides and Trichuris trichiura were highest at Mtongani village, being 15.3% for both parasites (Table 8). When considered at village level, Kwembe village had the highest prevalence for hookworm (27.6%) followed by Kibamba (16.8%) (Table 8). The intensity of infection was generally low with 48.6% of all the infected cases falling under the light category, 36.0% under the moderate or medium category and only 15.4% falling under the heavy category (Table 9). The highest egg count was 21240 eggs per gram of faeces (epg) while the lowest count was 24 epg with a mean epg count of 1076 epg. Latrine coverage rate was generally poor with 15% of the households without latrines (Table 10). The quality and hygienic standard of the available latrines (Table 11) was far from satisfaction as the majority of the latrines provided no adequate privacy and encouraged fly-breeding. All latrines considered as unfit for use by the research team were surprisingly still in use. The overall prevalence rate for malnutrition (Table 12) in the surveyed area was quite high (40.2%). However, the majority of those affected

(36.2%) had first degree (mild) malnutrition and only a minority (4%) had moderate to severe forms of malnutrition (Table 12). An effort was made to determine a possible relationship between malnutrition and geohelminthiasis through calculation of the odds ratio (OR) in relation to presence or absence of geohelminth infection using the formula:

$$OR = \frac{a\ d}{b\ c}$$ (Sawaya et al 1990).

According to Sawaya et al; (1990) the odds ratio (OR) was calculated after establishing the following parameters:

a) Number of children malnourished and infected = 88

b) Number of children malnourished but non-infected = 126

c) Number of children found nutritionally normal but infected = 28

d) Number of children found nutritionally normal and non-infected = 266

Thus computing:

$$OR = \frac{88 \times 266}{126 \times 28} = 6.63\ (4.03,\ 10.99)$$

$P < 0.001$

Since the odd ratio of 6.63 shows a highly significant association between geohelminthiasis and malnutrition, it is possible to conclude that geohelminthiasis is an important causative factor of malnutrition among pre-school children in Kinondoni district. In an effort to asess the level of perception on geohelminths among parents or guardians of the examined children (Table 13), 339 adults were interviewed. The results of the interview (Table 14 - 16) revealed that most of the participatns were not conversant on the subject.

Table 3: Distribution of the study population by villages surveyed, sex and age groups.

Age groups in months	Village Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	M	F	M	F	M	F	M	F	M	F	M	F
24 - 35	16	17	16	11	9	6	16	12	11	9	68	55
36 - 47	11	10	13	16	6	12	9	17	5	13	44	68
48 - 59	6	14	10	6	7	9	13	12	5	8	41	49
60 - 71	7	13	9	7	6	4	8	9	5	8	35	41
72 - 83	18	13	10	15	8	9	12	14	3	5	51	56
Total	58	67	58	55	36	40	58	64	29	43	239	269

Table 4: The prevalence rate for Ascaris lumbricoides by age groups and sex.

Age groups in months	Males			Females			Total		
	Total	positives		Total	positives				
	No	No.	%	No.	No	%	No.	positives	%
24 - 35	68	3	4.4	55	4	7.3	123	7	5.7
36 - 47	44	7	15.9	68	2	2.9	112	9	8.0
48 - 59	41	2	4.9	49	0	0.0	90	2	2.2
60 - 71	35	1	2.9	41	1	2.4	76	2	2.6
72 - 83	51	1	2.0	56	4	7.1	107	5	4.7
Total	239	14	5.9	269	11	4.1	508	25	4.9

The overall prevalence rate for Ascaris was found to be 4.9% whereas the highest age specific prevalence rate was 8% which was observed in the 3 year age group. There was no significant difference in prevalence rates between males and females ($P = 0.358$).

$P > 0.05$

Table 5: The prevalence rate for Trichuris trichiura by age groups and sex.

Age Groups in months	Males			Females			Total		
	Total	Positives		Total	Positives				
	No.	No.	%	No.	No.	%	No.	positi-ives	%
24 - 35	68	2	2.9	55	3	5.5	123	5	4.1
36 - 47	44	3	6.8	68	3	4.4	112	6	5.4
48 - 59	41	2	4.9	49	0	0.0	90	2	2.2
60 - 71	35	2	5.7	41	0	0.0	76	2	2.6
72 - 83	51	0	0.0	56	0	0.0	107	0	0.0
Total	239	9	3.8	269	6	2.2	508	15	3.0

The overall prevalence rate for Trichuris was found to be 3.0% while the highest age specific prevalence rate was observed in the 3 year age group. There was no significant difference in prevalence rates between males and females ($P = 0.308$).

$P > 0.05$

Table 6: The prevalence rate for hookworm by age groups and sex.

Age Groups in months	Males			Females			Total		
	Total	Positives		Total	Positives				
	No.	No.	%	No	No	%	No.	posit-ives	%
24 - 35	68	8	11.8	55	5	9.1	123	13	10.6
36 - 47	44	3	6.8	68	8	11.8	112	11	9.8
48 - 59	41	5	12.2	49	7	14.3	90	12	13.3
60 - 71	35	6	17.1	41	7	17.1	76	13	17.1
72 - 83	51	12	23.5	56	10	17.9	107	22	20.6
Total	239	34	14.2	269	37	13.8	508	71	14.0

The overall prevalence rate for hookworm was found to be 14.0% with the highest age specific prevalence rate being observed in the 6 year age group. There was no significant difference in prevalence rates between males and females ($P = 0.879$).

$P > 0.05$

Table 7: The prevalence rate for Strongyloides stercoralis by age groups and sex.

Age Groups in months	Males			Females			Total		
	Total	Positives		Total	Positives				
	No.	No.	%	No.	No.	%	No.	posit-ives	%
24 - 35	68	1	1.5	55	0	0.0	123	1	0.8
36 - 47	44	0	0.0	68	2	2.9	112	2	1.8
48 - 59	41	0	0.0	49	0	0.0	90	0	0.0
60 - 71	35	0	0.0	41	1	2.4	76	1	1.3
72 - 83	51	0	0.0	56	1	1.8	107	1	0.9
Total	239	1	0.4	269	4	1.5	508	5	1.0

The overall prevalence rate for Strongyloides was found to be 1.0% with the highest age specific prevalence rate being observed in the 3 year age group.

Table 8: The prevalence rates for *Ascaris*, *Trichuris*, Hookworm and *S. stercoralis* in each of the surveyed villages.

Villages surveyed and number of children in brackets.	Number and percentage of infected cases per worm in each village of survey.							
	Ascaris		Trichuris		Hookworm		S.stercoralis	
	No.	%	No.	%	No	%	No	%
Kibamba (n=125)	4	3.2	1	0.8	21	16.8	2	1.6
Kiluvya (n=113)	4	3.5	1	0.9	10	8.8	0	0.0
Kwembe (n=76)	1	1.3	0	0.0	21	27.6	1	1.3
Mbezi (n=122)	5	4.1	2	1.6	12	9.8	1	0.8
Mtongani (n=72)	11	15.3	11	15.3	7	9.7	1	1.4
Total (n=508)	25	4.9	15	3.0	71	14.0	5	1.0

Hookworm was by far the most prevalent geohelminth in the study area. The total number of infected children with geohelminths was 116.

Table 9: Distribution of the infected cases per parasite and intensity of infection expressed in eggs per gram of faeces (epg) according to Purnell (1967).

Infected cases with Ascaris

(A)

Light	Moderate	Heavy	Total
1 - 100 epg	101 - 1000epg	1001 + epg	cases
7	9	9	25

Infected cases with Trichuris

(B)

Light	Moderate	Heavy	Total
1 - 100 epg	101 - 1000 epg	1001 + epg	cases
8	5	2	15

Infected cases with Hookworm

(C)

Light	Moderate	Heavy	Total
1 - 100 epg	101 - 500 epg	501 + epg	cases
39	26	6	71

Table 10: Proportion of households without latrines in the surveyed villages.

Household Latrines	Villages Surveyed					Total
	Kibamba	Kiluvya	Kwembe	Mbezi	Mtongani	
Number of households visited	94	62	48	85	50	339
Without Latrines	18	6	2	7	18	51
% Without Latrines	19.1	9.7	4.2	8.2	36.0	15.0

The overall proportion of households without latrines was 15% with Mtongani village taking the lead on the table.

Table 11: Comparison of latrine categories in the surveyed area.

Categories on household Latrines	Villages Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	No	%	No	%	No.	%	No	%	No	%	No	%
Good and clean	6	7.9	4	7.1	1	2.2	8	10.3	11	34.4	30	10.4
Satisfactory	52	68.4	43	76.8	42	91.3	65	83.3	18	56.3	220	76.4
Unfit for Use	18	23.7	9	16.1	3	6.5	5	6.4	3	9.4	38	13.2
Total	76	100.0	56	100.0	46	100.0	78	100.0	32	100.0	288	100.0

The proportion of latrines of acceptable standard was quite low while the proportion of those considered "unfit for use" was quite high.

Table 12: Distribution of children by degree of malnutrition and age groups.

Age groups in Months and Number of children in brackets	Degree of Malnutrition and Number of cases				
	Normal	Mild Malnutrition	Moderate Malnutrition	Severe Malnutrition	Overall % of Malnutrition cases
24-35(n=123)	78	41	1	3	36.6
36-47(n=112)	65	45	2	0	42.0
48-59(n=90)	59	26	5	0	34.4
60-71(n=76)	44	29	3	0	42.1
72-83(n=107)	58	43	5	1	45.8
Total(n=508)	304	184	16	4	40.2

The overall prevalence for malnutrition in the surveyed area was 40.2%. The majority of those affected (90.2%) were in the mild category of malnutrition.

Table 13: Distribution of respondents by age groups, sex and villages of residence.

Age Groups in years	Villages Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	M	F	M	F	M	F	M	F	M	F	M	F
15 - 29	7	20	3	20	3	15	8	7	6	14	27	76
30 - 44	5	36	6	21	3	17	6	28	2	16	22	118
45+	4	22	2	10	2	8	0	36	1	11	9	87
Total	16	78	11	51	8	40	14	71	9	41	58	281

The majority of interviewees were females (82.9%) who were mostly in the age group 30 - 44 years. The majority of them (78.3%) were primary school leavers.

Table 14: Distribution of responses according to the perceptions of respondents on at least one disease preventable through proper use of latrines.

Perceptions on at least one disease	Villages Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	No.	%	No.	%	No	%	No	%	No	%	No.	%
Geohelminth Infections	14	14.9	8	12.9	10	20.8	12	14.1	7	14.0	51	15.0
Other Intestinal Worm Infections	17	18.1	18	29.0	17	35.4	22	25.9	13	26.0	87	25.7
Cholera	36	38.3	20	32.3	9	18.8	12	14.1	9	18.0	86	25.4
Enteric fever	0	0.0	0	0.0	0	0.0	5	5.9	0	0.0	5	1.5
Diarrhoeal Diseases	27	28.7	15	24.2	6	12.5	20	23.5	5	10.0	73	21.5
Don't Know	20	21.3	15	24.2	13	27.1	29	34.1	18	36.0	95	28.0
No. of Respond-ents per village	94		62		48		85		50		339	

The study revealed that 28% of the respondents did not know even a single disease preventable through hygienic disposal of human excreta.

NB: Other respondents gave more than one answer.

Table 15: Distribution of responses according to the perceptions of respondents on at least one mode of infection with geohelminths.

Perceptions on at least one mode of Infection	Villages Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	No	%	No.	%	No.	%	No	%	No.	%	No	%
Faecally Contamina-ted foods	14	14.9	10	16.1	15	31.3	38	44.7	19	38.0	96	28.3
Through skin Penetration	14	14.9	7	11.3	1	2.1	2	2.4	10	20.0	34	10.0
Unsafe Water	0	0.0	10	16.1	3	6.3	3	3.5	1	2.0	17	5.0
Don't know	79	84.0	43	69.4	36	75.0	51	60.0	28	56.0	237	70.0
No. Of Res-pondents per Village	94		62		48		85		50		339	

Over half of the respondents (70.0%) did not know even a single mode of infection with geohelminths.

NB: Other respondents gave more than one answer.

Table 16: Distribution of responses according to the perceptions of the respondents on at least one protective measure against infections with geohelminths.

Perceptions on at least one protective measure	Villages Surveyed										Total	
	Kibamba		Kiluvya		Kwembe		Mbezi		Mtongani			
	No	%	No.	%	No.	%	No	%	No.	%	No	%
Proper use of Latrines	15	16.0	6	9.7	5	10.4	5	5.9	9	18.0	40	11.8
Wearing shoes	7	7.4	2	3.2	2	4.2	8	9.4	4	8.0	23	6.8
Use of safe water	0	0.0	0	0.0	1	2.6	1	1.2	0	0.0	2	0.6
Avoiding Indiscriminate Defaecation	8	8.5	4	6.5	1	1.6	11	12.9	5	10.0	29	8.6
Upkeep of good food and Personal Hygiene	0	0.0	4	6.5	7	14.6	9	10.6	9	18.0	29	8.6
Regular Deworming	0	0.0	3	4.8	6	12.5	0	0.0	1	2.0	10	2.9
Periodic medical Check-up	9	9.6	7	11.3	8	16.7	7	8.2	2	4.0	33	9.7
Don't Know	78	83.0	46	74.2	33	68.8	57	67.1	26	52.0	240	70.8
No. of Respondents per village	94		62		48		85		50		339	

The level of awareness of respondents on the protective measures against geohelminths was quite low with 70.8% of the respondents being unaware.
NB: Other respondents gave more than one answer.

8. DISCUSSION

From the results, it is evident that geohelminthiasis is a public health problem among pre-school children in Kinondoni district since 116 (22.8%) out of 508 children examined were found infected. As can be deduced from the results (Tables 4-8), the overall prevalence rates for Ascaris lumbricoides (4.9%), Trichuris trichiura (3%), and Strongyloides stercoralis (1%) were generally low while that for hookworm (14%) was quite high. The investigator of this study is of the opinion that, the following factors could be responsible for the low prevalence rates recorded. Firstly, that most areas of the surveyed villages had access to tap water because of their proximity to the main supply line from Ruvu to the city centre. Safe, clean and adequate water supply plays an important role in raising both personal and public hygienic standards. This in turn helps to reduce the prevalence of geohelminths particularly Ascaris lumbricoides and Trichuris trichiura. Secondly the dry spell of climate during which this study was undertaken could also have negatively affected the results. This is in line with the opinion of Miller (1969) that, wet season has a direct relationship to a high prevalence in geohelminth infections. The same opinion was also supported by WHO (1967); McCullough (1974) who acknowledged that

rainfall accounts for the accentuation of transmission and therefore leads to an increase in prevalence both for ascariasis and trichuriasis. This is equally true of the hilly and mountainous areas of Tanzania with high rainfall (Kihamia, 1992). However, Kinondoni district consists of a lowland area with scarce to moderate rainfall. Thirdly, these results confirm previous results (Sturrock, 1964, 1966; Vaughan, 1973) that Ascaris lumbricoides, Trichuris trichiura and Strongyloides stercoralis are generally less prevalent along the coastal belt of Tanzania as compared to hookworm which is quite prevalent (Table 8). The development of the various species of geohelminths depends much on the physical texture of the soil (Augustine and Smillie, 1926). Ascaris lumbricoides and Trichuris trichiura do well in clay and other types of dense soil with suitable moisture, temperature, and shade (Beaver, 1961). Since Kinondoni district is largely devoid of clay soil, this may most likely affect negatively the prevalence rates for Ascaris lumbricoides and Trichuris trichiura. Conversely, with the soil texture in most areas of the district being sandy, it is most likely that hookworm would predominate over the other species of geohelminths. This study revealed no difference in prevalence rates between males and females. This finding contradicts that of Girges (1934) who observed that females are

more liable to geohelminth infection than males. The observation by Girges (1934) could probably not be experienced in this study due to the possible fact that, pre-school children have more or less a similar life-style whether they are males or females and hence would experience the same exposure rate to geohelminthiasis.

This study did not therefore find any significant difference in prevalence rates between males and females for Ascaris lumbricoides (P=0.358), Trichuris trichiura (P=0.308) and hookworm (P=0.879). The significance of the difference in prevalence by sex for strongyloidiasis could not be tested because of the small number of the infected cases. In further analysis of the infected cases two facts surfaced. Firstly, that most of the children detected with ascariasis and trichuriasis were in the age group of 2-4 years (Tables 4-5). This could be explained by the fact that most children in this age group can easily infect themselves with soiled fingers, objects or foodstuffs with embryonated eggs than is the case with older children. Secondly, that the majority of children detected with hookworm infection were in the older age group of 5-6 years. Children in this age group were more exposed to hookworm infection as most of them were able to cover reasonably long distances through various activities such as playing and in most

cases without shoes (personal observation). Taking the number of infected cases as a whole, the exposure rate in the two year old was lower (4.7%) than was the case in the 6 years olds (5.1%).

Probably, this may be explained by the fact that, the two year olds are in most of the time kept indoors or in their mothers' or attendants' laps.

This would in one way or another minimized their exposure to infection with geohelminths. Regarding the intensity of infection (Table 9), the majority of infections were of low intensity falling under the light and moderate categories of infection. Heavy infections were generally few with the highest egg count being 21240 eggs per gram of faeces. Mtongani village was the most heavily affected by Ascaris lumbricoides and Trichuris trichiura having a prevalence rate of 15.3% for both parasites (Table 8). The commonest type of double infection found was that of Ascaris/Trichuris which was mostly seen at Mtongani village. The population density at Mtongani village is quite high with 36% of the households without latrines (Table 10). There is also a lot of fishing activities going on at Mtongani village since it borders the Indian Ocean and yet not even a single latrine could be located within the vicinity of the shores. As a

result, indiscriminate defaecation is rampant along the ocean shores (personal observation and communication). This would definately favour transmission of geohelminths. On the other hand, Kwembe village was the most heavily affected by hookworm infection (Table 9) with a prevalence rate of 27.6% despite having the highest latrine coverage rate (Table 10) in the area. This contradiction can only be explained by the possibility that most probably, the available latrines are not properly utilised with indiscriminate defaecation still being widely practiced. The situation on household latrine coverage was quite appalling with a proportion of 15% of the households having no latrines.

Judging from the public health view point, a proportion of 15% without a hygienic means of excreta disposal in a community is high enough to lead to environmental pollution.

Further still, 13.2% of the available latrines were condemned by the research team as unfit for use and yet were still in operation. The quality of the latrines therefore left a lot to be desired. Almost half of the available latrines had shallow pits (of less than 2.5 metres) a situation which encouraged fly breeding especially when taken into consideration that 67.7% of

the latrines inspected had no roofs. The most common reason given for not roofing the latrines was that of encouraging ample ventilation and therefore reduce the possibility of emission of objectionable odours. Other reasons included constraints of funds to meet the roofing costs. The building material commonly used was palm leaves and gunny bags. Such material did not provide adequate privacy for the would be users of such latrines. Only 22.4% of the latrines were constructed using concrete bricks and only 10.4% of all the inspected latrines reached the required standard of a good and clean latrine. Most latrines were located well over 20 metres from the living houses. Ideally a distance of 10-20 metres would suffice (Winblad and Kilama, 1980) although Wagner and Lanoix (1958) recommended a distance of 6 metres.

A longer distance than 20 metres may mitigate against regular use, proper maintenance and cleanliness of the latrines. Concerning environmental sanitation care, this was not quite satisfactory in most of the inspected households. Faeces of toddlers was not immediately collected for hygienic disposal and was in certain instances permanently ignored.

This created favourable conditions for helminth ova to grow and become infective. The level of awareness of the general population on soil-transmitted helminths in

the surveyed area was quite low. More than a quarter of the interviewees could not even single out any disease preventable through hygienic disposal of human excreta (Table 14). The situation was even worse as it regarded perception on the mode of infection and preventive measures against geohelminths with 70% of the respondents being unaware (Table -16). The problem of malnutrition was alarmingly high in the area, reaching a proportion of 40.2% (Table 12). Out of the malnourished children, 4% had moderate to severe malnutrition while the remaining majority (36.2%) had mild malnutrition which is amenable to nutritional rehabilitation. The results show a highly significant assocaition between geohelminth infection and malnutrition. Although this cross-sectional study cannot prove causation, the strong association observed suggests that geohelminthiasis is possibly causal to malnutrition among pre-school children in Kinondoni district.

9. SUMMARY

The following is a summary of the major findings which came out of this study:

1. The prevalence rate for soil-transmitted helminths among pre-school children in Kinondoni district was 14% for hookworm, 4.9% for Ascaris

lumbricoides, 3% for Trichuris trichiura and 1% for Strongyloides stercoralis.

2. The exposure rate for geohelminth infection was highest among the 6 years olds. However, both males and females were equally exposed to the infection.

3. Latrine coverage among the 339 households studied was 288 (85%) households with latrines. Among the encountered latrines, 38 (13.2%) were condemned as unfit for use, 30 (10.4%) were good and clean, while 220 (76.4%) were satisfactory.

4. The intensity of infection with geohelminths was generally low with the majority of infections (84.6%) falling under the light to moderate category of worm burden. Only 15.4% of the infected cases fell under the heavy category of infections. The lowest number of eggs per gram of faeces (epg) was 24 while the highest number was 21240 with a mean count of 1076 epg.

5. Mtongani village had the lowest latrine coverage rate (64%) and was the most affected area by Ascaris lumbricoides (15.3%) and Trichuris trichiura (15.3%) with the majority of those infected showing double infections (Ascaris/Trichuris).

6. The level of awareness among the general population on geohelminths was generally low with 28% of the respondents being unaware of the existence of geohelminth infection. Only about 30% of the respondents knew of the mode of transmission and preventive measures regarding geohelminths.

7. Malnutrition was found to be quite prevalent with 40.2% of the examined children being malnourished.

   Out of those malnourished, 4(0.8%) had severe (third degree) malnutrition, 16(3.2%) had moderate (second degree) malnutrition, while 184 (36.2%) had mild (first degree) malnutrition.

10. CONCLUSION AND RECOMMENDATIONS

This study has revealed that the problem of geohelminthiasis among pre-school children in Kinondoni district is substantial while malnutrition is rampant. Hookworm proved to be the most prevalent geohelminth among pre-school children in the district. The abscence of an adequate number of hygienic sanitary facilities at household level would facilitate transmission of geohelminth infections and therefore increase the exposure risk to the infection.

The low level of perception on geohelminths among the general population in the district also would facilitate transmission of geohelminths. Lastly, this study has revealed that there is a direct relationship between geohelmintiasis and malnutrition among pre-school children in Kinondoni district.

RECOMMENDATIONS

For the control of geohelminth infection to be possible, the following pre-requisites need to be fulfilled:

1. There is a strong need for carrying out more baseline epidemiological surveys on the sanitation status as well as on geohelminths in the district. This would definately give more reliable data on the whole problem and therefore caution the

concerned authorities to take appropriate measures.

2. Emphasis should be made in improving people's perception on geohelminths and to educate them on the importance of latrines and their proper use in order to discourage indiscriminate defaecation. This can be attained through training of local health workers who would disseminate health education in their respective areas.

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