

"
PREVALENCE STUDY OF INTESTINAL PARASITES
AMONG PATIENTS ATTENDING HEALTH CENTRES IN
NAIROBI "

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT FOR THE
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1997

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DEDICATION

To all those who supported me during my studies.

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ABSTRACT

The prevalence study of intestinal parasites presented here involved 592 out-patients of whom 310 (52.4%) were males and 282 (47.6%) were females, at three City Council health centres in Nairobi. The age ranged 1 year to 71 years, with a mean of 24.8 years. Fresh stool samples were collected in pre-labelled plastic containers from the study population and examined for intestinal parasites using three methods: direct smear in normal saline, formol-ether concentration and modified Zeihl-Neelsen staining technique for detecting *Cryptosporidium* sp. A standard questionnaire was administered to each patient to obtain information on their ethnic background, age, sex, duration of stay in Nairobi, water source, toilet facilities and level of education.

The overall parasitic infection rate was 56% (332/592) in which 57.2% (190/332) of the infected participants had multiple infections. Of the 332 patients infected with parasites, 238 (71.7%) harboured protozoa only, 41 (12.3%) had helminths only and 53 (16%) were infected with both protozoa and helminths. The most common protozoal infections were: *Entamoeba coli* 165 (27.9%), *Endolimax nana* 111(18.7%), *Entamoeba histolytica*

93(15.7%) and *Blastocystis hominis* 63 (10.6%). Helminthic infections were much less prevalent than protozoa. The most prevalent helminths were: hookworm sp 43(7.3%), *Ascaris lumbricoides* 27(4.5%) and *Trichuris trichiura* 21(3.5%). The most infected age groups were 21 - 25 and 26 - 30 years old. Drinking of unboiled water was strongly associated with both protozoal ($\chi^2 = 10.8$; $P < 0.001$) and helminthic infections ($\chi^2 = 16.3$; $P < 0.001$)

The high parasitic infection rate and the frequency of multiple infections may suggest an interrelationship of environmental, hygienic and socio-economic factors which support transmission rather than single factor. The results of this study emphasises the need to carry out a prevalence studies on intestinal parasites from time to time to enable health planners to improve sanitary condition of the community.

1.0 INTRODUCTION AND LITERATURE REVIEW

Intestinal parasitic infections are distributed almost everywhere in the world, with high prevalences in areas where water supplies and the environment become faecally contaminated. In endemic areas, children are more frequently infected with intestinal parasites than adults and in particular children who are malnourished. Amoebiasis, ascariasis, hookworm infection and trichuriasis are among the ten most common infections in the world (WHO, 1987).

The endemic state of infection with pathogenic and non-pathogenic intestinal parasites among populations, particularly those of low socio-economic status, has been linked to the route of their dissemination, lack of intermediate hosts (except for intestinal flukes) and the short period they require to become infective. Since the portal entry for intestinal parasites is mainly the oral cavity, the organisms have to pass through the environment from the faeces of an infected person, reach the infective stage and back to a susceptible person (WHO, 1987).

Faecal-oral transmission occurs mostly through faecal contamination of food, water and hands. Infection with intestinal protozoa is acquired by accidental swallowing of viable cysts (except *Trichomonas hominis*) and it is suggested that the infective

dose may be very low (Rendtorff and Halt., 1954). Transmission via contaminated brackish and tap water in the case of *Giardia lamblia* (Jephcott *et al.*, 1986; Moore *et al.*, 1993., Kent *et al.*, 1988)) and person-to-person transmission, particularly in overcrowded places, mental hospitals and nursery schools have been reported (Black *et al.*, 1977; Keystone *et al.*, 1978; Pickering *et al.*, 1981; Omar, M.S.,1991). Most species of intestinal nematodes are soil transmitted. A person becomes infected by ingesting infective eggs (*Ascaris lumbricoides*, *Trichuris trichiura* and *Enterobius vermicularis*) or by infective larvae penetrating the skin i.e: hookworm and *Strongyloides stercoralis*.(Marsden, 1978; Ilardi *et al.*, 1987). Other helminthic infections i.e. intestinal trematodes, are transmitted through intermediate hosts.

Diseases related to water and sanitation are the major causes of high morbidity and mortality in developing countries, especially in infants and children under five years. Water can be polluted directly by faeces, or faecal material may be washed in from polluted soil at the sides of the river bank or unprotected wells (Adungo *et al.*, 1991). The lack of enough clean water supplies and inadequate waste disposal in developing countries often lead to high levels of water borne infections. Patel (1980) reported that the most important environmental factor which greatly contributed

to infant morbidity and mortality in Sri Lanka was the type of water supply. This cannot, therefore, be neglected and deserves great attention. In Saudi Arabia, Omar *et al.*, (1995) reported that there is a high risk of contracting *E. histolytica* and *G. lamblia* infections in those who drink jar water and well water compared to those who drink desalinated water.

In Kenya, a number of prevalence surveys of intestinal parasites have been undertaken but majority of these surveys have emphasised helminthic infections rather than protozoa as reviewed by Chunge *et al.*, (1985). Furthermore, the few studies done on intestinal protozoa have mostly been conducted outside Nairobi (Chunge *et al.*, 1991; Iseki *et al.*, 1983; Kamunvi & Situbi 1983; Odhiambo *et al.*, 1980). In their studies, Chunge and co-workers observed that in an area of Kiambu District of Kenya, that out of the 1129 individuals examined, 81.4% were positive for at least one intestinal parasite. *E. coli*, *E. nana* and *G. lamblia* were the most prevalent protozoan infections encountered. Of the helminths, *A. lumbricoides* (13.3%) and *Hymenolepis nana*(4.7%) were the most common. Kamunvi & Situbi (1983) reported that 242 patients out of 906 who attended six rural health units in South Nyanza had *E. histolytica* giving an infection rate of 26.7%. Other protozoan infections found included *E.coli* (31.6%), *I. butschlii* (9.1%), *E.*

nana (2.0%) and *G. lamblia* (1.0%). Intestinal helminths had remarkably high rates of infections with *Ancylostoma duodenale* (11.25%), *A. lumbricoides* (11%) and *Taenia* spp (10.3%) being most common. Iseki *et al* (1983) studied the prevalence of intestinal protozoa in various parts of Kenya and found *E. histolytica* (31.8%) as the most frequent pathogenic protozoa in these areas. *G. lamblia* was found to be far less prevalent than *E. histolytica* at an average prevalence of 8.3% .

Although studies done in Nairobi are few, Wijers (1972) reported that 64.8% of school children in Bahati area of Nairobi city harboured intestinal helminths with *A. lumbricoides* notably the most common parasite (46%). Of the protozoa *E. coli* (39.0%), *E. nana* (43.8%) and *E. histolytica* (15.7%) were most prevalent.

Duncan (1978) reviewed records of some intestinal disease agents at Kenyatta hospital laboratories (Nairobi) from 1972 - 1976 and found that intestinal parasitism constituted 33.4% of the total prevalence. He suggested that pathogenic *E. histolytica* was the most important protozoal infection at the time. Ritho (1982) compared the prevalence of intestinal parasites among children from high cost and low cost nursery schools in Nairobi and found the prevalence rate of *E. histolytica* to be 1.2% , while *E. coli* and

G. lamblia were 14.8% and 8.0% respectively. Helminth infections particularly *A.lumbricoides* and *T.trichiura* were found to be higher in low cost pre-primary schools than in the high cost schools and had prevalence rates of 28% and 15% respectively. A follow-up survey conducted by Wamanda (1986) in non fee-paying and fee-paying primary schools in Nairobi showed prevalence rates of intestinal protozoa to be significantly lower than those reported by Ritho (1982). Both investigators found prevalence rates of intestinal parasites similar to those of Rijptra (1975).

Although *Cryptosporidium* sp has been known as a zoonotic parasite since the beginning of this century, it was first described in humans in 1976 (Meisel *et al.*, 1976; Nime *et al.*, 1976). Numerous recent studies have since shown that human cryptosporidiosis is world-wide in distribution, and often causes profuse and watery diarrhoea in both immuno-compromised and immuno-competent patients (Current, W.L., 1983; Andy, W.K. & Aikins-Bekoe,1986 and Wolfson, J.S., 1985). In addition to diarrhoea, other clinical features of cryptosporidiosis include: nausea and vomiting, abdominal cramps and fever. Although the organism is generally restricted to the small intestine, the stomach and colon may be involved as well as the gall bladder and pancreatic duct. Severe fluid loss and continued vomiting can lead to a fatal outcome in

malnourished children and immuno-deficient patients. However, this opportunistic parasite is not looked for in the majority of routine laboratory services offered in Kenya despite reports indicating it is an endemic infection in children with diarrhoea (Simwa *et al.*,1989; Estambale *et al.*,1989).

From the above, it is evident that intestinal parasites pose a major problem in communities which have high infection rates. Prevalence studies of intestinal parasites in Nairobi are relatively few and almost all of them were conducted a decade ago (Wijers, *et al.*, 1972; Ritho, 1982; Wamanda, 1986). Continued population migration to the city in search of full or part time employment and constant travel of Nairobi residents to the rural areas where re-infection is almost certain, call for conducting a prevalence surveys from time to time to assess the burden of parasitic infections on the community.

It was against this background that this study focused on the out patients attending three randomly selected government health centres in Nairobi.

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1.1. OBJECTIVES

1.1.1 The broad objective was:

To determine the overall prevalence of parasitic infections among patients attending health centres in Nairobi.

1.1.2. The specific objectives were:

- a) To determine the prevalence of infection among the study population.
- b) To determine the associations between prevalence of infection and age, sex, ethnicity, water supply, duration of stay in Nairobi and socio-economic status.
- c) To compare the results of this survey with previous prevalence studies conducted in Nairobi.

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2.0 MATERIALS AND METHODS

2.1 STUDY AREA.

This survey was conducted in the city of Nairobi between April and September 1995. Of the 15 government health centres in Nairobi, three were randomly selected* (Figure 1). The health centres included in the survey were:

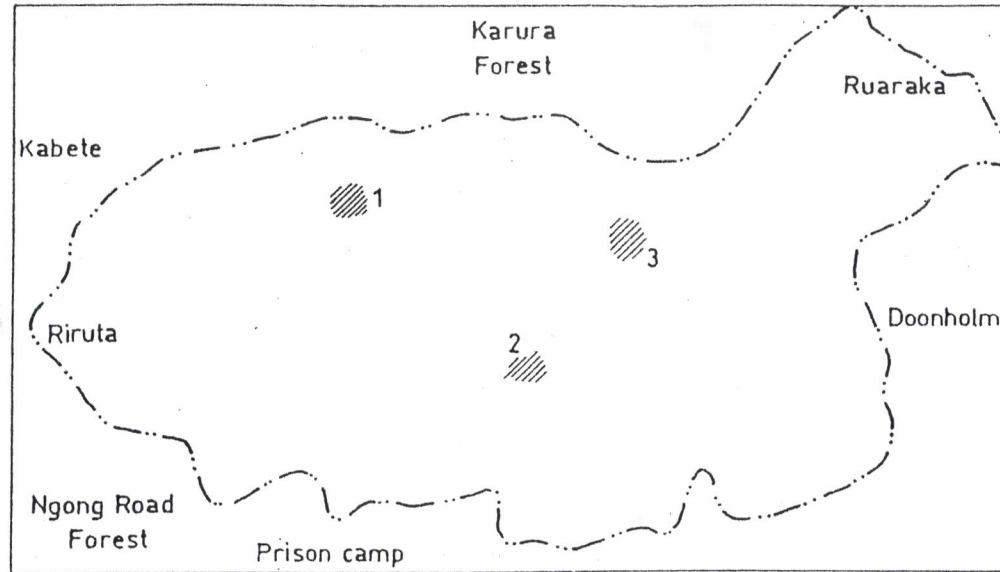
1. Westlands Health Centre which is about three kilometres from the city centre.
2. Rhodes Health Centre situated in the city centre.
3. Ngara health centre, about two kilometres north of the city centre.

These health centres are under the Nairobi City Council.

Permission to carry out this study was obtained from the Nairobi City Council Medical Officer of Health (MOH). The officers in charge of each health centre were contacted and the purpose of the study was explained to them prior to the start of the survey.

* Random numbers Table XXXIII of Fisher and Yates (1963) was used to select the health centres.

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1. Westlands health centre 2. Rhodes health centre 3. Ngara health centre

Fig.1. Map of Nairobi city showing the locations of the selected health centres.

Arrangements for visits were then made with the respective health officers and dates were set for stool collection as follows:

1. Mondays from Ngara Health Centre.
2. Tuesdays and Thursdays from Westlands Health Centre.
3. Wednesdays from Rhodes Health Centre.

Since Westlands Health Centre is located in an area of people with a high socio-economic status, users of this facility were coming from as far as Kangemi (a village which is about ten kilometres west of the city centre) and its surrounding areas. The number of patients coming to this health centre was less than those using the other two health centres. Because of this, another day was set aside to visit Westlands Health Centre to obtain the required sample.

2.2 COLLECTION OF FAECAL SAMPLES.

Since participants who were included in the study were exclusively out-patients attending the selected health centres, it was necessary to explain the nature of the study to those recruited every morning at the respective health centres. Of the three health centres, only Rhodes had laboratory services and patients were being charged for the services rendered. The fact that this study was offering free

service and laboratory reports were available on the same day, encouraged the subjects to participate in the study.

After getting their informed consent verbally, pre-labelled stool containers were then distributed systematically* to the volunteering patients. For each subject recruited, a standard questionnaire was administered to obtain information on their age, sex, housing, type of water supply, toilet facilities, occupation, level of education, duration of stay in Nairobi etc (Appendix I). The specimens obtained were sealed carefully, put in a special flask to keep the temperature of the samples fairly constant and transported to the department of Medical Microbiology, University of Nairobi for immediate examination. Here the specimens were categorised into three groups according to their consistency. These consisted of:

- i) Formed: stools from which the water content had been reabsorbed.
- ii) Semiformed or unformed: soft faeces with no specific shape.
- iii) Fluid or watery: The colour and presence of any flakes of mucus and blood was noted.

* Patients were seated on a bench and selected every second patient on the line.

2.3 EXAMINATION OF SPECIMENS.

2.3.1 Direct Smear Method

This method was used to examine semi-formed / unformed and the watery samples. Approximately 2 mg of fresh faeces was placed on a glass slide using the tip of a wooden applicator and then emulsified in a drop of warm physiological saline. The preparation was covered with a 22 mm cover-slip and examined under a light microscope. The total area of the cover-slip was scanned from side to side using x10 objective initially, and the x40 objective as required. Lugol's iodine solution was applied to aid in identifying protozoan cysts. To avoid self infection, used slides were discarded into a sink containing disinfectant (Lysol).

2.3.2 Formol-ether concentration method.

All the three categories of the stool specimens were examined by formol-ether concentration technique (Allen & Ridley, 1970) in order to increase the possibility of finding ova, cysts and larvae in the samples in which they may have been too scanty to be seen by direct microscopy. Cysts seen were measured using an ocular micrometer to reduce misdiagnosis of some species particularly *E. histolytica* (10-15um) and *E. hartmanni*; (<10um) cysts which are very similar except for their size.

The concentration technique involved the following steps:

1. Approximately 1 g of faeces was emulsified in 7ml of 10 percent formol water in a mortar.
2. The suspension was strained through a nylon tea strainer and collected in a beaker.
3. The suspension was then transferred to a conical tube, added 3ml of ether and mixed well by hand shaking for about one minute.
4. The formalin/ether suspension was transferred into a clean centrifuge tube and centrifugated at 3000 rpm for 1 minute.
5. Ether, faecal debris, and formalin were discarded by loosening the fatty plug and debris at the top of the tube.
6. The deposit was then shaken and one drop transferred onto a glass microscope slide, covered with a cover-slip and then scanned using x10 objective and x40 if required.

2.3.3 Modified Ziehl-Neelsen technique

In this method, two slides of thin fresh faecal smears were prepared from each specimen, air dried and stained using the technique and examined for *Cryptosporidium* oocysts as follows:-

1. Air-dried faecal smears were fixed in 70% methyl alcohol for three minutes.
2. The samples were then stained with carbol fuchsin for about 15 minutes.
3. This was followed by decolorization with 3% hydrochloric acid (HCl) in 95% ethanol until no more colour flowed from the smear.
4. The slides were then counter stained with 0.4% malachite green for 30 seconds after which the stain was washed with clean water.
5. The back of the slides were wiped clean and blotted to dry and the specimen examined under a light microscope.

2.4 DATA ANALYSIS.

The information collected in the questionnaires was coded. Ten age groups were created from the wide range of ages obtained from the study patients and then entered into a personal computer. The data analysis was done using Epi-info version 6.02 (Dean, A.D *et al.*, 1994). In order to examine the extent to which the different variables and parasitic infections were associated, the Chi-squared statistic was used and 2x2 contingency tables were constructed for each pair of infections. Because of the small sample size, it was found necessary to use the quick formula with the continuity correction as shown below(Kirkwood, B.R.,1988).

$$X^2 = \frac{n(|ad-bc|-n/2)^2}{efgh}, \quad \text{d.f.}=1$$

3.0 RESULTS

A total of 592 out-patients from three health centres in Nairobi supplied stool specimens for examination. Out of these 212 (35.8%) were from Westlands Health Centre, 223 (37.7%) from Rhodes Health Centre and 157 (26.5%) were from Ngara Health Centre. The age of the study population ranged from 1 to 71 years old.

Out of the total 592 patients examined, 332 (56%) were infected with one or more intestinal parasites. The remaining 260 (44%) of the study subjects were free from intestinal parasitic infections (see Table 1).

Table 1: Overall prevalence of intestinal parasites in the three health centres.

Name of health centre	No of people examined	Positive for parasites	Negative for parasites
Westlands	212	105 (49.5%)	107 (50.5%)
Rhodes	223	144 (64.5%)	79 (35.5%)
Ngara	157	83 (52.8%)	74 (47.2%)
TOTAL	592	332 (56.0%)	260 (44.0%)

A total of 16 different species of both protozoa and helminths were detected during the study. Of the protozoa, *E. coli* was seen in 165 of all attending patients (27.9%), *E. histolytica* in 93 (15.7%), of which five had trophozoites, *E. nana* in 111 (18.7%), *B. hominis* in 63 (10.6%), *I. butschlii* in 38 (6.4%) and *G. lamblia* in 25 (4.2%). Of the helminths, hookworm was found in 43 (7.3%), *lumbricoides* in 27 (4.5%) and *Trichiura trichuris* in 21 (3.5%). The remaining parasites are listed in Tables 2a and 2b respectively.

Table 2a: Frequency of intestinal protozoal parasites detected.

Potentially pathogenic	Positive specimen	Non-pathogenic	Positive specimen
<i>E. histolytica</i>	93 (15.7%)	<i>E. coli</i>	165 (27.9%)
<i>G. lamblia</i>	25 (4.2%)	<i>E. nana</i>	111(18.7%)
<i>Cryptosporidium</i> sp	2 (0.3%)	<i>B. hominis</i> *	63 (10.6%)
		<i>I. Butschlii</i>	38 (6.4%)
		<i>C. mesnili</i>	21 (3.5%)
		<i>T. hominis</i> *	6 (1.0%)
Total		291	(49.1%)

* *B. hominis* (Nimri & Batchoun, 1994) and *T. hominis* (Chunge, C.N. et al., 1988) have been implicated in pathogenicity.

Table 2b: Frequency of intestinal helminthic parasites detected.

Species	Positive specimen	%
Hookworm	43	7.3
<i>A. lumbricoides</i>	27	4.5
<i>T. trichiura</i>	21	3.5
<i>Schistosoma mansoni</i> *	15	2.5
<i>Hymenolepis nana</i>	4	0.6
<i>Taenia</i> sp.	1	0.1
<i>Strongyloides stercoralis</i>	1	0.1
Total	94	15.8

*The eggs of *S. mansoni* are diagnosed through the faeces. The adult stage of this parasite resides mainly in the inferior mesenteric venous system.

Fifty seven percent (57.2%) of the infected patients had multiple intestinal parasitic infections (190/332). Figure 2 shows the rate of multiple infections in the study subjects by number of species. Among 332 infected patients; 142(42.8%) were infected with one parasite, 108(32.5%) with two parasites, 59(17.7%) with three and 23(7%) harboured four or more kinds of parasites.

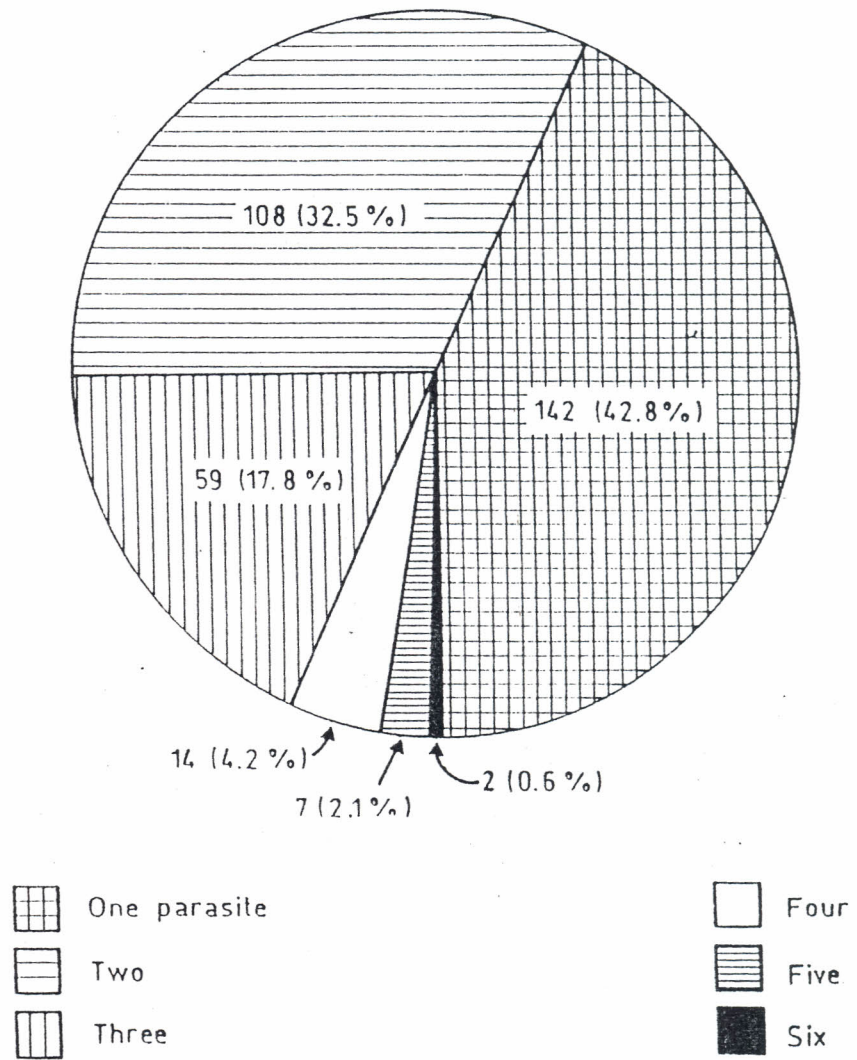


Fig 2: Frequency distribution of multiple infections in the study subjects.

Table 3. indicates the relationship between individual parasites and host age. Not shown are *H.nana* (four cases) and *Taenia* sp, *S.stercoralis* and *Cryptosporidium* sp (one case each). *E. coli* and *E. histolytica* were found to be most prevalent in the 21 - 25 year age group with percentage prevalences of (35.9%) and (17.4%) respectively. *G. lamblia* was observed to be most prevalent among the 1 - 5 year age group (15.9%) compared to 3.3% in the 21 - 25 age group $\chi^2 = 6.46$; $P < 0.01$. Hookworm infection was found to be commonest among the 21 - 25 year age group (21.7%) , while its lowest rate was recorded among 1 - 5 years (1.4%) age group. The difference between the two was highly significant $\chi^2 = 12.57$; $P < 0.001$.

Table 3: Prevalence of individual parasites among age groups.

Agegroup	No. Exam	<i>E.histolytica</i>	<i>E.coli</i>	<i>E.nana</i>	<i>I.butshlii</i>	<i>B.hominis</i>	<i>G.lambliia</i>	<i>T.hominis</i>	<i>C.mesnili</i>	<i>Ascaris</i>	H/worm	<i>Smasoni</i>	<i>T.trichiura</i>
1-5	69	4 (5.8%)	14 (20.2%)	2 (2.9%)	1 (1.4%)	5 (7.2%)	11 (15.9%)	0	2 (2.9%)	3 (4.3%)	1 (1.4%)	0	1 (1.4%)
6-10	63	11 (17.5%)	15 (23.8%)	11 (17.5%)	4 (6.3%)	3 (4.8%)	7 (11.1%)	0	1 (1.6%)	5 (7.9%)	3 (4.8%)	0	1 (1.6%)
11-15	31	3 (9.7%)	9 (29.0%)	7 (22.6%)	1 (3.2%)	5 (16.1%)	1 (3.2%)	0	0	3 (9.7%)	2 (6.5%)	0	3 (9.7%)
16-20	44	7 (15.9%)	10 (22.7%)	7 (15.9%)	7 (15.9%)	6 (13.6%)	0	1 (2.3%)	0	5 (11.4%)	3 (6.8%)	4 (9.1%)	2 (4.5%)
21-25	92	16 (17.4%)	33 (35.9%)	21 (22.8%)	10 (10.9%)	8 (8.7%)	3 (3.3%)	0	7 (7.6%)	1 (1.1%)	20 (21.7%)	4 (4.3%)	4 (4.3%)
26-30	110	19 (17.3%)	39 (35.5%)	26 (23.6%)	5 (4.5%)	11 (10.0%)	0	2 (1.8%)	5 (4.5%)	4 (3.6%)	5 (4.5%)	6 (5.5%)	4 (3.6%)
31-35	70	12 (17.1%)	15 (21.4%)	11 (15.7%)	3 (4.3%)	9 (11.9%)	1 (1.4%)	1 (1.4%)	3 (4.3%)	2 (2.9%)	3 (4.3%)	1 (1.4%)	2 (2.9%)
36-40	39	7 (17.9%)	11 (28.2%)	8 (25.5%)	2 (5.1%)	5 (12.8%)	0	0	0	3 (7.7%)	3 (7.7%)	0	1 (2.6%)
41-45	33	7 (21.2%)	10 (30.3%)	9 (27.3%)	3 (9.0%)	3 (9.0%)	2 (6.0%)	1 (3.0%)	0	0	1 (3.0%)	0	2 (6.0%)
>46	41	7 (17.0%)	9 (22.0%)	9 (22.0%)	3 (7.3%)	8 (19.5%)	0	1 (2.4%)	3 (7.3%)	1 (2.4%)	2 (4.9%)	0	1 (2.4%)
Total	592	92	165	111	39	63	25	6	21	27	43	15	21

Table 4. shows the prevalence of protozoa and helminths in males and females. A higher proportion of female patients were infected with both protozoa and helminths (12.4%) than males (5.8%). The difference was statistically significant. $\chi^2 = 7.11$; $P < 0.01$. However, there was no statistically significant difference between the sexes with regard to individual prevalence of protozoa and helminths $P > 0.05$.

Table 4: Prevalence of protozoa and helminthic infections in relation to gender.

Sex	Negative for parasites	Positive for protozoa	Positive for helminths	Positive for both	Total
Males	143 (46.1%)	125 (40.3%)	24 (7.7%)	18 (5.8%)	310
Females	117 (41.5%)	113 (40.1%)	17 (6.0%)	35 (12.4%)	282
Total	260	238	41	53	592

The prevalence of individual parasites by the sex of the participant is shown in Figure 3. Hookworm was significantly more prevalent in females (10.3%) than in males (4.5%) $\chi^2 = 6.46$; $P < 0.01$. The prevalence of other parasites was not found to differ significantly between the two sexes.

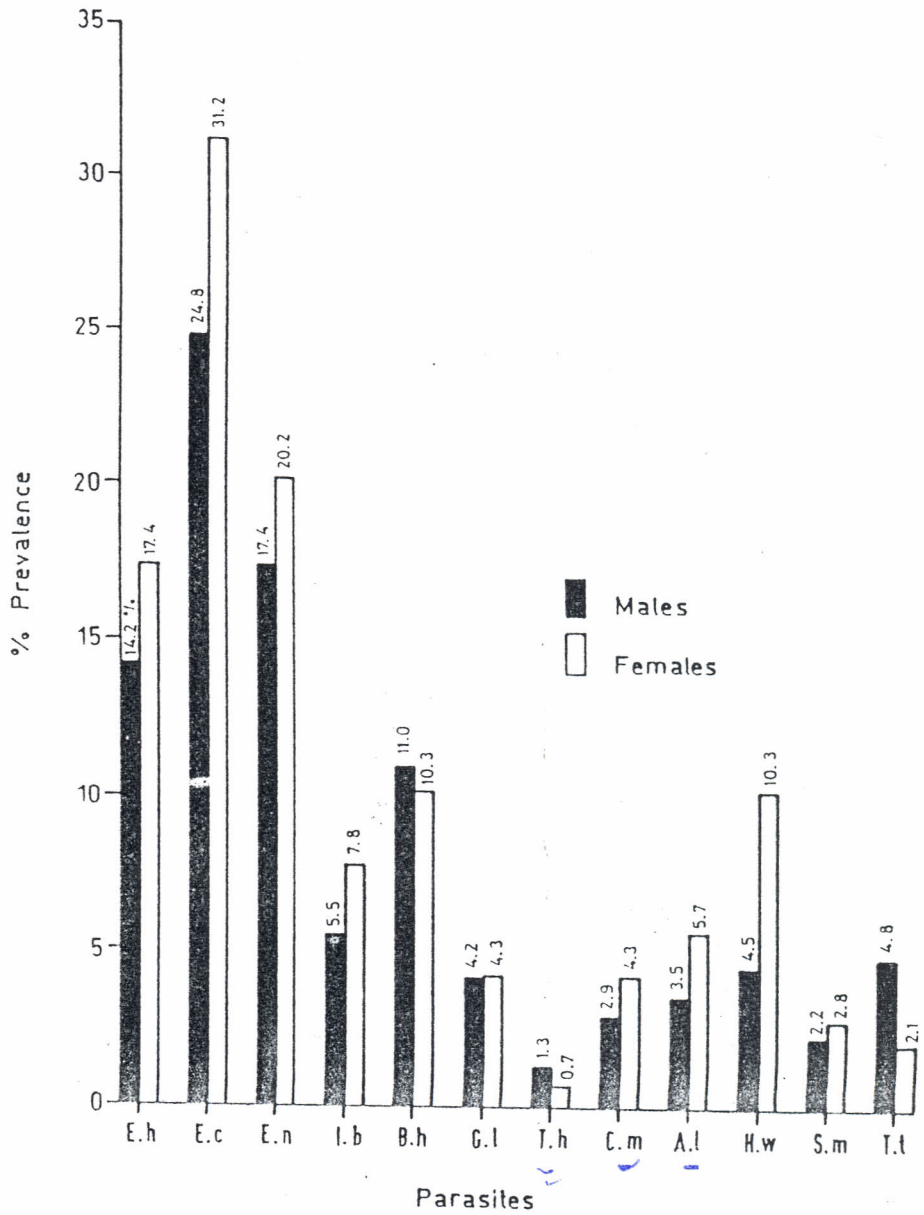


Fig. 3: Prevalence of individual parasites in relation to gender.

Key.

E.h=*E. histolytica*, E.c=*E. coli*, E.n=*E. nana*, I.b=*I. butschlii*, B.h=*B. hominis*,
 G.l=*G. lamblia*, T.h=*T. hominis*, C.m=*C. mesnili*, A.l=*A. lumbricoides*,
 H.w=*hookworm*, S.m=*S. mansoni*, T.t=*T. trichiura*.

As Figure 4 indicates, poly-parasitism was common in both sexes. It may appear that infection with three, four and five different species of parasites is commoner in females (42.6%) than in males (24.4%), but there was no significant difference between the sexes $P > 0.05$. Two patients, both males, had six species at once.

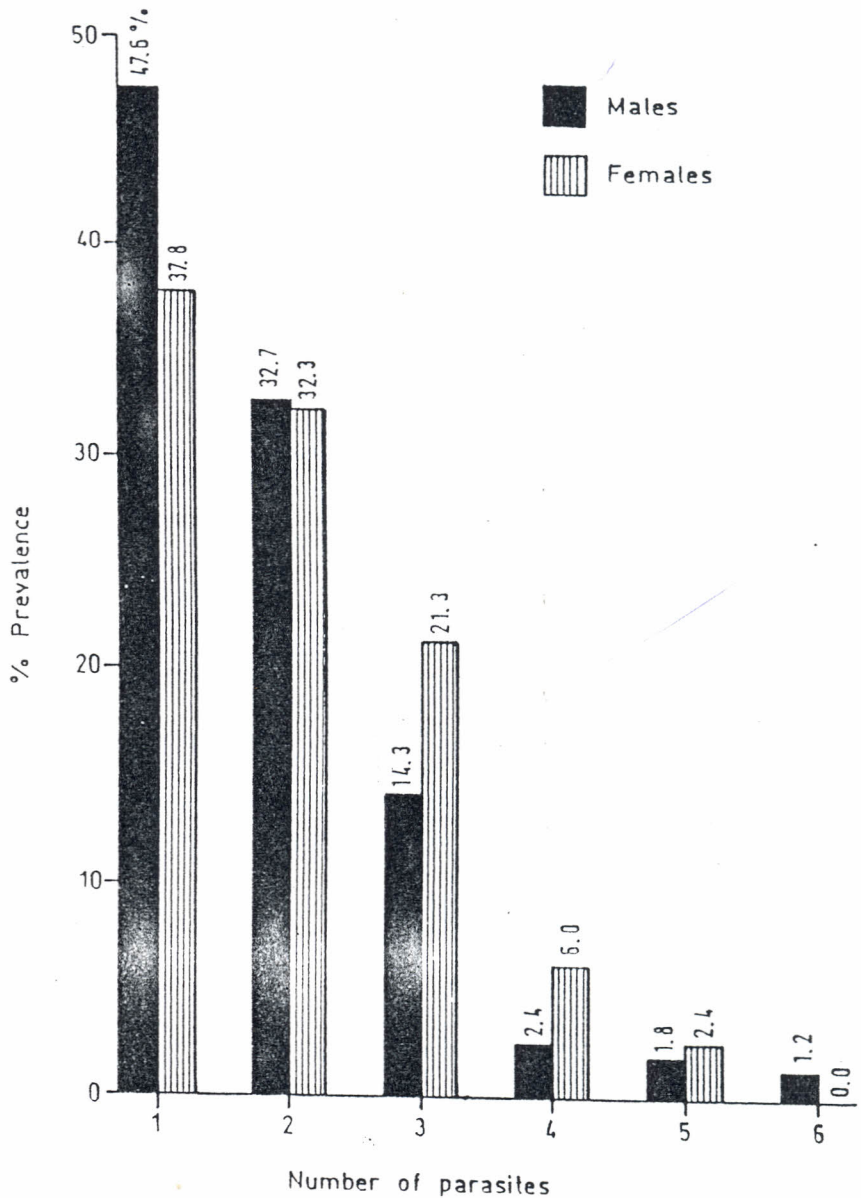


Figure 4: Relationship between multiple parasitic infections and gender.

As shown in Table 5, 320 out of 592 patients examined were asked the duration they had stayed in Nairobi. 22 (6%) had stayed only days, 40 (12.5%) had stayed for less than a year, and 258 (80.6%) had lived in Nairobi for one or more years. There was no significant difference between these three categories with regard to prevalence of parasitic infection.

Table 5: Relationship between prevalence of parasitic infections and duration of stay in Nairobi.

Duration of stay in Nairobi	Positive for parasites	Negative for parasites	Total
Days	7 (31.8%)	15 (68.2%)	22
Months	16 (40.0%)	24 (60.0%)	40
Years	107 (41.5%)	151(58.5%)	258
Total	130	190	320

Table 6 shows the prevalence of parasitic infections in relation to employment status. Out of the 259 employed subjects, 148 (57.1%) were infected with at least one parasite, while of the 167 unemployed patients 100 (59.8%) were positive for at least one parasite. The difference between the two groups with regard to individual prevalences of protozoa and helminths was not statistically significant $P > 0.05$. Nevertheless, infection with both protozoa and helminths was more in unemployed patients 29 (17.3%) than employed subjects 15 (5.8%). The difference was highly significant $\chi^2 = 13.46$; $P < 0.001$.

Table 6: Prevalence of parasitic infections in relation to employment.

Employment	Negative for parasites	Positive for protozoa	Positive for helminths	Positive for both	Total
Child	82 (49.4%)	61 (36.7%)	14 (8.4%)	9 (5.4%)	166
Unemployed	67 (40.1%)	60 (35.9%)	11 (6.6%)	29 (17.4%)	167
Employed	111 (42.9%)	117 (45.2%)	16 (6.2%)	15 (5.8%)	259
Total	260	238	41	53	592

As can be seen from Table 7, patients were classified according to their level of education. Of the 592 out-patients examined 37 (6.3%) had tertiary education, 198 (33.4%) were educated at secondary level, 259 (43.7%) at primary level and 98 (16.6%) had no formal education. Patients educated up to primary and tertiary levels had significantly more *E. coli* with percentage prevalence of (30.1%) and (35.1%) than those with secondary level education (14.1%) with $\chi^2 = 15.1$; $P < 0.001$ and $\chi^2 = 8.1$; $P < 0.01$ respectively.

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Table 7 : Prevalence of individual parasites in relation to level of education.

Education	No.exam	<i>E.histolytica</i>	<i>E.coli</i>	<i>E.nana</i>	<i>I.butshlii</i>	<i>B.hominis</i>	<i>G.lambliia</i>	<i>T.hominis</i>	<i>C.mesnili</i>	<i>Ascaris</i>	<i>H/worm</i>	<i>S.mansoni</i>	<i>T.trichiura</i>
None	98	11 (11.2%)	16 (16.3%)	12 (12.2%)	4 (4.1%)	11 (11.2%)	7 (7.1%)	2 (2.0%)	5 (5.1%)	6 (6.1%)	5 (5.1%)	2 (2.0%)	2 (2.0%)
Primary	259	46 (17.8%)	78 (30.1%)	52 (20.0%)	21 (8.1%)	30 (11.6%)	17 (6.6%)	1 (0.3%)	4 (1.5%)	10 (3.9%)	27 (10.4%)	4 (1.5%)	9 (3.5%)
Secondary	198	31 (15.7%)	28 (14.1%)	35 (17.7%)	13 (6.6%)	21 (10.6%)	1 (0.5%)	3 (1.5%)	9 (4.5%)	11 (5.6%)	11 (5.6%)	9 (4.5%)	6 (3.0%)
Tertiary	37	5 (13.5%)	13 (35.1%)	12 (32.4%)	1 (2.7%)	1 (2.7%)	0	0	3 (8.1%)	0	0	0	4 (10.8%)
TOTAL	592	93	165	111	39	63	25	6	21	27	43	15	21

Table 8 shows the prevalence of infection in relation to the type of water supply used by the patients. 194 (32.8%) patients had piped water in their house and 347 (58.6%) were using communal taps, 33 (5.6%) were using bore-hole water and 18 (3%) were fetching water from streams. There was no statistically significant difference in prevalence of intestinal parasites in relation to different types of water supply in the study population $P > 0.05$.

Table 8: Prevalence of intestinal parasites in relation to water Source.

Water source facility	Negative for parasites	Positive for protozoa	Positive for helminths	Positive for both	Total
Piped to House	96 (49.5%)	76 (39.2%)	10 (5.2%)	12 (6.2%)	194
Communal Tap	146 (42.1%)	136 (39.2%)	29 (8.4%)	36 (10.4%)	347
Bore Hole	10 (30.3%)	18 (54.5%)	2 (6.1%)	3 (9.1%)	33
Stream	8 (44.4%)	8 (44.4%)	0	2 (11.1%)	18
Total	260	238	41	53	592

Table 9 shows the relationship of parasitic infection with type of drinking water used by the patients. Out of 494 patients interviewed, 392 (79.3%) said they drink unboiled water. This group was found to be significantly more infected with protozoa 201 (51.3%) and helminths 79 (20.1%) than those who drink boiled water with percentage rates of 36 (35.3%) and 5 (4.9%) respectively. $\chi^2 = 10.85$; $P < 0.001$ for protozoa and $\chi^2 = 16.3$; $P < 0.001$ for helminths.

Table 9: Relationship between prevalence of Intestinal Parasites and Drinking Water.

Drinking water	Negative for parasites	Positive for protozoa	Positive for helminths	Positive for both	Total
Unboiled	157 (40.1%)	156 (39.8%)	34 (8.7%)	45 (11.5%)	392
Boiled	62 (60.8%)	35 (34.3%)	4 (3.9%)	1 (0.9%)	102
Total	219	191	38	46	494

Relationship of multiple infection and type of drinking water is shown in Figure 5. Infection with two or more parasites was significantly more in patients who drink unboiled water 137 (34.9%) than those who drink boiled water 15 (14.7%) $\chi^2 = 14.6$; $P < 0.001$.

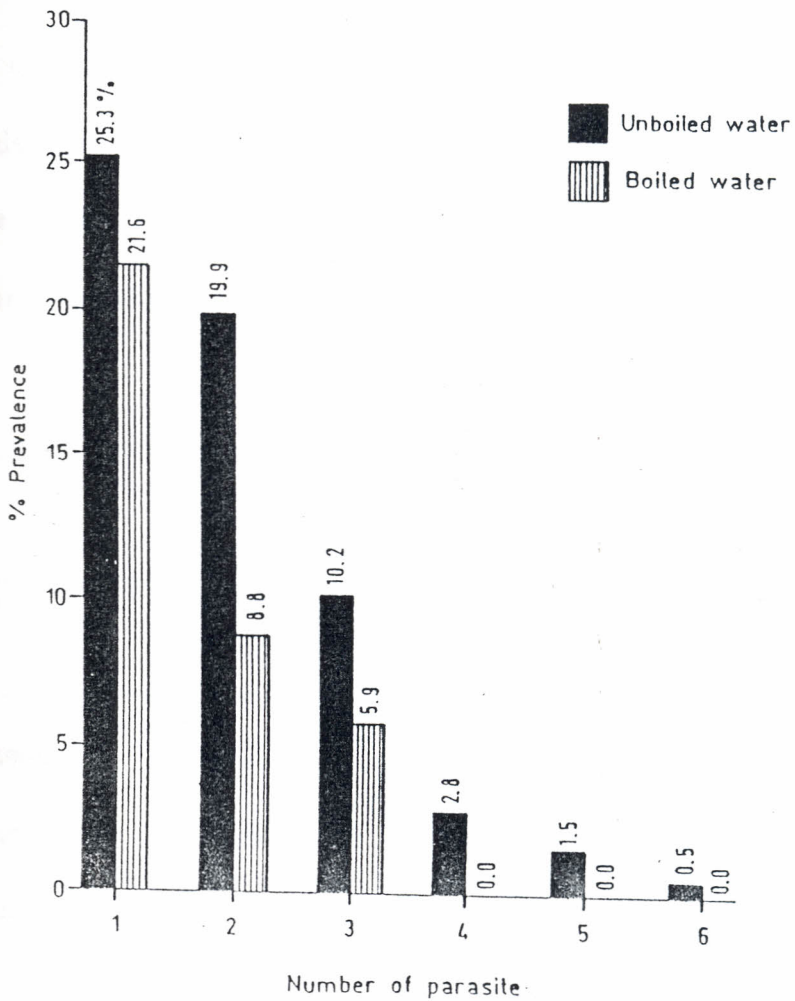


Fig. 5: Relationship of multiple infection and type of drinking water.

As can be observed from Tables 10a and 10b, the relationship of infection with intestinal parasites and type of excreta disposal facility used by the patients was also investigated. Of the 592 patients examined, 151 (25.5%) had an indoor toilet while 235 (39.9%) were using a communal toilet, and the rest 206 (34.8%) had a pit latrine. Helminthic infections were common in communal toilet users $\chi^2 = 7.9$; $P < 0.01$ compared to indoor toilet users. Considering individual helminths (Table 10b), communal and pit latrine users were significantly more infected with hookworm compared to those who had an indoor toilet $\chi^2 = 10.9$; $P < 0.001$.

Table 10a: Relationship of intestinal parasites and type of excreta disposal facility.

Excreta facility	Negative for parasites	Positive for protozoa	Positive for helminths	Positive for both	Total
Indoor toilet	74 (49.0%)	65(43.0%)	4 (2.6%)	8 (5.3%)	151
Communal toilet	95 (40.4%)	96 (40.8%)	21(8.9%)	23 (9.8%)	235
Pit latrine	91 (44.2%)	77 (37.4%)	16 (7.8%)	22 (10.7%)	206
Total	260	238	41	53	592

Table 10b: Prevalence of individual parasites in relation to the type of excreta disposal facility.

Toilet	No. exam	<i>E.histolytica</i>	<i>E.coli</i>	<i>E.nana</i>	<i>I.butshlii</i>	<i>B.hominis</i>	<i>G.lambliia</i>	<i>T.hominis</i>	<i>C.mesnili</i>	<i>Ascaris</i>	<i>H/worm</i>	<i>S.mansoni</i>	<i>T.trichiura</i>
Indoor	151	19 (12.5%)	38 (25.5%)	26 (17.2%)	9 (6.0%)	21 (13.9%)	7 (4.6%)	2 (1.3%)	5 (3.3%)	3 (2.0%)	1 (0.6%)	2 (1.3%)	5 (3.3%)
Communal	235	39 (16.7%)	71 (30.2%)	46 (19.6%)	15 (6.4%)	20 (8.5%)	10 (4.3%)	2 (0.8%)	8 (3.4%)	16 (6.8%)	22 (9.4%)	8 (3.4%)	6 (2.5%)
Pit latrine	204	34 (16.7%)	56 (27.5%)	39 (19.1%)	15 (7.4%)	22 (10.8%)	7 (3.4%)	2 (1.0%)	8 (3.9%)	8 (3.9%)	20 (9.8%)	5 (2.5%)	10 (4.9%)
Other	2	1 (50.0%)	0	0	0	0	1 (50.0%)	0	0	0	0	0	0
Total	592	93	165	111	39	63	25	6	21	27	43	15	21

Table 11 shows the prevalence of intestinal parasites among ethnic groups in the study subjects. Apart from Kikuyu, the sample sizes of the other tribes were very small such that no comparisons could be done among tribes.

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TABLE 11: Prevalence of intestinal parasites in relation to patient's ethnic background.

Tribe	No. exam	<i>E.histolytica</i>	<i>E.coli</i>	<i>E.nana</i>	<i>I.butshlii</i>	<i>B.hominis</i>	<i>G.lamblia</i>	<i>T.hominis</i>	<i>C.mesnili</i>	<i>Ascaris</i>	<i>H/worm</i>	<i>S.mansoni</i>	<i>T.trichiura</i>
Kikuyu	272	37 (13.6%)	55 (20.2%)	45 (16.5%)	18 (6.6%)	27 (9.9%)	11 (4.0%)	3 (1.1%)	7 (2.6%)	11 (4.0%)	13 (4.8%)	5 (1.8%)	6 (2.2%)
Kamba	78	19 (24.4%)	31 (39.7%)	15 (19.2%)	8 (10.2%)	10 (12.8%)	3 (3.8%)	1 (1.2%)	2 (2.6%)	3 (3.8%)	7 (9.0%)	8 (10.2%)	1 (1.2%)
Luo	74	13 (17.6%)	26 (35.1%)	13 (17.6%)	7 (9.5%)	5 (6.8%)	2 (2.7%)	1 (1.4%)	5 (6.8%)	5 (6.8%)	7 (9.5%)	2 (2.7%)	4 (5.4%)
Luhya	57	8 (14.0%)	20 (35.0%)	12 (21.1%)	4 (7.0%)	11 (19.3%)	2 (3.5%)	0	1 (1.8%)	5 (8.8%)	8 (14.0%)	0	2 (3.5%)
Meru	32	9 (28.1%)	8 (25.0%)	11 (34.4%)	0	1 (3.1%)	5 (15.6%)	0	2 (6.3%)	1 (3.1%)	3 (9.4%)	0	0
Kisii	27	3 (11.1%)	12 (44.4%)	5 (18.5%)	1 (3.7%)	1 (3.7%)	1 (3.7%)	1 (3.7%)	2 (7.4%)	2 (7.4%)	4 (14.8%)	0	0
Somali	22	1 (4.5%)	5 (22.7%)	2 (9.0%)	0	3 (13.6%)	1 (4.5%)	0	0	0	0	0	8 (36.3%)
Kalenjin	10	1 (10.0%)	3 (30.0%)	4 (40.0%)	0	2 (20.0%)	0	0	1 (10.0%)	0	0	0	0
Embu	9	1 (11.1%)	3 (33.3%)	0	1 (11.1%)	2 (22.2%)	0	0	0	0	0	0	0
Boran	6	0	1 (16.6%)	1 (16.6%)	0	0	0	0	1 (16.6%)	0	0	0	0
TOTAL	592	92	165	111	39	63	25	6	21	27	43	15	21

4.0 DISCUSSION

Infection with intestinal protozoa was very common in the study population compared to helminths and almost all patients infected with protozoa were asymptomatic cyst carriers. The few who complained of abdominal pain were found to be harbouring trophozoites of *E. histolytica*. Only one case of *G. lamblia* was associated with diarrhoea.

Since the study population was exclusively made up of out-patients, it was not possible to obtain more than one specimen. However, the examination of stool samples using three different methods namely; direct smear, concentration method and modified Zeihl-Neelsen staining technique made diagnosis in the present study fairly reasonable. The results of this study were consistent with other studies of a similar nature both in Kenya (Wijers *et al.*, 1972; Hall *et al.*, 1982; Chunge *et al.*, 1991) and other African countries (Annan *et al.*, 1986; Ilardi *et al.*, 1987; Gbakima, 1994).

E. histolytica infection was the most common pathogenic protozoa in the study subjects. Studies in Nairobi have reported prevalences of *E. histolytica* varying between 2.5% and 15.7%

(Wijers *et al.*, 1972; Ritho., 1982; Wamanda., 1986). Other studies from other parts of the country have even reported higher prevalence of this organism (Iseki *et al.*, 1983; Kamunvi & Situbi., 1983). The apparent variation in *E.histolytica* prevalence between this study and previous surveys may be partly due to environmental differences of the study areas or, as pointed out by some researchers (Chunge *et al.*, 1991; Wijers *et al.*, 1972), *Entamoeba hartmanni* might have been confused for *E. histolytica* since they resemble each other in every aspect except their size.

Differences in infection rates of individual parasites with respect to age of the host were observed in this study. For instance, infection of *histolytica* and other protozoa transmitted by contamination except for *G.lamblia* rose with age. This strongly indicates that faecal-oral contamination is not greatly reduced in adults. Similar results were observed by Iseki *et al* (1983) who reported prevalence of *E. Histolytica* in Naivasha and Kitui to be very high among the older age groups. In another study in Kiambu District, Chunge *et al* (1991) found that the prevalence of *E. histolytica* gradually increased with the age of the host with the exception of *G.lamblia* which decreased with age. The decrease in prevalence of *G.lamblia* could be due to strong age-related immunity in the host in which the Giardia trophozoites are coated

with Immuno-globulin A (IgA) which may reduce their motility and prevent adhesion (Taylor and Wenman, 1987).

Occurrence of *G. lamblia* was low in the present study population. This could be explained by the fact that only a single specimen was examined for each participant. The prevalence of this parasite was commoner among children under 5 years of age than the older patients. The high prevalence in younger children may be due to child-to-child transmission particularly in over crowded places (Keystone *et al.*, 1978; Black *et al.*, 1981). However, this observation is similar to what has been reported previously (Annan *et al.*, 1986., Chunge *et al.*, 1991).

Another common yet controversial parasite in the study population was *B. hominis*. None of the patients infected with this parasite were complaining of any discomfort. Studies done on this parasite are not consistent. Some strongly believe that *B. hominis* is a pathogen capable of causing diarrhoea and argue that they be treated like other pathogenic protozoa (Nimri and Batchoun, 1994., Sheehan *et al.*, 1986), while others consider it a commensal organism (Senay & Mac-Pherson, 1990., Markell and Udkow, 1986). Still others believe that the question of pathogenicity is not conclusive because most of the studies associating this parasite

with pathogenicity were carried out on symptomatic patients and were thus inherently biased. Nonetheless, this study did not associate *B. hominis* with any pathogenicity.

Cryptosporidium sp. was encountered at very low levels in this study than in previous studies both locally (Simwa *et al.*, 1989; Estambale *et al.*, 1989) and in other African countries (Mersha & Tiruneh, 1992; Andy & Aikins-Bekoe., 1986). A possible explanation for the difference could be partly due to selection bias in these studies, i.e: these surveys were done exclusively on diarrhoeic patients hence the chances of detecting this organism was high. Nonetheless, this finding is useful for future surveys in that *Cryptosporidium* sp must be included among parasites sought in prevalence studies carried out in the general population.

Generally, the prevalence of common intestinal helminths among this study population was very low compared to previous surveys done in Kenya (Duncan, 1978; Hall *et al.*, 1982; Kamunvi & Situbi., 1983). The reduction of helminthic infections might be attributed in part to the availability of anti-helminthic drugs over-the-counter, as part of the control methods, which are known to easily dislodge and expel most intestinal helminths. Another possible explanation

could be, although not documented, that the pharmaceutical companies often advertise anti-helminthic drugs rather than protozoal ones in the electronic and print media. The combination of these two factors may have influenced the perception of the common man towards parasitic infections in that they think all parasites are helminths. However, the health awareness programmes which are offered in the health facilities and schools may have also contributed significantly in the reduction of parasitic infections.

The burden of multiple infections was clearly noticed in the study subjects. Of particular interest was the finding that the infection with three or more parasites was more in females than in males, save for two male patients infected with six parasites at once. This may be due to socio-cultural differences between the sexes which is worth investigating further. The data also showed a significant reduction in parasite load in those who boil their drinking water. However, the previous studies on the prevalence of poly-parasitism in Kilifi District (Ashford *et al.*, 1992) and Kiambu and Machakos Districts (Chunge *et al.*, 1991 & 1995) showed similarity to the one reported in this survey.

Large differences in prevalence of hookworm infection was noted between male and female patients, with more females being infected compared to males. In contrast, Wijers *et al.*, (1972) reported hookworm infection was more in boys than in girls. One possible factor which can increase the opportunity for infection with skin penetration of hookworm larvae could be the habit of females in the urban poor to walk barefooted in the compounds around the houses where indiscriminate defecation is usual. However, the overall prevalence of *A.lumbricoides*, *T.trichiura* and *S.mansoni* in the study were significantly lower than the prevalences of previous studies carried out in Nairobi.

Protozoal infections were also more prevalent among females than males. This could also be related to the behavioural differences between the sexes (Chunge *et al.*, 1991). Culturally, females tend to have closer contact with faecally contaminated objects particularly when wiping children's bottom and washing their soiled clothes hence the chances of protozoal infections become higher in females compared to males.

The lack of significant association between duration of stay in Nairobi and parasitic infections might be related to the movement of people to and from the rural areas where urban dwellers may

easily get infected with parasites. Similar results were found by Wijers *et al.*, (1972) who compared the burden of parasitic infections between school children who stayed in Nairobi for less than three years and those who stayed for more than three years. He suggested that the children may be getting re-infected regularly while on holiday in their rural areas.

Prevalence of parasites among different ethnic groups was not an important factor in the study subjects. Mostly, the prevalence of parasites depend on the sanitary condition of the patients' place of residence, personal hygiene, geographical and perhaps, the most important, the climatic factors. In their study Wijers *et al.*, (1972) reported that Kikuyu and Kamba children had higher prevalence of *S.mansoni* and *H. nana* infection, while Luo and Luhya children were infected more by *T.trichiura* and hookworm. However, their study failed to consider other possible factors which can influence the prevalence of these parasites.

The employment status among the study population did not affect parasite prevalence. Perhaps this was because those who were working were not earning enough money to lead a more reasonable life than those who are not working. Wamanda (1986) found that children in the non-fee paying primary schools whose mothers

worked had less parasitic infections than those whose mothers were not working. Possibly the employment status of a mother is a more important determinant of infection than general employment status.

The association between level of education factor and parasitic infections could not be adequately demonstrated without considering the bias due to other variables. For example, an educated person might be sharing his place of residence and his source of water with uneducated persons thus exposing him to infection. Another possible explanation is that the patients might have completed their education in a rural areas where sanitation facilities may be very poor. However, the difference of levels of education among study population with regard to most of the parasitic infections was not statistically significant. This is similar to the findings in a study by Omar *et al.*, (1995) in Saudi Arabia but contrasts to the observation in Eldoret, Kenya (Kamar, 1995) which found an inverse relation between educational status and incidence of diarrhoea among studied subjects.

In the present study, the different kinds of water supply did not seem to affect the prevalence of intestinal parasites among the study population. Several factors could account for the lack of more positive findings among communal and bore-hole users. One

reason might be the shortage of water supply in many parts of the city which affects all including those who had piped water in their house thus forcing them to get water from the same source as communal and bore-hole users. Respondent information bias can not also be ruled out because it was difficult for most of the people to distinguish between communal tap and piped water in the house. Mason *et al.*, (1986) reported that there was marked reduction in helminthic infections where piped water was available. This was not, however, the case with protozoan parasites particularly *G. lamblia* which was more common in subjects with access to piped water. While provision of water supply may contribute towards reduction in the prevalence of parasitic infections, significant reduction may not be achieved unless the provision of water supply is coupled with concomitant interventions in other sources of infection.

Almost all prevalences of intestinal protozoal infections among communal toilet and pit latrine users were slightly higher than users of indoor toilet. None of the differences was significant among the three groups. Considering helminthic infections, communal and pit latrine users had a significantly higher hookworm prevalence than the group with the best facility. No effort was, however, made to observe the places of residence of the study

subjects. According to the information given in the questionnaire, it would be expected that the over-all faecal contamination of their residential areas is high. Faechem *et al.*, (1983) suggested that having a particular type of toilet does not necessarily affect the rates of intestinal parasitic infections if the over-all level of faecal contamination of the environment is high. However, the provision of improved water supply and excreta disposal facility, which are strongly interrelated, may become unproductive unless accompanied by proper health education and perhaps, most important, a major changes in cleanliness behaviour among the general population.

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The present study showed a high prevalence of protozoal and helminthic infections among patients who do not boil water for drinking than those who drink boiled water. Thus, the possibility of faecal pollution of water supply can not be excluded as a potential source of infection. Quasi-similar results were found by Karama *et al.*, (1995) who reported heating drinking water at 70 °C resulted in marked reduction in the number of coliforms and other water borne organisms. In another study, Omar *et al.*, (1995) found prevalence of *G.lambli*a and *E.histolytica* to be more common in people using well water and jar water than those using desalinated water. Nevertheless, improvement in domestic water

supplies with constant motivation to boil drinking water is likely to have significant decreases in prevalence of water-borne intestinal infections among the local population.

5.0 CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

- 1) It was observed that the prevalence of human intestinal parasites is high among Nairobi residents.
- 2) The level of infection with protozoa was found to be unchanged after quarter of a century, whereas the level of helminthic infections has reduced.
- 3) Females were found to be infected slightly more with protozoa than males. This could be related to socio-cultural and behavioural factors.
- 4) Multiple infections were common among the study subjects, Infection with three, four and five parasites was more in females patients than in males. Two patients, both males, had six different intestinal parasites.
- 5) There was no significant difference between duration of stay in Nairobi, level of education, employment status, water source and parasitic infections.

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- 6) Unboiled drinking water was strongly associated with protozoal and helminthic infections.
- 7) Most of the socio-economic and environmental factors are interrelated which makes it difficult to reach conclusions about independent effects.

5.2 Recommendations

A. There is a need to focus more attention on low income population dwelling urban slums in order to achieve health improvement. This can be achieved by:

- construction and/or rehabilitation of sewerage system and improving availability of water supply.

B. Health education and health awareness programmes for the general population attending health facilities should be promoted by:

- giving them, upon arrival at the health centres, a short talk on the importance of health and personal hygiene for example: washing hands after defecation and before eating.

- urging them to boil water for drinking as this kills not only parasites in water but also other water borne infections.

C. Prevalence studies of intestinal parasites should be encouraged from time to time. This will enable health authorities to improve the sanitary condition of the general population.

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Appendix
QUESTIONNAIRE

Name _____ Survey No: _____
Tribe _____ Age _____ Sex _____
Place and duration of residence(Nairobi) _____ Days _____ Months _____ Years _____
Address _____ Tel _____

Details of housing (circle as appropriate)

Type of Roof

1) Iron sheet 2) Tile 3) Asbestos 4) Grass 5) Cemented

Type of Wall

1) Brick 2) Cement Block 3) Wood 4) Metal 5) Mud 6) Stone

Type of Floor

1) Wood 2) Cement 3) Dirt 4) Stone

Total number of rooms in the house _____

Number of people in the house _____ Adults _____ Children _____ Boys _____ Girls _____

Water Source

1) Piped to house 2) Communal tap 3) Well 4) Rain water 5) Bore hole
6) Tank 7) Stream

Type of drinking Water

1) Unboiled 2) Boiled 3) Mineral water

Excreta facility

1) Indoor toilet 2) Pit Latrine 3) Communal tap 4) Others

Employment

1) Child 2) Unemployment 3) Employment

Education

1) Primary 2) Secondary 3) Tertiary 4) None

Abdominal Pain:

1. Yes 2. No