THE EFFECT OF INTESTINAL SCHISTOSOMIASIS ON THE HAEMOGLOBIN LEVELS IN PRIMARY SCHOOL CHILDREN IN MAKI^ENI DISTRICT - KENYA

BY: MAYANJA MARTIN NSUBUGA
W61/8156/06
E-mail nmmavanjaffl vahoo.co.uk

UNIVERSITY OF NAIROBI INSTITUTE OF TROPICAL AND INFECTIOUS DISEASES (UNITID)

RESEARCH REPORT SUBMITTED IN PARTIAL FULFILMENT OF A POSTGRADUATE DIPLOMA IN BIOMEDICAL RESEARCH METHODOLOGY OF THE UNIVERSITY OF NAIROBI

SUPERVISOR: DR.KIARIE JAMES
UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OBSTETRICS AND GYNAECOLOGY
E-mail: jkiarie@csrtkenya.org
SIGNATURE OF SUPERVISOR:
DATE

TABLE OF CONTENTS PAGE

DECLARATION	2
DEDICATION	3
ACKNOWLEDGEMENT	4
ABSTRACT	5
CHAPTER 1	
0.0 INTRODUCTION	6
1.2 HYPOTHESIS	7
1.3 OBJECTIVES	7
1.3.1 GENERAL OBJECTIVES	7
1.3.2 SPECIFIC OBJECTIVES	7
1.4 JUSTIFICATION	7
CHAPTER 2	
1.0 LITERATURE REVIEW	11
CHAPTER 3	
2.0 METHODOLOGY	12
3.1 STUDY AREA	12
3.2 STUDY DESIGN	14
3.3 STUDY PROCEDURE	14
3.3.1 ENROLMENT	14
3.3.2 STOOL COLLECTION	14
3.3.3 NUTRITIONAL STATUS	15
3.4 INCLUSION CRITERIA	15
3.5 EXCLUSION CRITERIA	15
3.6 STUDY LIMITATIONS	15
3.7 ETHICAL CONSIDERATIONS	16
3.8 DATA HANDLING	16
3.9 DATA ENTRY AND ANALYSIS	17
3.10 VARIABLES/MEASUREMENTS	17
3.11 DATA QUALITY CONTROL	17
CHAPTER 4	
3.0 RESULTS	21
CHAPTER 5	
4.0 DISCUSSION	28
CHAPTER 6	
5.0 CONCLUSIONS AND RECOMMENDATIONS	36
5.1 CONCLUSIONS	36
5.2 RECOMMENDATIONS	37
REFERENCES	38
APPENDIX	41

• \

LIST OF TABLES

TABLE 1 Descriptive Statistics...21

TABLE 2Prevalence of *Schistosoma mansoni*..23

TABLE 3 Intensity of *Schistosoma mansoni* infection................................24

TABLE 4Proportion of Anaemia in different age groups...........................25

LIST OF FIGURES

FIGURE 1 Map of Makueni district showing Kibwezi division.....................15

FIGURE 2 *Schistosoma mansoni* infection distribution..............................25

FIGURE 3Haemoglobin level distribution...26

FIGURE 4 Correlation between schistosome infection and the haemoglobin levels 27

DECLARATION

This research report is my original work and has not been presented for any award in any other institution

MARTIN MAYANJA NSUBUGA

SIGNATURE.................................DATE

This report has been submitted for examination to my supervisor in partial fulfillment for the award of a Post Graduate Diploma in Biomedical Research Methodology of the University of Nairobi Institute of Tropical and Infectious Diseases.

• *i* ·

SUPERVISOR: DR JAMES KIARIE

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF NAIROBI

SIGNATURE..... . . . . . .DATE.....\!?.\"1.j.9.7.

DEDICATION

To my wife Annet Nanyunja, my first born child, little Rachael Namayanja and my mother Betty Katana.

ACKNOWLEDGEMENT

The work presented in this report has been made possible due to the input of many people; a few of them deserve special mention because of the role they played.

I thank the entire administration of the Danish Bilharziasis Laboratory and UNITID for funding my studies at the University of Nairobi.

I am sincerely grateful to my supervisor Dr James Kiarie of the Department of Obstetrics and Gynaecology University of Nairobi for his guidance, suggestions, corrections and criticisms throughout the study period.

I am also grateful to Professor Benson Estambale the Director of UNITID who supplied part of the equipment, reagents, drugs and part of the technical staff plus all the printing and photocopying services for both the proposal and report.

I thank the Head of Division of Vector Borne Diseases (Kenya)-Ministry of Health Dr Eric Muchiri for introducing me to the study area in Makueni, for accepting to use the existing facilities and infrastructure already in Mtito to the benefit of my study. I also thank him for providing me with the vehicle that I used during the fieldwork.

I am sincerely grateful to Dr Ambrose Onapa the Head of Vector Control Division/Ministry of Health (Uganda) for introducing me to this Course/Study. I also thank him for giving me time off my duty at the station to attend studies in Nairobi. I acknowledge the assistance given by the technical staff of DVBD and UNITID.

Sincere appreciation is extended to the Head teachers, parents and pupils of Miangeni and Iviani Primary schools for their co-operation and understanding without which this study would not have been possible.

Finally I extend my sincere gratitude to wife Annet Nanyunja, my first born child (Rachael), my mother and relatives for their inspiring and moral support.

ABSTRACT

Background

Chronic morbidity is one of the major impacts of schistosomiasis in Kenya. Anaemia in children and women of childbearing age is mainly attributed to malaria, nutrition-status and other helminthes worms there-fore anaemia identified in primary care settings is rarely attributed to schistosomiasis and prevalence of anaemia due to schistosome infection in high prevalence areas like Kibwezi division of Makueni district is not known.

Objectives

The objective of the study was to determine the effect of intestinal schistosomiasis on the haemoglobin levels in children

Methods

The potential relationship between schistosome infection and the haemoglobin levels was examined in an analytical cross-sectional study using a simple questionnaire. Stool and blood samples were obtained from a total of 380 primary school children who had assented to the study.

Data obtained from the laboratory examination of the samples and the questionnaire was entered using Microsoft Access and analyzed using Intercooled Stata 9.2.

Results

The overall prevalence of intestinal schistosomiasis for all the children examined in both schools was 41.3% (95%, CI 36.3%-46.3%), the geometric mean was 82epg and the mean egg count was 230epg. The maximum observed egg count was 2580 epg at Miangeni primary school. An epg of 2400 was' observed at Iviani primary school. The mean haemoglobin level of the infected children was 12.77g/dl as compared to the 12.88g/dl of the un-infected children. The difference in mean haemoglobin levels between the infected and uninfected was not statistically significant at (P=0.3931). The prevalence of anaemia among school children was 25.7% with the highest prevalence being within the age group of 12-14 years.

Conclusion

In conclusion, the study revealed that children who are infected with intestinal schistosomiasis are not likely to be more anaemic than the un-infected children since there is no significant difference between the haemoglobin levels of the two groups being compared.

to

yd

N

CHAPTER 1

1.0 Introduction

Schistosomiasis and soil transmitted helminthes are a major cause of morbidity in many communities in Kenya (DVBD-NCP Report 1). Their prevalence, intensity of infection and distribution vary considerably in different regions. Schistosomiasis is found in 41 districts out of the 72 districts in Kenya.

Out of the Kenyan population of approximately 30 million people, the population at risk of schistosomiasis and soil transmitted helminthes infection in the endemic districts using the 1999 national census is about 14 million people and over 5 million are estimated to harbor schistosomiasis infection.

The population of school-aged children (5-19 years) nationally is about 11 million, 70% of whom are in the category that carries the heaviest infection.

The disease is characterized by high morbidity and low mortality. (Idle Farah et al 2003).

Both urinal and intestinal schistosomiasis have been reported to be widely spread in Kenya. (DVBD-report-NCP).

Chronic disability was reported to be high in Kibwezi division among women compared to men. Malaria, gastroenteric infections and respiratory disease were reported to be the commonest ailments while diarrhoea; measles, parasitosis and malnutrition were most frequent among children.

Malaria and schistosomiasis were seen as the major problems in women's health in this region.

In a study carried out in Kibwezi division, the prevalence of anaemia was 69 % and this was attributed to malaria. (Hans Verhoef et al 2001). Prevalence of anaemia due to schistosomiasis and soil transmitted helminthes in this region is not known.

1.2 Hypothesis

Children infected with intestinal schistosomiasis are more likely to be anaemic than uninfected children.

1.3 Objectives

1.3.1General Objective

Determine the effect of intestinal schistosomiasis on the haemoglobin levels in primary school children.

1.3.2 Specific Objectives

1. Determine the prevalence and intensity of infection of intestinal schistosomiasis among primary school children in Kibwezi division of Makueni district.
2. Determine the level of haemoglobin in the blood of school children.
3. Compare haemoglobin levels among children infected with intestinal schistosomiasis to haemoglobin levels in*uninfected children.

1.4 JUSTIFICATION

Chronic morbidity is one of the major impacts of schistosomiasis. Many of the studies have reported the impact of schistosomiasis on cognitive development, education achievement, and physical fittiness, working capacity and work productivity and some on immune response

Anaemia in children and women of childbearing age is mainly attributed to malaria, nutritional status and other helminthes worms and is rarely attributed to schistosomiasis therefore the effect of schistosomiasis on the haemoglobin levels in this region is not known

It is there- fore important to study schistosomiasis in relation to anaemia, which results in lowered resistance to infections and affects child growth.

2.0 Literature review

The severity of the symptoms and signs of anaemia depend on the rate at which the anaemia developed as well as the level of haemoglobin in the blood.

Anaemia in children and women of childbearing age is mainly attributed to malaria, nutrition status and other helminthes worms. This anaemia results in lowered resistance to infections and affects child growth (Irene.A.Agyepong 1985,). Anaemia identified in primary care settings is rarely attributed to schistosomiasis, moreover it has been observed that in almost all areas in the world where malaria is endemic, polyparasitism (multiple parasitic infections) is potentially the rule rather than the exception (Jane Carter and Oregenes Lemma) In a study carried out in Kibwezi (Hans Verhoef et al 2001) division the prevalence of anemia was 69% and all this was attributed to malaria. The relative role of schistosomiasis as a causative agent for anaemia Dili] O'er, particularly compared with that known for hookworm infection, remains controversial (Coutinho .H.M et al 2005) \

The normal range for haemoglobin levels in human beings is dependent on age and sex. Normal values for men (adults) are 13.0-18.0g/dl, women (adults) are 12.0-16.0g/dl, infants (full term) isl3.5-19.5 g/dl, children 1-9 years isl 1.0-14.0 g/dl and children 10-12 years is 11.5-15.0 g/dl. Anaemia has been defined as the reduction of haemoglobin in the blood below normal for the age and sex of the patient. According to WHO guidelines, children between 5 to 11 years old with Hb<l 1.5 g/dl and children between 12 to 14 years old with Hb<12.0 g/dl are anaemic. It is important to note that the presence of symptoms and signs of anemia does not correlate well with the haemoglobin levels. Patients who develop anaemia rapidly for example after severe bleeding may have signs and symptoms of anaemia when the haemoglobin level is just below normal.

Epidemiology

Epidemiological patterns of ^schistosomiasis vary considerably between areas and localities. It can thus, be expected that morbidity patterns are highly heterogeneous in different communities and therefore variations in prevalence and intensity of infection (Wilkins 1987). A'-number of factors determine the transmission of schistosome infections. These factors include the manner in which the environment is contaminated by human laeces, the water contact patterns, the distribution of the intermediate hosts and its population dynamics, the relationship between the parasite and the host (WHO 1999). Schistosomes like many other helminthes are over dispersed within the population but only a small part of the population excrete most of the eggs (Anderson and Gordon 1982). The prevalence and intensity of infection generally peak in the second decade of life (Polderman, 1979) where the majority of the infected individuals in endemic areas have light infections and are asymptomatic. There is high evidence that high worm burdens are more[N] likely to cause clinical disease and health impairment than light infections (Cook et al 1974). The severity of the disease has been shown to relate to the number of eggs in the tissues and the excreta.

Pathology of intestinal schistosomiasis

Intestinal lesions such as inflammation, fibrosis and colonic polyposis characterize intestinal schistosomiasis. Pathology is represented by isolated periovular granulomas, which are formed in the intestines, liver and less frequently in the lungs. Tumor masses may be found in the intestines, mesentery, and perirectal or pericolonal areas and may present intestinal polyps or may simulate lymphoma by involving the mesenteric lymph nodes. Severe lesions in the large intestine may cause stenosis and may simulate an adenocarcinoma of the coloif. Schistosomal polyps have been observed in adults resulting in a syndrome of anemia and bloody diarrhea. Intermittent diarrhea has been reported in patients with intestinal schistosomiasis. Patients suffer from constipation and faeces sometimes contain blood and mucus. On palpation, the abdomen appears tender, liver may be enlarged and hardened but hepatic function tests are invariably normal. Pallor, emaciation, dehydration, dependent oedema, ascites and clubbing of the fingers are common.

In a cohort study carried out in Uganda on morbidity indicators of *Schistoma mansoni* (2006) multivariate logistic regression model was used to calculate the probability of a child being anaemic; this model also included intensities of *S.mansoni* and hookworm infections and the analysis controlled for age and sex; this was also used for the assessment of between-school variation in anaemia prevalence.

There was need to control for malaria as a potential confounder that can attribute to anemia in children since it is highly endemic in most parts of Uganda.

In my study the history of malaria within the last 24 hours will be obtained from children and those found positive will be excluded. In the same study it was observed that children heavily infected with *S.mcmsoni* or hookworm had significantly lower haemoglobin counts at baseline compared with those not infected.

Their results showed that anaemia is associated with schistosomiasis and hookworm infection in Ugandan children.

Halfolan Mahler (1985) note4 that the transmission of infection for all schistosome species is dependent on human water contact and the extent plus duration of this contact in association with domestic and occupational activities.

Water related activities may be gender influenced, and are generally different for males and females, and may be modified by age and cultural traditions. Children may contribute to adult activities of both sexes but appear to be at greatest risk as a consequence of playing and swimming in water.

In view of the above interviewing and a standardized questionnaire will be used to determine the risk factors that expose children to infection.

The health consequences noted include anemia.and weight loss in the affected group.

Life cycle of Schistomes

The human schistosomes (blood flukes) are digenetic trematodes in super family Schistomatoidea.

S. mansoni, S. haematobium and S. japonicum are the three most important species affecting man. *S. mekongi and S. intercalatum* are less widely distributed.

S. mansoni and S. haematobium are endemic in Africa. All these species may cause clinical disease and significant morbidity (WHO, 1985). The life cycle of schistosomes involve an alternation of generations with sexual reproduction in the vertebrate host and the asexual reproduction in the snail to replace the considerable parasite losses between man and the snail. Secondly, all the offspring's of a single egg will be of the same sex. The adult worms do not multiply in the vertebrate host each successful cercaria develops into a single adult worm. The free living stages that is; the miracidium and cercaria do not feed, are short lived and are adapted to life in a hypotonic, aquatic environment.

Aquatic fresh water snails of the genus *Biomphalaria* act as intermediate hosts for intestinal schistosomiasis that is widely distributed in 35 countries in Africa, South of Sahara and in Egypt.

CHAPTER 3

3.0 METHODOLOGY

3.1 Study area:

The study was conducted in Kibwezi division in Makueni district. Kibwezi is located 200Km southeast of Nairobi city and is a schistosomiasis endemic area (Farah Idle et al 2003). Climatically Kibwezi is dry with erratic rains distributed in two seasons declining down slope from 800mm to 500mm.The inhabitants of this region belong almost exclusively to the Akamba ethnic community and live in widely scattered homesteads.

By 1999 the population of Makueni district was 771,545 people, 51.7% were females and 48.3% were males (Ker^ya National Bureau of Statistics 1999 Census).

This region is characterized by a large population of non -human primates, which have been reported as natural hosts of human schistosomiasis (Ekro et al 2000).

Using data on schistosomiasis from DVBD in Makueni district, 2 primary schools that is Mangieni which is near River Kambu and Iviani which is near River Mtito were selected based on prevalence. Children from classes 2,3,4,$.ahd'6,7 and 8 who had assented were requested to provide the stool and blood samples.

if

A*

HAP OF MAKUENI DISTRICT SHOWING K1BWEZI DIVISION

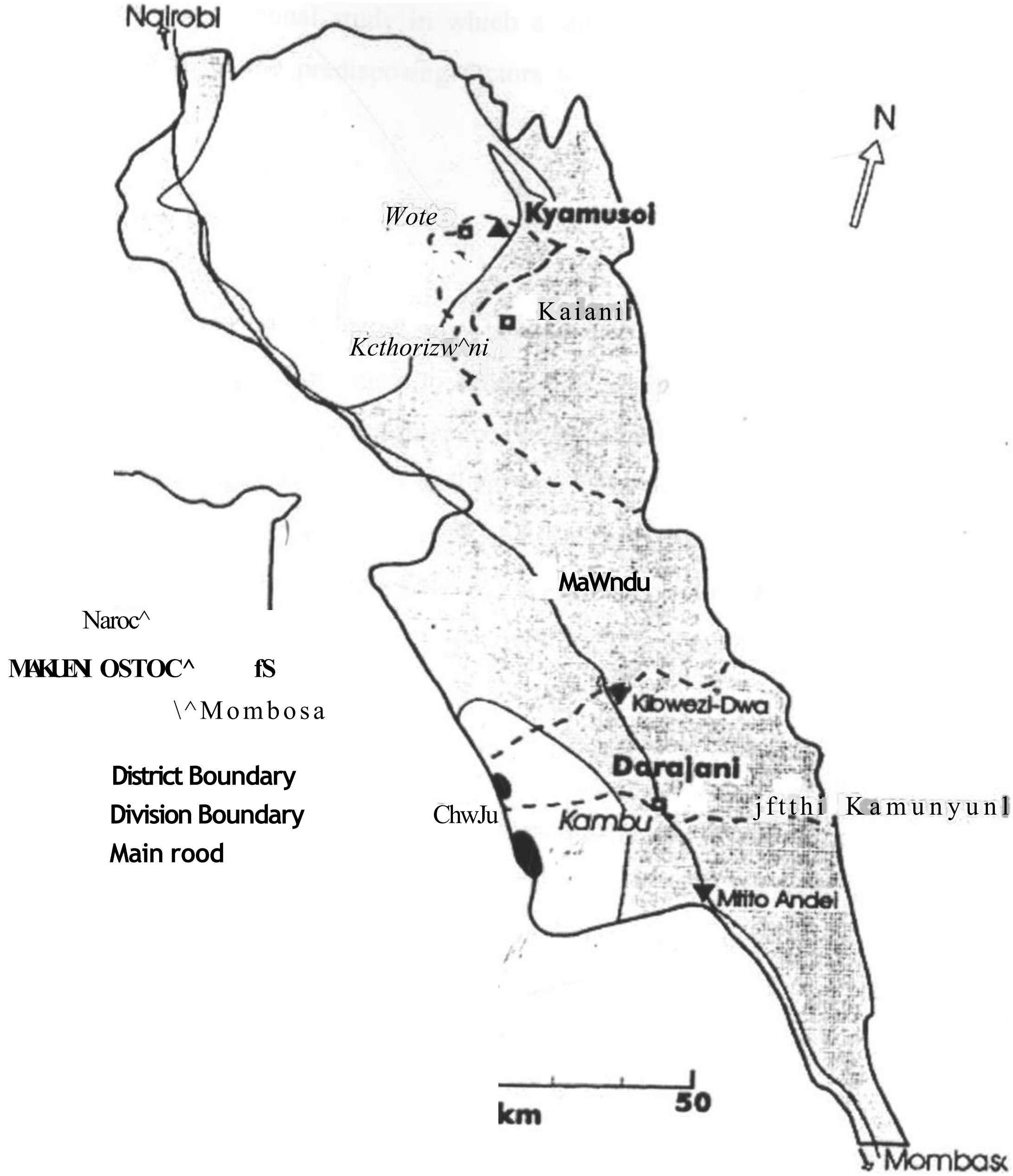

Figure 1

3.2 Study design:

Analytical cross sectional study in which a simple questionnaire was administered to determine some of the predisposing factors in relation to prevalence and intensity of infection.

3.3 Study procedure:

3.3.1 Enrolment:

Head teachers from both selected schools were approached and briefed about the study. Permission was sought from them to conduct the study in there schools. Children from classes 2,3,4,5 6,7 and 8 were informed of the study and written consent forms in Swahili and English languages were given to them to take to their parents to read or be read by the child and consent or decline for the child to participate in the study. The following day, those children whose parents had consented were selected by systematic sampling and every third child was selected and taken through the questionnaire by one of the field assistants. \ t >

3.3.2 Stool collection:

Each child was given a polypot with his name labeled on it and requested to provide a stool sample. Two separate Kato-Katz faecal smears were prepared for each sample provided by the child by the field assistants at the DVBD station (Mtito) were the slides were read by two technicians, with each technician reading a slide per sample using an electric compound microscope. Hookworm eggs were read on the very day of slide preparation as these would dissolve in,the Kato reagent.

Blood drawing:

A sample of blood was collected by qualified technicians from DVBD (Kenya) following the Standard Operating Procedures laid down in Lab SOP No: 301.Blood was collected by qualified and experienced personnel from DVBD. Technicians put on protective clothing and gloves and kept laboratory safety practices. Technicians established rapport with the child by explaining what they were going to do. The client was told to sit on a chair and hyper-extend his or her arm. The third or fourth finger of the hand was pricked the hand, which is*ot used by the pupil for writing. The finger prick site was cleaned

3.2 Study design:

Analytical cross sectional study in which a simple questionnaire was administered to determine some of the predisposing factors in relation to prevalence and intensity of infection.

3.3 Study procedure:

3.3.1 Enrolment:

Head teachers from both selected schools were approached and briefed about the study. Permission was sought from them to conduct the study in there schools. Children from classes 2,3,4,5 6,7 and 8 were informed of the study and written consent forms in Swahili and English languages were given to them to take to their parents to read or be read by the child and consent or decline for the child to participate in the study. The following day. those children whose parents had consented were selected by systematic sampling and every third child was selected and taken through the questionnaire by one of the field assistants. < »

3.3.2 Stool collection:

if

Each child was given a polypot with his name labeled on it and requested to provide a stool sample. Two separate Kato-Katz faecal smears were prepared for each sample provided by the child by the field assistants at the DVBD station (Mtito) were the slides were read by two technicians, with each technician reading a slide per sample using an electric compound microscope. Hookworm eggs were read on the very day of slide preparation as these would dissolve in the Kato reagent.

Blood drawing:

A sample of blood was collected by qualified technicians from DVBD (Kenya) following the Standard Operating Procedures laid down in Lab SOP No: 301.Blood was collected by qualified and experienced personnel from DVBD. Technicians put on protective clothing and gloves and kept laboratory safety practices. Technicians established rapport with the child by explaining what they were going to do. The client was told to sit on a chair and hyper-extend his or her arm. The third or fourth finger of the hand was pricked °n the hand, which is rtet used by the pupil for writing. The finger prick site was cleaned

3.2 Study design:

Analytical cross sectional study in which a simple questionnaire was administered to determine some of the predisposing factors in relation to prevalence and intensity of infection.

3.3 Study procedure:

3.3.1 Enrolment:

Head teachers from both selected schools were approached and briefed about the study. Permission was sought from them to conduct the study in there schools. Children from classes 2,3,4,5 6,7 and 8 were informed of the study and written consent forms in Swahili and English languages were given to them to take to their parents to read or be read by the child and consent or decline for the child to participate in the study. The following day, those children whose parents had consented were selected by systematic sampling and every third child was selected and taken through the questionnaire by one of the field assistants.

3.3.2 Stool collection:

if

Each child was given a polypot with his name labeled on it and requested to provide a stool sample. Two separate Kato-Katz faecal • smears were prepared for each sample provided by the child by the field assistants at the DVBD station (Mtito) were the slides were read by two technicians, with each technician reading a slide per sample using an electric compound microscope. Hookworm eggs were read on the very day of slide preparation as these would dissolve in the Kato reagent.

Blood drawing:

A sample of blood was collected by qualified technicians from DVBD (Kenya) following the Standard Operating Procedures laid down in Lab SOP No: 301.Blood was collected by qualified and experienced personnel from DVBD. Technicians put on protective clothing and gloves and kept laboratory safety practices. Technicians established rapport with the child by explaining what they were going to do. The client was told to sit on a chair and hyper-extend his or her arm. The third or fourth finger of the hand was pricked on the hand, which is^-not used by the pupil for writing. The finger prick site was cleaned with a methylated spirit swab and allowed to air-dry. A sterile lancet was used to puncture the center of the finger pad. The finger was massaged gently to allow a drop of blood to clot at the punctured site. The pupil was given a small ball of dry cotton wool to hold over the punctured site for a few minutes to stop bleeding. One drop of blood was collected in a haemocue microcuvette and the haemoglobin concentration was read directly in the field.

3.3.3 Nutritional Status of Children:

Height and weight and of children were measured. These parameters were used to deteTmine body mass index and wasting which is weight for height.

They were also used to determine the level of malnutrition, which is a potential confounder.

3.4 Inclusion criteria:

Children from the study area and whose parents, had consented to provide the required samples. Primary school children from classes2, 3,4,5,6, 7and 8.

3.5 Exclusion criteria:

Fingers that were swollen, scarred or covered with a rash were not be pricked.

Those who had had a history of fever in the last 24 hours prior to the study and body temperature above 37.2°C

3.6 STUDY LIMITATIONS:

The principal investigator did not know the local languages of the community where the study was carried out, laboratory technicians along with the three field assistants based at the station in the field were of the Akamba tribe and were the people who could communicate with the children. Majority of the children though in school could not understand English therefore .the entire questionnaire was conducted in Kamba language by the field assistants.

Some parents along with their Children refused to consent but for those who refused a substitute was always,pi'cked on for replacement.

3.7 Ethical Considerations:

Ethical approval for this study was sought from UON Ethical Review Committee.

Written informed consent was obtained from the Head teacher of each School.

Consent was obtained from the parent on behalf of the children to participate by giving stool and blood required for the study. Oral assent was obtained from the children before getting samples from them. Confidentiality of children's identity was upheld and all information given by the same was securely kept. Children found with schistosomes were noted down and names referred to the nearest health facility for treatment with a dose of Praziquantel. The children identified with anaemia were referred to the nearest Health center for treatment.

3.8 DATA HANDLING

Field data collection took six days, four interviewers were involved in the exercise; the team comprised of two laboratory technicians, three field assistants and the principle investigator plus one driver. The processing oV the results began shortly after the fieldwork commenced with the cross checking of the questionnaires returned after the days work, this was a distinct advantage as the principle investigator would discuss the errors detected with the field assistants in' preparation of the following days work, checking was also done on the slides read as hookworm was read immediately before the eggs would dissolve in the Kato reagent.

Sample size:

$N=Z^2*pq/d^2$

Where

n is the desired sample,

Z is the standard normal deviate at 95%confidence interval;

P is the proportion in the target population estimated to have schistosomiasis =45%,(DVBD-Report). d is the accuracy of measuring prevalence of schistosomiasis= 5%.A minimum of 380 school children from class2, 3, 4,5, 6,7 and8 who had assented were provided with polypots U> provide stool, urine and a sample of blood to have 80% power to estimate prgyalence of schistosomiasis at 45%± 5%.

^ 7 Kthical Considerations:

Ethical approval for this study was sought from UON Ethical Review Committee.

Written informed consent was obtained from the Head teacher of each School.

Consent was obtained from the parent on behalf of the children to participate by giving **stool and** blood required for the study. Oral assent was obtained from the children before **getting** samples from them. Confidentiality of children's identity was upheld and all **information** given by the same was securely kept. Children found with schistosomes were **noted down** and names referred to the nearest health facility for treatment with a dose of **praziquantel.** The children identified with anaemia were referred to the nearest Health **center** for treatment.

3.8 DATA HANDLING

Field data collection took six days, four interviewers were involved in the exercise; the team comprised of two laboratory technicians, three field assistants and the principle investigator plus one driver. The processing of*the results began shortly after the fieldwork commenced with the cross checking of the questionnaires returned after the <f days work, this was a distinct advantage as the principle investigator would discuss the errors detected with the field assistants in preparation of the following days work, checking was also done on the slides read as hookworm was read immediately before the eggs would dissolve in the Kato reagent. ' •

Sample size:

$N=Z^2*pq/d^2$

Where

n is the desired sample,

Z is the standard normal deviate at 95%confidence interval;

P is the proportion in the target population estimated to have schistosomiasis =**45**%,(DVBD-Report). d is the accuracy of measuring prevalence of schistosomiasis= · 4

5%.A minimum of 380 school children from class2, 3, 4,5, 6,7 and8 who had assented were provided with polypots to provide stool, urine and a sample of blood to have 80% Power to estimate prevalence of schistosomiasis at 45%± 5%.

3.9 Data entry and analysis:

Data was entered in the computer and cleaned up using Microsoft Access. It was managed and analyzed using lntercooled Stata 9.2. Questionnaires were coded and infection rates computed. Potential confounders were controlled using multivariate analysis. Egg-counts were log-transformed to ensure normality. The observed differences in the haemoglobin levels between the infected and the un-infected was compared using a student's t-test to see whether the difference was statistically significant. The association between haemoglobin levels and parasitic infections were studied using univariate analysis.

3.10 Variables/Measurements:

Independent variables that were measured included anthropometric characteristics such as height and weight, socio-demographic characteristics such as age and sex were also determined using a questionnaire. Egg- count was done using a compound microscope and this was used to determine intensity of infection. One of the main outcome variables of interest to this study was the haemoglobin level amongst the children examined that is both the infected and the un-infected so that a comparison could be done.

Possible confounders in this study include: malaria infection, nutritional- status sex and age. The mentioned confounding variables were controlled both at the design and analysis stage. Measuring anthropometric characteristics was used to assess nutrition status. Information was obtained in reference to the time of on-set of malaria; body temperature was determined and those found with temperature above $37.2^{U}C$ were excluded from the study. We were unable to examine for malaria parasites due to limited funds and time as a way of controlling for this potential confounder.

Control of confounding was done by stratification and regression analysis.

3.11 Data quality control:

All specimen **containers.**were'labeled with identification numbers using **a** pencil. All specimen containers were checked by the field assistants while still in the field to see whether they contained the appropriate samples. All identification numbers on the specimen bottles were verified with the registration sheet by the field assistants. All questionnaires were reviewed by the principal investor after every days work and part of the data was being entered on a daily basis as th* ^ading of the slides was going but all could not be completed because of too much The principal investigator along with the technicians reviewed the entire laboratory ^ t s that had been read at the field station and proceeded with the rest of the unfinished /ric to Nairobi were the reading of the remained slides and other unfinished work completed at the University of Nairobi in the Microbiology department.

A*

4.0 RESULTS

Two schools were visited, 214 pupils from Miangeni participated in the study out of which 55.61% were boys and 44.39% were girls. From Iviani primary school, which is just across River Mtito, 168 pupils were enrolled into the study out of which 55.95% were boys and 44.05% were girls; total enrollment was 382 pupils. Total enrollment for boys in both schools was 213, which is 55.76% of the total number of pupils that participated in the study while 169 girls participated in the study, which is 44.24% of the total number of pupils that participated in the study. Iviani primary school had a slightly lower population of pupils compared to Miangeni and this proved difficult to recruit children from classes 3, 4, 5 and 6 as planned earlier on, as a result we took on pupils from class 2 up to 8.Figure 1 shows a summary of the demographics and descriptive information obtained through interviewing the school children examined in both schools.

Table 1: Descriptive characteristics

Variable	Overall > (N=382)	Miangeni (N=214)	Iviani (N=168)
Sex, n (%)			
Boys	213 (55.76)	119(55.61)	94 (55.95)
Girls	169 (44.24)	95 (44.39)	74 (44.05)
Age, n (%)			
5-11 years	154*(40.31)	74 (34.58)	80 (47.62)
12-14 years	188 (49.21)	113 (52.80)	75 (44.64)
15-18 years	40(10.47)	27(12.62)	13 (7.74)
Religion '	.		
Protestant	273 (71.47)	149 (69.63)	124 (73.81)
Catholic	109 (28.53)	65 (30.37)	44 (26.19)
Availability of radio at home			
Yes	17(4.45)	10(4.67)	7(4.17)
No	365 (95.55)	204 (95.33)	161 (95.83)
Awareness about bilharzia			
No	190 (49.74)	99 (46.26)	91 (54.17)
Yes	192 (50.26)	1 15 (53.74)	77 (45.83)
Source of information on bilharzia			
Radio	33 (8.64)	26(12.15)	7(4.17)
Poster	1 (0.26)	1 (0.47)	0 (0.00)
School	105 (27.49)	72 (33.64)	33 (19.64)
Friend	14(3.66)	6 (2.80)	8 (4.76)
Relative	24 (6.28)	5 (2.34)	19(11.31)
Others	15(3.93)	6 (2.80)	9 (5.36)
Not applicable	190 (49.74)	98 (45.79)	92 (54.76)

Continuation of Table 1

Source of water			
River	105 (27.49)	5 (2.34)	100 (59.52)
Stream	9 (2.36)	2 (0.93)	7(4.17)
Pond	4(1.05)	4(1.87)	0 (0.00)
Piped water	242 (63.35)	198 (92.52)	44 (26.19)
Others	22 (5.76)	5 (2.34)	17(10.12)
Knowledge of family with/without toilet			
No	42(10.99)	34 (15.89)	8 (4.76)
Yes	340 (89.01)	180 (84.11)	160 (95.24)
Type of toilet			
Flush toilet	14(3.66) 365	14(6.54)	
Pit latrine	(95.55)	197 (92.06)	168 (100)
No toilet	3 (0.79)	3 (1.40)	
Families that share toilets			
No	339 (88.74)	177 (82.71)	162 (96.43)
Yes	40 (10.47)	34 (15.89)	6(3.57)
Not applicable	3 (0.79)	3 (1.40)	
Number of families sharing toilets			
Not applicable	340 (89.01)	172 (80.37)	168 (100)
Less than 5	27 (7.07)	27 (12.62)	
More than 5	15(3.93)	15 (7.01)	
Swimming			
No	243 (63.61)	134 (62.62)	109 (64.88)
Yes	139 (36.3$)	80 (37.38)	59 (35.12)
Place of swimming			
Not applicable	243 (63.61)	134 (62.62)	109 (64.88)
River Mtito	118 (30.89)	62 (28.97)	56 (33.33)
River Kambu	1 (0.26)	1 (0.47)	
Indian ocean/Mombasa	4(1.05)	4 (1.87)	
Others	16 (4-19)	13 (6.07)	3 (1.79)
Deworming			
No	241 (63.09)	127 (59.35)	114(67.86)
Yes	141 (36.91)	87 (40.65)	54 (32.14)
Stomach problem			
No	278 (72.77)	155 (72.43)	123 (73.21)
Yes	104 (27.23)	59 (27.57)	45 (26.79)
Staying near water			
No	292 (76.44)	172 (80.37)	120 (71.43)
Yes	90 (23.56)	42 (19.63)	48 (28.57)
Blood in stool			
No	329 (86.13)	190 (88.79)	139(82.74)
Yes	53 (13.87)	24(11.21)	29(17.26)
Blood in urine			
No	367 (96.07)	208 (97.20)	159 (94.64)
Yes	15(3.93)	6 (2.80)	9(5.36)
Blood vomited			
No	374 (97.91)	213 (99.53)	161 (95.83)
Yes	8 (2.09)	1 (0.47)	7(4.17)

Continuation of Table 1

Schistosoma mansoni infection			
Negative	223 (58.38)	135 (63.08)	88 (52.38)
Positive	157(41.10)	77 (35.98)	80 (47.62)
Missing	2 (0.52)	2 (0.93)	
Hookworm infection			
Negative	367 (96.07)	209 (97.66)	158 (94.05)
Positive	12(3.14)	4(1.87)	8 (4.76)
Missing	3 (0.79)	1 (0.47)	2(1.19)

PREVALENCE AND THE MEAN EGG COUNT

Table 2: Prevalence of *Schistosoma mansoni* infection

	Percentage (%)	P-value
Overall prevalence	41.3 (36.3-46.3)	
Prevalence by school		
Miangeni	36.3 (29.8-42.8)	0.0263
Iviani	47.6 (40.0-55.2)	
Prevalence by sex		
Boys	50.9 (44.2-57.7)	0.0000
Girls	29.2 (22.3-36.1)	
Prevalence by sex and school		
Miangeni boys	46.6 (37.5-55.7)	0.1573
Iviani boys	56.4 (46.3-66:5)	
Miangeni girls	23.4 (14.80-32.0)	0.0640
Iviani girls	36.5 (25.4-47.6)	

Prevalence is one of the measure of disease frequency that can be used in cross-sectional studies as this one to easily determine the amount of disease burden in a population, for this reason it was used to determine the worm burden as mean and geometric mean were used to determine the intensity of infection.

Table 2 above summarizes the overall prevalence, prevalence according to school and according to sex:

Table 3 below summarizes the mean egg count and geometric means that were used to determine the intensity of infection

	Mean egg count (Eggs/g)	**Geometric mean (Eggs/g)**	**P-value**
Overall intensity	230.1 (162.7-297.4)	82.2 (65.8-102.7)	
By sex			
Boys	263.6 (175.8-351.3)	92.2 (69.4-122.3)	0.0000
Girls	157.0 (62.9-251.1)	64.1 (45.2-91.1)	
By school			
Miangeni	193.9 (110.9-277.0)	72.8 (53.4-99.2)	0.0183
Iviani	265.3 (159.8-370.8)	92.7(67.0-128.1)	

Table 3: Intensity of *Schistosoma mansoni* infection

The geometric mean intensity for both schools was 82 epg. Boys had a higher geometric mean intensity of infection than girls as shown from the table above. This is due to the more water contacts they make as compared to girls!

The graph below shows a normal distribution of infections with most of the infections concentrated around the mean. T his graph shows a distribution for only infected children from the two schools after the egg-count was log-transformed.

S mansoni infection distribution

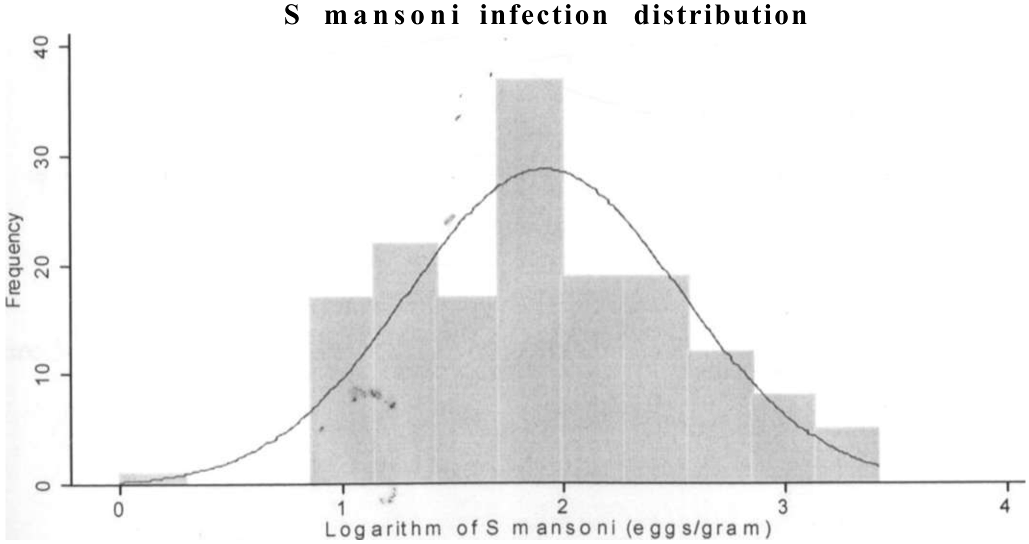

Figure 2

PROPORTION OF CHILDREN WITH ANAEMIA IN THE STUDY POPULATION

The Table 4 below shows the number and percentage of school children who were anaemic within the different age groups:

Table 4: Proportion of anaemia in different age groups

Age category	Normal (n, %)	Anaemic (n, %)
5-11 years	129 (83.77)	25 (16.23)
12-14 years	151 (80.32)	37 (19.68)
15-18 years	31 (77.50)	9 (22.50)

The graph below shows that within the study population there was some children whose haemoglobin level was below lOg/dl, which is in agreement with the information obtained in relation to the different age groups, these outliers were the children who were anaemic as shown below:

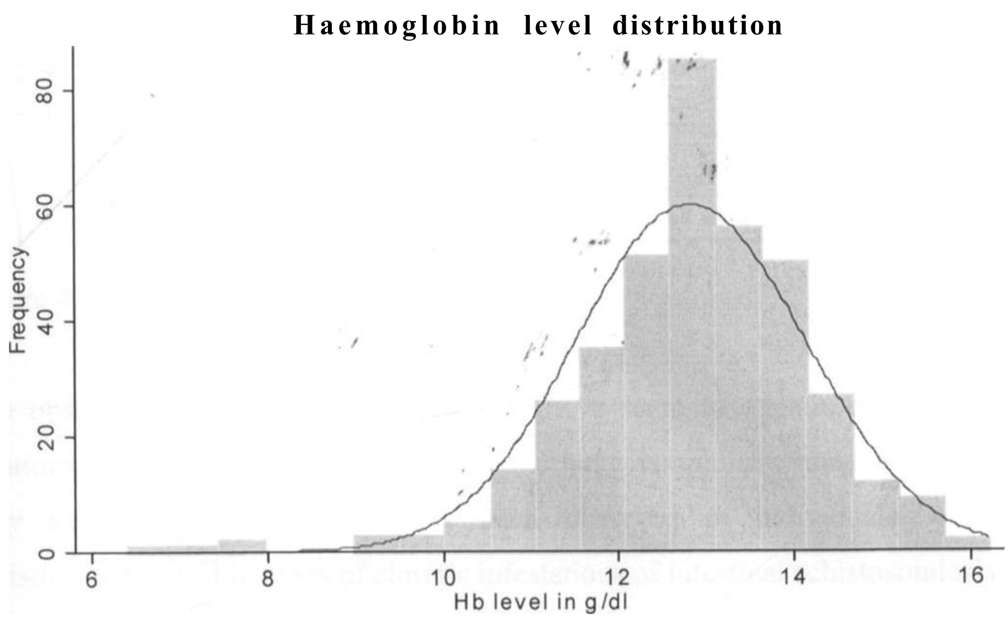

Figure 3

CORRELATION BETWEEN SCHISTOSOME INFECTION AND THE HAEMOGLOBIN LEVELS:

Despite the absence of a direct cause-effect relationship between intestinal schistosomiasis caused by S.mansoni and the observed haemoglobin levels a correlation done in this study to investigate the association showed an inverse relationship with a correlation coefficient of r= -0.1194 as indicated below:

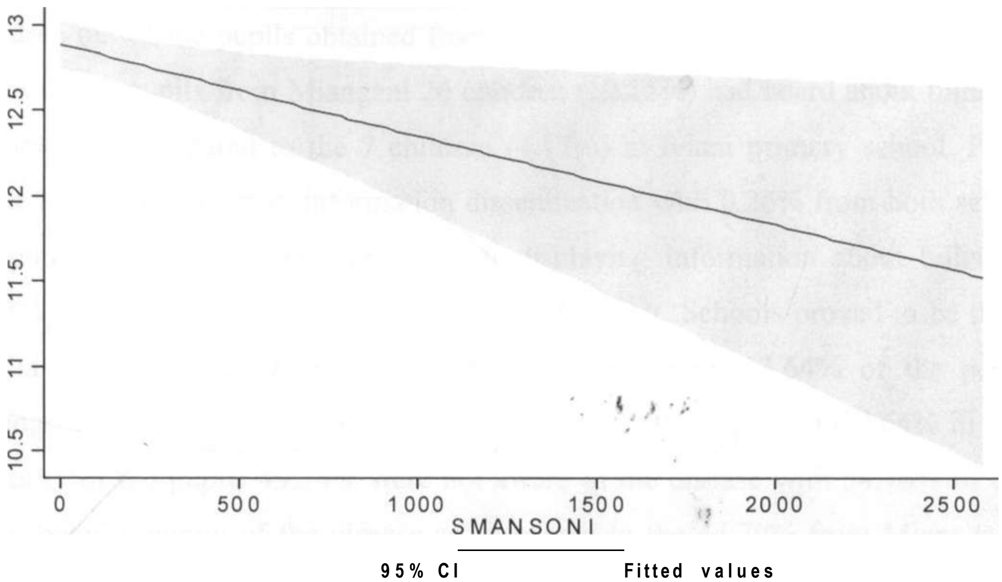

Figure 4

The observed correlation in the figure 4 above seem to explain a weakly significant relationship, this could as well be due to the large sample size and the coefficient being very small however anaemia has been observed in individuals with intestinal schistosomiasis and in cases of chronic infestations of intestinal schistosomiasis but much of it is attributed to portal hypertension.

CHAPTER 1

DISCUSSION

INFORMATION ACCESS ABOUT BILHARZIA

Out of the 382 children who participated in the study, 17 children (4.45%) had no radios in their homes, 365 children (95.55%) had radios in their homes. From Miangeni primary school 204 children (95.33%) had radios while in Iviani it was 95.83%, which is 161 children out of the pupils obtained from this school the difference being not significant. More of the pupils from Miangeni 26 children (12.15%) had heard about bilharzias over the radio as compared to the 7 children (4.17%) in Iviani primary school. Posters and other IEC ranked least in information dissemination with 0.26% from both schools with no pupil in Iviani having seen a poster displaying information about bilharzia. Only 0.47% of the pupils from Miangeni had seen a poster. Schools proved to be the greatest media of health education accounting for 27.49% with 33.64% of the pupils from Miangeni having heard about the disease at school as compared to 19.64% in Iviani.The majority of the pupils 49.74% were not aware of the disease with 54.76% of the pupils from Iviani ignorant of the disease as compared to the 45.79% from Miangeni primary school.

According to the KDHS of 2003, information access is essential in increasing peoples knowledge and awareness of what is taking'place around them; this may eventually affect their perceptions and behaviour. Different means can be used to reach out to the people even in the most remote parts of the country; these include airing out messages over the radio in local languages, use of posters and other IEC materials, use of film vans, use of political and religious leaders, information dissemination at schools and acting out plays among others. Health education in schools seemed to be the most effective way of reaching out to the school children as compared to the rest whose effect on the population was insignificant. This probably explains the high proportion of the children in Iviani (59.74%) of the pupils from this school who had never heard about bilharzias in their life time a disease endemic in their own area, these results also correlate with the higher prevalence of the disease in the same school as compared to their counterparts.

SOURCE OF WATER

The main source of water in this region is piped water (63.35%) with 92.52% of the pupils from Miangeni using piped water which is pumped from the main bore hole to the different taps in the surrounding areas; however a lower proportion of the pupils 26.19% from Iviani primary school use/access piped water with the majority of them 59.52% using water from River Mtito for both domestic and other purposes. This is an unprotected source of water; 4.17% of the pupils from Iviani use water from the streams as compared to their counterparts from the other school where only 0.93% use water from the streams. Although a greater proportion of the pupils seem to have access to piped water, a significant proportion of the pupils 30.9% use unprotected sources of water.

People from this area have access to different sources of water some of which include piped water, rivers streams, some ponds, and water reservoirs among others. These sources can be broadly divided into protected and unprotected waters. The source of water used by the people in this area could not statistically explain the observed infections at ($P=0.38, x^2=4.2$). This is probably du^ to the fact that many of the people in the area use piped water 63.35%, as compared to the other group. Alarge proportion of the children from Iviani 59.2% use water from rivers and'streams, this partly explain the high infections amongst the children from this school.

This region also experiences long dry periods of drought most of the year around and most of the rivers and streams dry up, with such a hostile environment people resort to buying water at a subsidized fee from the water reservoirs /tanks that were constructed through the technical co-operation of the American Government (USAID) and the Kenyan Government. Most of the time, people tend to use the nearby and easily accessible sources of water for domestic purposes; through the questionnaire administered, distance could not explain the observed prevalence and intensities of

• 9 • r*

infection at (P=0.583,X =0.3). This could be due to the moderate levels of awareness for the need to use safe water.

USE AND AVAILABILITY OF TOILETS

Participants were interviewed about the availability and use of toilets in their local areas, knowledge about this i^vital in explaining the disposal of faecal matter that would otherwise explain the observed prevalence and the continued existence of the disease despite the continuous attempts to control it within the region by the different stakeholders.

Children were interviewed about the use and availability of toilets in their homes and surrounding places, 0.79% of the overall children enrolled into the study admitted to not having toilets in their homes with all of them 1.4% coming from Miangeni primary school while an overall 10.99% of the pupils knew of a family at least without a toilet still with a greater proportion of 15.89% of the pupils coming from Miangeni primary school having knowledge of a family without a toilet as compared to the 4.76% in Iviani primary school. 10.47% of the pupils from both schools come from homes where toilets are shred amongst families with 15.89% of the pupils from Miangeni as compared to 3.57% of the pupils from Iviani primary school. 7.07% of the children come from homes where a toilet is shared amongst less than five families while 3.4% of them come from homes where a toilet is shared amongst more than five families, with 12.62% of the children from Miangeni primary school coming tfrom. homes where a toilet is shared amongst less than five families and 6.07% of the children from Miangeni coming from homes where a toilet is shared amongst more than five families. There was no sharing of toilets amongst children from Iviani primary school.

Sewage contaminated with schistosome eggs once carried into water bodies such as rivers and streams can maintain the continued existence and proliferation of this worm thus increasing the risk of infection. For those who don't have toilets and are next to water bodies stand a risk of being infected in highly endemic areas. The life cycle of this worm has been described in great detail by a'number of authors all indicating the need for water to hatch to the next stage and the involvement of both the primary and the secondary host for its continued existence. In this study three children (0.79%) reported for not having toilets at their homes, while an overall 10.99% knew of a family without a toilet in their home places, however this association between the observed prevalence and the absence of toilets was not statistically-significant at (P=0.021,X~=5.36), this could be due to the very small number of lack of toilets recorded in relation to the relatively large sample size.

A*

SWIMMING

A large proportion of the children 64.14% did not know how to swim, however 35.86% of the total enrollment knew how to swim with 36.45% from Miangeni swimming as compared to the 35.12% from Iviani primary school. The majority of those who knew how to swim 31.15% did it in River Mtito followed by 1.05% who go for swimming in the Indian Ocean with the rest swimming in other water bodies. Out of the 36.45% from Miangeni primary who knew how to swim, 29.44% swim in River Mtito while 33.33% of the 35.12% from Iviani primary swim in this Mtito river implying that most of the children in this area swim in this river. 63.09% of the total number of children enrolled have never taken drugs for deworming yet are highly susceptible to infection with only36.91% claiming to have taken Praziquantel and other antihelminthes drugs. Only 40.65% of pupils from Miangeni had taken drugs before as compared to 32.14% from Iviani hence a larger proportion of the pupils from Iviani had never been treated before. 27.23% of the total enrollment had experienced stomach problems in the last two weeks with 26.79% of the pupils who participated in the §tudy from Iviani primary reporting stomach problems in the last two weeks as compared to the 27.57% who reported a similar problem from Miangeni primary. Given the low proportion of children who had taken deworming tablets before in both schools it is imperative that all children from these schools be treated with at least with a dose of Praziquantel regardless of their infection status. , ,

Swimming was one of the observed factors that could statistically explain the observed prevalence at ($P=0.000, X^2=22.68$). In fact the odds of acquiring the infection amongst those who swim was 2.81 times higher than those who don't swim. There was statistically significant association between swimming activity and observed infections amongst girls and boys ($P=0.08, X^2=3.13$ and boys $P=0.004$, $X^2=8.3$) respectively. As observed earlier on, a greater proportion of the children from both schools who go swimming swim in River Mtito (31.15%) thus this is likely to be one of the main sources of infection. This partly explains the higher infections observed in Iviani (46%) as compared to Miangeni (35%) since a greater proportion of the pupils from Iviani who swim (33.33%) do so in River Mtito as compared to the 29.44% from Miangeni primary who swim in the same*river.

Although the general prevalence was 41.3% more of the infections occurred in Iviani primary school which is nearer to River Mtito than Miangeni primary school. Swimming is one of the exposure variable that statistically account for the observed infections with a ($P=0.005, X^2=7.93$) among others. Out of the 35.86% of the children who know how to is 36.3%. Also in terms of distance though we could not measure due to logistic problems and time, but generally Iviani is nearer to this River than Miangeni with a collapsed bridge and therefore children are most likely to cross through these waters since these waters are not fast moving and children have to move from one side to the other.

In both schools boys who were infected had a higher worm burden than females, these differences in prevalence and intensity of infection which were statistically significant could be explained by the differences in water contact patterns between the two sexes. Boys have a higher water contact behaviour than girls, they are the ones who fetch water most of the time, take cattle for grazing and drinking water and are more engaged in swimming, comparatively girls are more engaged in domestic work than boys, thus boys tend to spend more hours in water as they carry pu^ different activities thus increasing their chances of infection. This agrees with the study carried out by Kloos *et al*in 1997 in Machakos district. <>

PREVALENCE AND THE MEAN EGG COUNT

Overall, two schools were visjted, 382 pupils participated in the study, double Kato Katz smears were prepared and read per sample provided by each child, two slides got missing, this left us with a total of 380 slides. The overall prevalence of *S.mansoni* for all the children examined in both schools was 41.3% (95%, CI 36.3%-46.3%). The total geometric mean for all examined children was 82e.p.g (for infected cases only) and the mean egg count for all the examined children were 230e.p.g.The maximum observed epg was 2580 at Miangeni primary school. An epg of 2400 was observed at Iviani primary school. The mean egg count for boys (264 epg) was higher than that for girls, which was 157epg. Iviani primary had a ^higher mean egg count (265epg) than that of Miangeni which wasl94epg. Other helminthes such as *Trichuris, Ascaris, H.nana* were seen though with a negligible prevalence with hookworm being slightly higher than the rest with a prevalence of 3%. a*

PREVALENCE OF INFECTION BETWEEN SCHOOLS

In comparison, Iviani had a higher prevalence of 47.6% (95%, CI 40%-55.2%) as compared to Miangeni with a prevalence of 36.3% (95%, CI 29.8%-42.8%), the difference in prevalence between the two was statistically significant at (P=0.0263).

The prevalence of S.mansoni amongst girls examined in the two schools examined was 26% at (95%, CI 19%-33%) was lower than that observed amongst the total number of boys examined in both schools which was 51% at (95% CI 44.1%-57.9%) and the difference was statistically significant (P=0.000).

PREVALENCE OF INFECTION BY SEX WITHIN SCHOOL

The prevalence of *S.mansoni* amongst boys was 50.9% (95%, CI 44.2%-57.7%) and was statistically different at (P=0.0000) from that of all the girls examined.

The prevalence of *S.mansoni* amongst boys of Iviani was higher at 56.4% (95%, CI 46.3%-66.5%) than that for boys from Miangeni whose prevalence of infection was 46.6% (95%, CI 37.5%-55.6%), this difference was not statistically significant at P=0.1573) and therefore could only be explained by chance. Similarly the observed difference in prevalence between girls from Iviani,36.5% (95% CI, 25.5%-47.5%) was not statistically different at (P=0.064) from that of girls from Miangeni whose prevalence was 23.4% at (95% CI, 14.8-32%).

From both schools, 31.15% swim in River Mtito, this partly explains the higher infections observed in Iviani primary (47.6%) as compared to Miangeni primary where prevalence was relatively low. The observed prevalence and intensities of infection have been accounted for by such factors like swimming, water contact activities, and absence of toilets among others that could not be fully investigated due to financial constraints.

PROPORTION OF CHILDREN WITH ANAEMIA

Anaemia has been defined as the reduction of haemoglobin in the blood below normal for the age and sex of the patient. According to WHO guidelines, children between 5 tol 1 years old with Hb<l 1.3g/dl and children between 12 to 14 years old with Hb<12.0g/dl are anaemic. This was used as the basis for the categorization of the children according to age group to arrive to the above figure. Using the WHO definition, 72 children (25.7%) out of the total examined were anaemic. Out of the 154 children between the age group of 5-11 years, 25 of these had their haemoglobin levels less than 11.5g/dl representing 16.23% of the children within this age bracket, their haemoglobin levels ranged between 6.4g/dl-l 1.4g/dl. Out of the 188 children between the age group of 12-14 years, 37 of these had their haemoglobin levels ranging from 9.4g/dl-l 1.9g/dl representing 19.68% of the children within this age bracket. Out of the 40 children who were 15years and above, 9 of these had their haemoglobin levels ranging between 7.2g/dl-l 1.9g/dl representing 22.5% of the children within this age bracket, these are significant proportions registered that there is need to establish the cause of this in school going children.

COMPARISON OF THE MEAN HAEMOGLOBIN LEVELS BETWEEN THE INFECTED AND THE UN-INFECTED CHILDREN

Out of the 380 children fully examined 157ohi\dren (41.3%) were infected with *S.mansoni.* The mean haemoglobin level of the infected children wasl2.78g/dl as compared to the 12.88g/dl of the uninfected children. The mean haemoglobin level for all the children examined in both schools was 12.83g/dl with an overall range being 6.4g/dl tol6.2g/dl. The mean haemoglobin level for Miangeni was 12.69g/dl with a minimum Hb of 7.2g/dl and a maximum ofl5.3g/dl whereas the mean haemoglobin concentration for Iviani was 13g/dl with a minimum of 6.4g/dl and a maximum of 16.2g/dl. The mean haemoglobin level for boys in both schools was 12.85g/dl while that for girls was 12.8g/dl. Haemoglobin level for boys ranged from 6.4g/dl tol5.8g/dl while for girls it ranged from 7.8g/dl to 16.2g/dl. There was no significant difference in the observed haemoglobin levels (P=0.7167) between the two sexes.

The mean haemoglobin level of the infected children was 12.77g/dl as compared to the 12.88g/dl of the un-infected children. The difference between the two mean haemoglobin levels of the infected and uninfected when compared using a student's t-test were not statistically significant/different at (P=0.3931) implying that infected children are not likely to be anaemic as stated eairlier on in the hypothesis. The observed mean difference between the infected md uninfected was due to chance.

Although there was an observed difference between the mean haemoglobin level of the infected and uninfected children the difference was not statistically significant, the observed mean difference could have been due to chance or some confounder such as asymptomatic malaria given that this is also a malaria endemic region or nutrition status. All children that reported a history of malaria in the last 24 hours prior to this study or had a body temperature above 37.2°C were excluded. The prevalence of other helminthes that could cause anaemia was insignificant with hookworm having a higher prevalence of 3%, which was not statistically significant. No physiological process that takes place in the *S. mansoni* worms has been documented that require blood however (Moore *et ah,* 1975) noted the presence of haematin residues in the gut caeca of muscular females which are later regurgitated from the blind gut of the worm suggesting the presence of one of the components of blood.

CHAPTER 1

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

In conclusion, the study revealed that children who are infected with intestinal schistosomiasis are not likely to be more anaemic than the un-infected children since there is no significant difference between the haemoglobin levels of the two groups being compared. The difference in the haemoglobin levels between the infected and un-infected is not significant.

Intestinal schistosomiasis does not cause anaemia, however there was a weakly inverse relationship between schistosome infection and the haemoglobin levels which could either be due to chronic schistosome infections or portal hypertension or even could have been due to the large sample size in relation to the small correlation coefficient. It is important to note that haematin residues have been observed in the gut caeca of muscular females of the worm by (Moore *et al* 1975) suggesting<the presence some components of blood.

A significant proportion of the study population was anaemic with the prevalence of anaemia in the school children examined being 25%.*-'

The overall prevalence of intestinal schistosomiasis was 41.3% where as the overall intensity of infection was 82epg. There is a decline in the overall prevalence from 45%, which was used to calculate the sample size to 41.3% indicating a positive impact on the disease control by the programme implemented Prevalence of the disease differed significantly between schools and sex. Swimming, frequency of water contact, lack of information about the disease and absence of toilets accounted for the prevalence and intensities of infection observed. Distance from the water source and the type of water source did not explain the observed prevalence and intensity of infection.

Health education in schools is one of the most effective ways of reaching out to the population and this could bring about significant behaviour change that can lead to a decline in the infection rates. Media messages and use of other IEC materials ranked least in disseminating information to the public.

6.2 Recommendations

Despite the observed prevalence within the two schools sampled there is need to carry out a general prevalence survey within the region/district covering even the non-going school communities which would be used as a basis for assessing whether there is need to implement regional mass treatment.

Further studies need to be done to establish the cause of the observed prevalence of anaemia as this would affect children's health and performance at school.

A similar or related study should be done in which malaria is fully controlled for as a potential confounder by examining for the malaria parasites as this region is highly endemic for malaria.

Information dissemination need to be prioritized by the programme implemented, an integrated package involving radio messages, posters and use of related IEC materials need to be adopted as a way of reaching out to the people in order to realize a greater impact; a study needs to be carried out to determine the-level of awareness and the most effective way of reaching out to all the within the affected community.

it

There is need to reconstruct and rehabilitate the bridges that were washed away by the waters across River Kambu and River Mtito as children continuously wade through these waters as they cross from one side to the other thus increasing the risk of infection and during rainy seasons when the water levels' are high can even pause a greater risk to peoples lives.

The existing infrastructure and facilities put in place at the field station are such of a great value to operational research studies but can be improved further with the availability of computer and photocopying services as this would facilitate immediate data entry as soon as it is collected from the field.

An

REFERENCES:

Anderson, R.M; and Gordon, D.M 1982:Process influencing the distribution of parasite numbers within host populations with special emphasis on parasite-induced host mortalities. Parasitology: 373-398

Artemis Koukonari *et al* 2006: Morbidity indicators of *S.mansoni*: Relationship between infection and Anemia in Ugandan Schoolchildren before and after Praziquantel and Albendazole Chemotherapy Imperial College Faculty of Medicine: 278-286

Bradley D.J. 1972: Regulation of parasite populations, a general theory of the epidemiology and control of parasitic infections. Transactions of the Royal Society of Medicine

Cook, J.A; Baker.S.T; Warren K.S and Jordan 1974:A controlled study of morbidity due to *Schistosoma mansoni* in St. Lucia children based on quantitative egg excretion. Journal of Tropical medicine and hygiene625-633.

Coutinho H. M, McGarvey' S .T, Acosta LP et al 2005:Nutritional status and serum cytokine profiles in children, adolescents, and young adults with *Schistosoma japonicum*-associated hepatic fibrosis in Leyte, Philippines Infectious Diseases 528-536

Edward H.Michelson 1985:Women and Schistosomiasis. Division of Preventive Medicine. Maryland USA: 24-32

Ferguson A 1986: Women's-health in a marginal area of Kenya.

Government of Kenya Population Census Report 1999: Central Bureau of Statistics (Kenya)

Hans Verhoef *etal* 2001:Serrum transferring receptor concentration indicates increased erythropoiesis in Kenyan children with increased asymptomatic Malaria

Herman Fieldmeier and Ingela Krantz: A synoptic inventory of needs for research on women and tropical diseases with an application for schistosomiasis. Nordic school of Public health Goteborg, Sweden and Buchhold Ann, Rain Germany pages 100-121

Irene A Agyepyong 1985: Women and Malaria: Social, economic and cultural behavior determinants of malaria. Adrabrake, Accra Ghana

Jane Carter and Oregenes Lemma: Practical laboratory manual for Health centers in Eastern Africa. Wilson Airport. Nairobi Kenya.

Katz; Chaves and Pellegrino.J 1972:A simple device for quantitative stool thick-smear technique in *Schistosoma mansoni. Revisto do instituto de medicina. Tropical de Sao Paolo* 397-400

ij

Kenya Demographic and Health survey 2003: Central Bureau of statistics and ministry of Health (Kenya)

Lab SOP No.301: Haematology SOP; Complete blood cell count by Coulter Analyzer.

Lemma.A.1970: Laboratory . and field evaluation of the Molluscicidal properties of *Phytolacca dodecandra.* Bulletin of the World Health Organization: 597-600

Mckerrow.J.H; Newport.G; Fishelson.Z: 1991 Recent insights into the structure and function of a larval proteinase in host infection by a multicellular parasite. Proceedings of the Society of the Experimental and Biological Medicine 119-124

Polderman.A.M 1979:-Transmission dynamics of endemic schistosomiasis. Tropical Geographical medicine 465-475

Sturrock.R.F 1993:The Parasites and their lifecycles in Human Schistosomiasis. (Eds.P.Jordan, G.Webbe and R.F.Sturrock) CAB International Wallingtonl-10

Wilkins H.A 1987:The epidemiology of Schistosome infections in Man. In the biology of schistosomes from genes to latrines (Eds.RollinsonD andSimpsonAJG) London Academic Press 379-397

World Health Organisation 1985: The control of Schistosomiasis. World Health Organization Expert Committee. Technical Report Series728

World Health Organization .1993:The control of Schistosomiasis. Report of a WHO Expert Committee. World Health OrganisationTechnical Report Series 830

World Health Organization 1999.Report of a World Health Organization, informal consultation on Schistosomiasis Control.Geneva.WHO/CDS/CPC/SIP/99.2

APPENDIX

Sample questionnaire to be used

1 Id no . . . . .Age... yrs

2. Sex... MaleD Female •

3. Religion

•-Protestant. D-Catholic D-Muslim. D-Hindu.

•-Traditional D-Others D-No religion.

4. Do you have a radio at home?

•Yes.... DNo....

5. Have you ever heard of Bilharzia?

•Yes.... DNo....

6. If yes, from who? . c

RadioD.... PosterD...NoneD SchoolQ.... FriendD.... RelativeD.... Others specify^..

if

7. What is the main source of water used for domestic work at home?

•River. •Stream. DPond. DHarvested rainwater. DPiped water. DOther sources

8. Do you know of any family in your area, which does not have a toilet?

Yes... DNo... •

9. What kind of toilet facility do you have at home?

Flush toilet •.... Pit latrine •....

No toilet •.... Use bush •.... Stream •....

10. Do you share this toilet with any other family? Yes...DNo....•

11. If yes, with how many families? Less than 5D More than 5...D

12. Do you know how to swim? Yes...DNo...•.

13. If yes, where do you go for swimming?

14. Have you ever been given drugs for deworming? YesDNoD

15. Have you had any stomacfi'problems in the last two weeks? YesQNo...Q

16. Do you stay near any water body or irrigation field? Yes • NoD

/ /

LTBTtAKT

MHIVB^

A*