THE RELIABILITY OF A QUESTIONNAIRE-BASED SELF-DIAGNOSIS IN ESTIMATING THE PREVALENCE OF SCHISTOSOMA HAEMATOBIUM IN KWALE DISTRICT

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any University or any other award.

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

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DEDICATION

This work is dedicated to my entire family and in particular my late aunties and grandmother who despite being illiterate made sure I went to school.
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Operational Definitions

Egg positive - Urine found with one or more eggs of shistosoma by microscopic examination.

Egg negative - Urine found without any eggs of shistosoma by microscopic examination.

Mild infection- egg count of 1-49 eggs per 10 ml. of urine.

Moderate infection- egg count of 50-999 eggs per 10 ml. of urine.

Severe infection- egg count of 1000 eggs and above per 10 ml. of urine.

Intensity of infection- severity of infection as determined by egg count.

Micro- haematuria- blood in urine as determined by reagent strips.

Macro- haematuria also sometimes referred to as gross haematuria.

Kisonono- the vernacular name for schistosomiasis.

Praziquantel- the drug used for the treatment of schistosomiasis.
Schistosomiasis is a chronic debilitating parasitic infection. It is currently estimated that 200 million people are infected by this world's most prevalent parasitic disease and 600 million are at risk of infection. It is endemic in 76 countries, 85% of all cases and virtually all of the most severe are in African countries.

Notwithstanding the situation in sub-Saharan Africa over the past 20 years, schistosomiasis control has been successful in other geographical regions especially due to reduction of morbidity by chemotherapy.

In Kenya, the distribution is along the lake Victoria, in central, eastern, and coast provinces. In most cases, the occurrence of schistosomiasis is in areas where irrigation and settlement schemes as well as water development projects have been established. Prevalence of up to 80% and above have been recorded among primary school children in endemic areas of the country.

Routine diagnosis of urinary schistosomiasis is by microscopic or chemical reagent strips. Both methods are expensive and are not available at the peripheral health units in the country where the disease is endemic.

The aim of this study was to assess the reliability of self-diagnosis through a questionnaire to estimate the prevalence of urinary schistosomiasis before and after treatment among 470 boys in 4 primary schools in Kinango division of Kwale district.

Before treatment, the prevalence of schistosomiasis by microscopic method was 79.9% while by reagent strip haematuria was 77.9% and proteinuria 76.9%. Self-diagnosis prevalence was 73.3%. Sensitivity and specificity of self-diagnosis were 84.8% and 71.1% while positive and negative predictive values were 92.4% and 55.7% respectively. After treatment, the prevalence of schistosomiasis by microscopic method was 27.1% while by reagent strip haematuria was 18.2% and proteinuria 22.6%. Self-diagnosis prevalence was 43.4%.

These results suggest that self-diagnosis is a reliable method of assessing prevalence before treatment and that despite the infection in terms of egg count being reduced by treatment, morbidity continued beyond three months after treatment and therefore self-diagnosis is a better tool to assess morbidity as well.
CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

1.1 GENERAL INTRODUCTION

Schistosomiasis is a major chronic debilitating parasitic disease. It is estimated that 200 million people are infected and 600 million are at risk of infection. It is endemic in 76 countries of the world and an estimated 85% of all cases and virtually all of the most severe are concentrated in African countries. The disease is widely distributed globally from China, Indonesia and Philippines (Schistosoma japonicum) through Eastern Mediterranean, Arabian Peninsula and African countries (S. haematobium and S. mansoni) and to the new world, Brazil, Surinam, Venezuela, Caribbean Island, Laos Peoples Democratic Republic and Cambodia (WHO, 1999).

The fatality rate of intestinal schistosomiasis due to S. mansoni is estimated as high as 1:1000 infected people in Sudan (Kheir, 1999). Mortality in urinary schistosomiasis most often associated with bladder cancer and in the hepato-splenic form related to bleeding from collateral shunting of blood through oesophageal veins, is difficult to estimate but exceeds 100,000 annually (Editorial Acta Tropica 2000). The global burden of schistosomiasis morbidity results in 156,000 years of life lost and accounts for 1.5 million disability adjusted life years (Hatz, 2001).
In 1990 there were estimated to be 1080 million school age children who shared a total burden of 150 million DALYs, 11% of the global burden of the disease for all age groups. (DALY years lived with disability). Some of the major forms of anaemia can be alleviated by the treatment of intestinal nematodes and schistosomiasis (Bundy and Guyatt, 1996). Schistosomiasis remains one of the most prevalent parasitic infections and has significant economic and public health consequences (Chitsulo, 2000).
1.2 LITERATURE REVIEW

1.2.1 Global picture of schistosomiasis distribution.

Schistosomiasis is a major chronic debilitating parasitic disease surrounded by controversy as to its explicit contribution to the overall morbidity, mortality and effect on productivity within the endemic countries. It is estimated that over 200 million people in 76 countries of the World are infected with schistosomiasis and 600 million are at risk of infection. Of the 200 million infected 120 million are symptomatic and 20 million suffer from severe disease (WHO, 1999). Target groups include school age children, fishermen, irrigation workers and also whole communities with high prevalence rates. The capacity to diagnose and to treat and the availability of affordable high quality drugs in sufficient amounts as part of essential drug packages at all levels of the health system are pivotal for success of control programme. In 1984 the committee on the Control of schistosomiasis endorsed a strategy for the control of morbidity due to schistosomiasis (WHO, 1984).

In the mid 1950s S. japonicum was endemic in 12 provinces: more than 100 million were at risk and more than 10 million were infected. The World Bank provided a loan of 71 million US dollars from 1992 to 2000 with the stated objective of reducing prevalence and intensity of schistosomiasis in humans and animals through interruption of transmission by chemotherapy (Yuan, 2000).
Morbidity due to schistosomiasis has decreased significantly. In the province of Hunan and Hubei which harbour most of the remaining areas with considerable transmission, the incidence of acute cases in 1999 was less than 0.25 per 100,000 inhabitants. Outbreaks of acute cases during heavy flooding has effectively been contained over the last 10 years. Between 1989 and 1995 prevalence in humans was reduced by 52% and in bovines by 32% (WHO, 2001).

Much success has been achieved in many countries in the control programmes especially through reduction of morbidity by frequent chemotherapy.

1.2.2. Schistosomiasis problem in the African Region

A major part of infected and at risk are in Africa south of Sahara (Savioli, 1997; WHO, 1999). In this region few countries have undertaken successful control programmes because of the limitation of resources. The infection has also spread in Africa because of water resources development schemes, population increase and population movements (Schisto manual TDR, 2001).

There are 3 schistosome types in the African continent namely, S. haematobium the cause of urinary schistosomiasis is present in 44 countries while S. interculatum and S. mansoni are endemic in 10 and 40 countries respectively (Schistosomiasis Maunal TDR 2001). A number of vertical programmes implemented during seventies and eighties in Malawi, Mali Senegal, and the Republic of Congo produced impressive results but were not sustainable in the long term due to lack of
resources and deteriorating health care infrastructure across countries of the African continent. Large areas of Africa remain whose urinary schistosomiasis status is unknown (Lengeler, 1991). Furthermore other health problems such as malaria diarrhoeal diseases and HIV/AIDS got higher priority (Magnussen, 2001).

In Egypt between 1989 and 1996 about 2.5 million patients were diagnosed and treated. *S. haematobium* prevalence fell from 11.9% in 1988 to 5.0% in 1996. In the middle and upper Egypt prevalence between the years 1969 and 1983 had varied between 22.6% to 45.7% but by 1998 was down to between 2.3 and 7.3%. In the lower Egypt prevalence in the year 1983 to 1993 was between 15.8 and 46.6% reducing to 4.4% to 11% by 1998 (WHO, 2001).

In Senegal the building of Diama dam on Senegal river has introduced schistosomiasis in the lower basin while in Somalia and Djibouti the infection has been introduced in due to population movement. In Burundi an eight (8) year follow up of a school based intestinal schistosomiasis control study in Bujumbura (Engels, 1994) a total reduction in prevalence of 73% and a reduction in moderate to heavy and heavy infection by >80%.

Population movements involving refugees from conflict, famine and natural disasters coupled with development of water resources projects for agriculture
hydroelectricity and water supply purposes promote the introduction spread and
intensification of the disease (Hunter, 1982).

The current strategy in schistosomiasis control in most African countries is to
concentrate on reducing morbidity rather than attempting to eradicate the disease
by transmission reduction (Hatz, 2001). Schistosomiasis is now being tackled in a
broader context integrating the epidemiology and control of geohelminths and
schistosome infections. Although these two groups of infections may be
independently distributed within countries where they are endemic (Brooker, 1999).
They both affect school children which simplified targeting within communities.

1.2.3 Distribution of schistosomiasis in Kenya

In Kenya the areas affected include Machakos, Kitui, Kwale, Taveta, Tana River
district, Mwea, other parts of central and districts along the lake Victoria. Different
organizations have been working on the control of schistosomiasis. These include
the Division of vector borne diseases of the Ministry of health, Kenya Medical
Research Institute and the National Irrigation Board in areas where such schemes
have been established. In Kwale district where the study was carried out prevalence
of between 50% and 78% have been recorded (Shimada, 1987). A preliminary
survey in Mwea revealed a prevalence of 69% in a study village after high
prevalence were reported in both hospital and National irrigation Board
records (Katsivo, 1986). In Kisumu an overall prevalence of 48.6% while in Bunyala and Samia prevalence of *S. mansoni* was as high as 70% (Masaba, 1981).

The Kenya Medical Research Institute in collaboration with Japanese International Cooperation Agency, are currently working out an integration programme for the control of all parasitic diseases through the Hashimoto Initiative where in collaboration with other relevant institutions a National control programme will be formulated. A training programme will also be undertaken where control managers from the Eastern Africa region will participate (JICA reports, 2002).

A good example of projects which have contributed to the increase in the transmission of schistosomiasis in Kenya include the Mwea irrigation and settlement schemes and the Masinga dam for hydroelectricity production. *S. mansoni* has a wide patchy distribution and it is believed that the high water temperatures with the absence of intermediate snail hosts in the Coastal Plain of Kenya restricts the extension of this trematode. In general it is found between elevations 300 and 2000 metres above sea level. *S. haematobium* is confined to the Coastal Plain and scattered foci in Eastern, Central, Western and Nyanza Provinces (Highton, 1975). *S. mansoni* occurs in the same areas as *S. haematobium* around Kitui, Taveta, Machakos and the lower parts of Kiambu and Murang'a.
The main snail vectors of *S. mansoni* in the country are *Biomphalaria pfeifferi* and *B. sudanica* which are distributed in most parts of Kenya except the Coastal Plain.

The main vector for *S. haematobium* along the Coast is the *Bulinus africanus* group (Brown, 1981). In particular *Bu. globosus* which may be found in various types of habitats including grassy lake edges, stream beds and their sides, swamps, dams and ponds especially on vegetation growth. *Bu. nasutus* and *Bu. prodauces* breed in isolated foci, the former with scattered distribution and the latter appearing to be restricted to warmer parts of Nyanza and Western Provinces.

*Bu. forskalii* is also widely distributed but in Kenya it is known to transmit *S. bovis* only.

In Machakos district observation on the effect of different treatment strategies on transmission and found that selective treatment of all infected people in an area resulted in an extended period of low transmission (Sturrock, 1994). A less extensive strategy including all infected school children led to reduction of transmission for two years. Long term studies on the snail population showed that chemotherapy alone would not have a lasting effect on transmission and reinfection rates were largely determined by ecological factors affecting the vector population. In Matuga Division of Kwale treatment was given once every 12 months and health education using locally developed materials was given by teachers. After two
treatments the overall prevalence of haematuria was reduced by 60% and the
prevalence of macro-haematuria by 73% (Magnussen, 1997).

In Msambweni Division of Kwale district it was shown (King, 1991) that the
reduction in prevalence and intensity of infection obtained after one to three
recoveries was maintained for at least 2 years after the last recovery. They also
observed a significant reduction in upper urinary tract pathology following repeated
therapy in the second and third year.

1.2.4 Age variation in prevalence and intensity of infection

The prevalence and intensity of schistosome infections in humans normally follows
a characteristic pattern of variation with age. Both the prevalence and intensity of
infection are low in young children, rise to a peak in the second decade of life and
decline to low levels among the oldest individuals (Agwanda, 1997). The reasons
for this age related characteristic have been subject of inconclusive debate during
the last two decades (McCullough and Bradley, 1973; Gryseels, 1994).

Two explanations have been given for this variation. First the age specific variation
in the levels of *schistosoma* infection reflects the age related susceptibility to
infection. Studies (Bradley and McCullough, 1973; Butterworth, 1985) have shown
that the reduction in levels of infection with age is due to a gradually acquired
protective immunity to infection among older individuals. The second explanation
is that age-specific variation in the level of schistosome infection reflects the age related rates of exposure to infection. Age groups supporting the highest prevalence and intensities of infection also have the highest levels of exposure in form of water contact behaviour associated with domestic, economic or recreational activities. Treating children with anti-helminthic drugs is one of the most attractive health service that can be provided in schools for a number of epidemiological clinical and practical reasons. First, school age children typically harbour the heaviest infection with many species of worms and such children appear to contribute most to the transmission of infections in their communities (Bundy, 1990).

1.2.5 Transmission of Schistosomiasis

Like most other endemic areas the transmission pattern of schistosomiasis in Kenya is varied ranging from continuous throughout the year in areas with perennial snail habitats to seasonal in places with seasonal habitats (Kombe, 1992). In Kwale district, *Bulinus* species were found to inhabit rivers and ponds which are seasonal some remaining dry for as long as 4-5 months (Nojiam, 1983). In Bujumbura a reduction in transmission was recorded during the period of yearly treatment with lower prevalence in new school entrants. However this was related to change in sanitation degree of urbanization and accessibility to rural transmission sites and thus not direct effect of treatment programme (Engels, 1994). In Kwale cercarial
densities at the surface of water 2-3 cm deep was at 11 hours those at middle point
25cm deep and at the bottom 50cm deep were at 12 hours and 13 hours
respectively (Mutua, 1994).

The adult schistosomes usually inhabit the venous vesical plexuses in male-female
pairs. After mating females migrate to the ends of venules where they lay
characteristic terminally spined eggs which make their way through the bladder wall
into the vesical cavity and eventually out of the host via the urine. The ova must
reach water in order to hatch and once this happens they form free living larval
stage (the miracidia) which infect a susceptible snail vector. In the snail they form
sporocysts which through asexual multiplicative stages eventually develop into
cercariae a second free swimming larval stage which shed from the snail into water
at an average rate of 213 per day for the shedding life of the snail (Hairston, 1973).

1.2.6 Control of Schistosomiasis

For many years the control of schistosomiasis has aimed at eradicating the disease
mainly through vector control. However after a long time of doing so with colossal
amounts of resources used, very little impact was realised on both the transmission
and disease. As a result a review of the control strategy was undertaken. Hence the
strategy of control of morbidity through chemotherapy was adopted (WHO, 1985)
as opposed to eradication, as this was viewed as unachievable. Treatment at the
community level results in a drop in prevalence of schistosomiasis.
To secure sustainability schistosomiasis control must be integrated in the existing health care service at the district level and a high degree of intersectoral collaboration is needed (Magnussen, 2001). Since prevalence is generally higher in school-aged children, control programmes often involve both health and education sectors. If transmission is not reduced concurrently however, a gradual return to pre-treatment prevalence occurs (Hatz, 2001).

In a field study, more than half of the community in an endemic area continued to use river water despite provision of a clean water supply (Karama, 1994). Community involvement to enhance participation in control takes time (Alaii, 1994). In confirming the need for an integrated approach it was observed that it was difficult to health educate people on an empty stomach (Katsivo, 1994). The importance of health education, using well tailored IEC (Information Education Communication approach) is widely accepted and can be implemented through the school system, but it is not easy to integrate such programmes into comprehensive medical programmes (Moji, 1996). Many attempts have been made to develop a vaccine against schistosomiasis, but a product for large-scale use that shows good cost effectiveness is not yet available and is unlikely to become available in the next decade (Capron, 1998).
1.2.7 Chemotherapy

Chemotherapy currently represents the single most effective and practical strategy to combat human schistosomiasis both in the individuals and the population. Praziquantel, the heterocyclic prazimo-isoquinoline compound discovered in 1972 is effective against all known human \textit{schistosoma} species and most other trematodes and cestodes. It is rapidly absorbed from the gastrointestinal tract reaching a maximum serum concentration in 1-2 hours and is rapid acting (Cooppan, 1986). The long term effect of treatment in reducing the risk for the development of chronic disease in spite of rapid re-infection has been assessed (Hatz, 1998).

Significant reduction in the prices for anti-helminthic drugs have occurred including praziquantel at the same time there has been a change in the control objective to focus more clearly on morbidity control (WHO, 1999). Using a strategy of 6 monthly mass chemotherapy with praziquantel in Namibia good results were obtained with a reduction of intensity of infection and hepatomegaly among school children by 92% after 3 years. Health education sanitary improvement and focal mollusciciding supported the programme (WHO 2001). In Matuga area of Kwale, after 2 treatments given at 12 months interval the overall prevalence of haematuria was reduced by 60% and the prevalence of macro-
haematuria by 73%. The greatest benefit being seen in schools with highest prevalence and intensity of infection (Magnussen, 1997).

1.2.8 Diagnosis

The capacity to diagnose and to treat, and the availability of praziquantel an high quality drug is important in schistosomiasis control programme (WHO, 1999). Also the availability of affordable high quality drugs in sufficient amounts as part of essential drug packages at all levels of the health system are pivotal for success of such programme (Hatz, 2001). Indirect and direct methods to detect infection and pathological lesions are available to assess schistosomiasis morbidity. Indirect methods such as egg counts and other laboratory tests measure the prevalence and intensity of infection (Vennervald, 1998). Since intensity of infection is key determinant of morbidity the development of markers of morbidity rather than surrogate indicators of intensity of infection are necessary. Other indirect approaches such as questionnaire reflect the amount of perceived level of disease (Hatz, 2001).

1.2.8.1 Parasitological Diagnostic Technique

These techniques involves microscopical observation of *S. haematobium* ova in specimens (urine) collected from the suspected patient. Three methods using filtration have been used, namely the Nuclepore, Nytrel, and the Paper Filter (Bradley, 1968). The nytrel is a woven polyamide monofilament material which is
available in various mesh sizes. The 20micron pore size has been used successfully for the filtration of *S. haematobium* eggs.

This type of filter tends to dry rapidly and require moistening with a drop of saline to permit adequate visualisation of the eggs. The nuclepore is a polycarbonate membrane filter which comes in various pore sizes ranging from 8 to 14 microns and in precut diameters of 13 or 25 mm filters or in sheets which filters may be punched. Paper filters of 12 or 25 mm have also been used with iodine or ninhydrin staining in syringe urine filtration techniques (WHO, 1983).

The advantage of these methods is that it is rapid, suitable in estimating the intensity of infection. Processed specimen can be preserved for microscopic examination later. They are also useful in evaluating morbidity related to schistosomiasis. The disadvantage is that they become relatively insensitive with decreasing intensity of infection. Another limitations would be the availability of equipment and supplies with trained personnel to undertake the procedure (WHO, 1993) and also the quality control in a remote setting. In countries with resource limitation it may not be affordable and therefore not accessible to those people in endemic areas who need it most.
1.2.8.2 Semi-quantitative Indirect Diagnostic techniques

These techniques have been designed to identify infected persons in areas endemic for schistosomiasis. Those that have been investigated widely include, "Detection of haematuria frank or microscopic through the use of reagent strips.

It is thought (Warren, 1982) that both haematuria and proteinuria observed in heavily infected children are associated with facial lesions or submucosa patches related to ovipositing by adjacent worm pairs. In the process, development of lesions may occur which later develop into sandy patches (healing and scarring lesions) with the oedema and cell infiltration around them decreasing. Thus the reduction in haematuria and proteinuria is associated with regression of the pathological lesions or gradual involution after ovipositing ceases.

In assessing 4 indirect methods of screening which included history of haematuria, visual haematuria and micro haematuria at 1+ and 2+ positivity limit by reagent strips, it was observed that the sensitivity of history of haematuria was higher in children 71% as compared to 40% in adults(Lwambo, 1997). Visual haematuria had a higher specificity, positive predictive value and was more efficient than history. Using haematuria trace up or proteinuria 1+ up, sensitivity and specificity of reagent...
strip before treatment was 69.6% and 84.4% respectively. The value remained at 70.7% and 81.2% after treatment (Kiliki, 1991).

1.2.8.3 Self Diagnosis

In determining whether self diagnosis could be used as a basis for giving treatment in Tanga region of Tanzania (Ansell, 1999) observed that an average of 75% of children were correct in their self diagnosis while 3% gave a false-positive diagnosis. Using a questionnaire approach in estimating prevalence would be a sustainable method as it is affordable and does not require equipment or any technical support. It therefore can be undertaken by teachers or other members of the community. A history of haematuria and or visual haematuria are appropriate methods or preliminary screening of communities to identify those at risk of morbidity (Lwambo, 1997).
1.3 RATIONALE OF THE STUDY

Of the 200 million infected 120 million are symptomatic and 20 million suffer from severe disease (WHO, 1999). These symptoms could therefore be used to create a guide for a quick diagnosis even in our rural health facilities which are not supported with a diagnostic laboratory. The capacity to diagnose and to treat and the availability of affordable high quality drugs in sufficient amounts as part of essential drug packages at all levels of the health system are pivotal for success of a control programme (Hatz, 2001).

Due to the low budgetary allocation for preventive health care, there is need to develop affordable and sustainable strategies for control of *S. haematobium* of which self diagnosis by individual pupils of primary school age using symptoms including haematuria could reduce the cost of diagnosis as well as provide an estimate of the prevalence of infection in the community.

Treating children with anti-helminthic drugs is one of the most attractive health service that can be provided in schools for a number of epidemiological clinical and practical reasons. First, school age children typically harbours the heaviest infections with many species of worms and such children appear to contribute most to the transmission of infections in their communities.
School children represent the age group with the highest prevalence of the disease in most endemic settings, compliance is high and follow up is easy when using the education system. In addition treating this age group also reduces the transmission in the community.

1.3.1 Statement of the problem

Despite schistosomiasis prevalence of up to 90% among school-age children in the endemic areas of Nyanza Central Eastern and the Coast provinces of Kenya, efforts to control schistosomiasis is waning and less priority is given to the disease. Most health facilities in the endemic areas do not have the capacity to neither diagnose nor to treat it due to limitation of resources.

1.3.2 Research questions

Is self-diagnosis reliable in estimating prevalence of urinary schistosomiasis in school-aged children in terms of high sensitivity and specificity before and after treatment. Does intensity of infection increase such sensitivity or specificity.

1.3.3 Justification for the Study

Cost of diagnosis for urinary schistosomiasis using microscopic or chemical reagent strips are both unaffordable and unaccessible for the rural communities where the
disease is endemic. Self-diagnosis could be used to administer chemotherapy to both individuals and community which will enhance reduction in morbidity and therefore reduction in transmission of infection. The findings of this study will be useful in establishing guidelines for the national schistosomiasis control programme.

1.4 Null Hypothesis

Self-diagnosis using a questionnaire approach cannot be a reliable method of estimating prevalence of schistosomiasis among school children.
1.5 OBJECTIVE OF THE STUDY

1.5.1 General Objective

The general objective of this study is to assess the feasibility of using the self-diagnosis using a questionnaire approach in the estimation of prevalence of *schistosoma haematobium* in endemic communities, with a view to apply this simple and inexpensive approach in the control of schistosomiasis through chemotherapy.

1.5.2 Specific objectives

1. To estimate the prevalence of *S. haematobium* among primary school children by self-diagnosis using the retrospective questionnaire approach, before and after treatment.

2. To determine the prevalence of *S. haematobium* among the same primary school children using the quantitative methods (reagent strips and microscopic methods).

3. Calculate the validity of the self-diagnosis using the questionnaire approach in prevalence estimation (i.e., Specificity, Sensitivity, Positive and Negative Predictive Values) using the microscopic method as a standard.
CHAPTER 2: MATERIALS AND METHODS

2.1 The study Area

Kwale district is situated in the south eastern part of Kenya along the Indian Ocean in the coast province. The district is bordered by Taita Taveta in the west, Kilifi district and Mombasa island in the north and Republic of Tanzania in the south. It covers a total area 8322sq kilometers of which 65sq kilometers is water. Kwale has a monsoon type of climate which is hot and dry from January to April. The rainfall is bimodal with long rains usually starting around March/April and continuing until July. The short rains are concentrated in October and November.(Social-economic profile 1990).

In Kinango division where the study is being conducted there are several health delivery points including one district hospital a health centre and several dispensaries. Bamako initiative a primary health care concept of drug distribution had also been started but due to poor management most units have collapsed. Except the district hospital which is between 15 and 25 kilometers from most of the study area all other health facilities do not have the capacity to diagnose schistosomiasis by laboratory means. The hospital more often also runs out of supplies such as reagent strips or filter paper to undertake the diagnosis and so may depend only on clinical manifestation. There are about 200 primary schools in the district with about 15 to 20 of them being in Kinango division.
Figure 1: The location of Kwale district in Kenya
Figure 2: Kwale district Indicating Study area
2.2 Study Population and subjects

Kwale district is predominantly settled by Mijikenda group (over 80%) of which Wadigo and Waduruma are numerically most important. The Wadigo inhabit the coastal strip while the Wadurumas the hinterland and are primarily cattle rearers. Wadigos are predominantly muslim while wadurumas are either muslims or christians and a few are traditionist believing in spirits and ancestral gods. This study involved 470 boys from 4 primary schools in Kinango division. This is part of a sample that was being followed up in an ongoing study that was looking at the morbidity caused by *schistosoma haematobium* and the urological problems and urination patterns by Japanese Government through Japan International Cooperation Agency who have been involved in the area for more than fifteen years. Their activities was mainly the control of schistosomiasis.

2.2.1 Sampling and sample size determination

The following formula used by Fisher et al; (1998) was used to determine the sample size.

\[ N = \frac{Z^2 P(1-P)}{d^2} \]

- \( N \) = minimum sample size
- \( P = 0.60 \) (Assumed prevalence of 60%)
- \( Z = 1.96 \) (level of confidence)
- \( d = 0.05 \) (absolute precision)
- \( I = 5\% \) level of significance

**Hence** \( N = 369 \)
However, since the 470 children were to be examined for the urination pattern and morbidity study, the whole number were involved in our study, which took into account dropouts between the first and the second examination.

2.2.2 The inclusion criteria

The criteria for selection of these schools was on the basis that they had not been involved in the schistosomiasis control for at least 3 years. The relevant administrative and technical authorities concerned, such as the Ministry of Health, Education, Local authority, and the Provincial administration, were informed and were willing to participate, were included. All boys in the schools who could respond or understand were involved.

2.2.3 The exclusion criteria

Schools where any control of schistosomiasis had been initiated or were ongoing were excluded. Also, schools which only had a few classes or were not a complete primary school were excluded from the study.

2.2.4 Ethical consideration

All participation was by informed consent after all relevant authorities had also consented. Those found to be infected with schistosomiasis were treated. Those found to be suffering from other illnesses were referred to the relevant health institution. Health education on prevention and control of schistosomiasis was conducted at the end of the study.
The community was involved through a public baraza. They are informed about the objectives of the study and the consent to involve their children was sought. At the school the students were informed of the study objectives and their role clearly explained to them.

2.3 Study Design

This was a cross sectional study which employed longitudinal data collection methods. Randomization of the individual subjects was achieved by examining all the school boys who were present during the visit. Selection of the schools was purposive on the basis of available information on the prevalence of schistosomiasis and the absence of any interventions.

The study was conducted in collaboration with a team from the Institute of Tropical medicine in Nagasaki who were testing a new technology in assessing the urine flow patterns under different morbidity situation among primary school boys. The equipment and the technology was developed to be used among older men with prostrate problems. The investigators were therefore trying to assess the usefulness of this equipment to assess morbidity among boys with urinary schistosomiasis. It is useful to note that my study was carried out within the limitation of this study and therefore the lack of gender sensitivity.
2.4 Data collection and Research instruments

2.4.1 Administration of Questionnaire

The purpose of the study was again explained to each class at a time and the process that we had adopted was fully described to all the pupils. This was necessary to avoid confusion and some children escaping some of the processes. Teachers were requested to assist together with the field workers that were recruited for the exercise. The questionnaire was administered to each student individually after which a urine specimen was collected. We classified prevalence of self-diagnosed schistosomiasis as a morbidity indicator because it reflects child’s feeling of illness.

Questions asked included question on knowledge about urinary schistosomiasis (Do you know what bilharzia is?) This was asked before asking the question of self-diagnosis to check the reliability of answers for self-diagnosis. (Do you think you have bilharzia at this moment?) and four symptoms; self-reported haematuria (Did you have blood in urine in the last two weeks?), self-reported pain in urination (Did you have pain in urination in the last two weeks?), self-reported sense of heat during urination (Did you feel a sense of heat during urination in the last two weeks?), and self-reported lower abdominal pain (Did you have lower abdominal pain in the last two weeks?).
The reagent strips was dipped in the urine to determine the levels of haematuria and proteinuria. This process was done in the field as the urine specimens were being received. This was recorded immediately in a form prepared for the purpose. The urine was then covered properly and packed in large crates to avoid spilling and were finally transported to the laboratory.
Figure 3: The Investigator explaining the study to the students

at Dumbule primary school
2.4.2 Laboratory Investigations

At the laboratory the urine is filtered using 25mm millipore filter on holder. The urine is well shaken to avoid sedimentation of the eggs at the bottom. The shaking could be done physically by shaking the container or by the use of the syringe which is used to draw the urine by drawing into the syringe and out consecutively and drawing the urine to be filtered without allowing the urine to settle. 10 ml of the urine is drawn from each sample. Where the urine is less than the 10 ml the volume of the urine is measured using the syringe or any other suitable measuring jar. The egg load is calculated on the basis of 10 ml for purpose of standardizing the intensity of infection. Where the urine is indicative of high haematuria by being red or pink only a small volume is filtered and the slide examined for eggs immediately before discarding the remaining urine. When there are no eggs seen the remaining urine is measured to the required 10 ml and is filtered and processed like the others. When eggs are seen the slide is processed and intensity calculated according to the quantity observed. This precaution is taken to avoid congesting the slide with heavy egg load which will make it difficult to assess the intensity of infection. After filtration the filter was fixed on a slide and viewed on the microscope using an appropriate magnification lense. The egg load is counted using a simple hand counter. Changes of prevalence of self-diagnosed urinary schistosomiasis, self-reported blood in urine, pain in urination, sense of heat during urination, lower abdominal pain by treatment among the school-children were analysed.
Then the changes of relationship between these indicators and infection and morbidity such as gross-haematuria, micro-haematuria and proteinuria were also studied. Both parasitological indicators and morbidity indicators were taken in the two examinations. Parasitological indicators are prevalence of infection, intensity of infection (geometric mean egg counts per 10ml of urine), and prevalence of mild, moderate and severe infection. Intensity of schistosomiasis infection were divided into the following four levels by egg counts per 10ml of urine; negative, 0; mild, 1-49; moderate, 50-999; severe, 1000 and over. Heavy infection (WHO, 1999) are defined as 50 or more eggs per 10ml of urine.

Morbidity indicators were taken by observation of colour of urine (gross haematuria), testing of urine by reagent stick (micro-haematuria and proteinuria) and by asking questions (self-diagnosis and self-reported symptoms). WHO (1999) classified prevalence of gross haematuria and micro haematuria as parasitological indicators because they reflect infection and intensity of infection. However because they are also indicating morbidity by schistosome infection we classified them into morbidity indicator.
Figure 4: The use of reagent strips at Moyeni primary school.
Figure 5: The urological equipment in operation
2.4.3 Treatment

All those found infected by the microscopic method were informed accordingly and were all given an appointment for treatment at the school. A trained nurse was invited to attend to the treatment. Body weight was taken for each child and the dosage calculated at 40 milligram per kilogram of body weight single dose.

Some children who were negative by the microscopic method but requested for treatment were also treated. Some few children who were positive and were due for treatment but were absent during the treatment days were left out from treatment.

The whole process of the questionnaire and the urine sample was repeated three months after treatment to avoid contamination of the data by reinfection which was likely to occur.

2.5 Sensitivity and Specificity

These are useful measures of validity of a screening method or test. They reflect the proportion of diseased persons who are correctly identified as such and the proportion of non diseased person who are correctly called negative respectively.

They were calculated as follows;

\[
\text{Sensitivity} = \frac{\text{Number of true positive}}{\text{True positive + False negative}} \times 100
\]

\[
\text{Specificity} = \frac{\text{Number of true negative}}{\text{True negative + false positive}} \times 100
\]

These measures are useful especially when screening community or populations.
2.6 Predictive values of a test

These values are an indication of the probability of a patient who has tested positive by a test or method to really have the disease or not respectively. These values are more useful in a hospital setting.

Positive predictive value = \( \frac{\text{Number diseased} \times 100}{\text{Number +ve}} \)

Negative predictive value = \( \frac{\text{Number not diseased} \times 100}{\text{Number -ve by test}} \)

2.7 Data Management

2.7.1 Data storage

All data was first written in the different forms and verified before being entered in the computer. Three sets of data was generated from this process. This include the results of the questionnaire, the results of the reagent strip and the results of the microscopic egg count before and after treatment. A structure for all the data was formed using SPSS and all the data was entered by the investigator. After data entry the data was verified using the original data and any errors rectified. To avoid loss of data by either power failures or mishandling the data was saved both in hard disk in 2 different computers and in several diskettes as backups.
2.7.2 Data Analysis

Frequencies were run to determine the prevalence as observed by the different diagnostic methods including microscopic which involved urine filtration and slide viewing. The intensities of infection were also grouped according to the WHO categories. This was necessary to assess the impact of intensity on self-diagnosis. Cross tabulations, the association between the different methods of diagnosis was analysed using SPSS statistical software. Chi-square was used to test for statistical significance.

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of morbidity indicators for schistosome infection were calculated in the first and the second examinations. Sensitivity of a morbidity indicator as a screening method for schistosome infection is the probability of the morbidity indicator finding infection (egg-positive) among those who are egg positive, or the proportion of egg positive who have the morbidity.

Specificity is the probability of absence of the morbidity indicator finding non-infection among those who are egg-negative, or the proportion of egg-negative who are free from the morbidity. PPV is the proportion of children with the morbidity who are egg-positive, and NPV is the proportion of children without the morbidity who are egg-negative. Small number of children answered as “don’t know” for self-diagnosis (4 children), self-reported symptoms one each for, blood in urine,
heat sense during urination, and lower abdominal pain. They were classified as negative for self-diagnosis and for the symptoms.
CHAPTER 3: RESULTS

3.1 Demographic characteristics of the study subjects

Overall, 412 school children went through both the urine examinations and responded to the questionnaire both before and after treatment. The ages of the children were between 6 and 19 years. The mean age and standard deviation were 13.2 ± 2.3 years old. There are more children in the age groups 11 to 14 which contributes more than 55% of the whole number examined. This age group is commonly most affected with schistosomiasis in endemic areas.
Table 1: The Age distribution of the study subjects

<table>
<thead>
<tr>
<th>Age</th>
<th>Number</th>
<th>Proportion %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>2.1</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>2.5</td>
</tr>
<tr>
<td>10</td>
<td>35</td>
<td>7.3</td>
</tr>
<tr>
<td>11</td>
<td>49</td>
<td>10.3</td>
</tr>
<tr>
<td>12</td>
<td>86</td>
<td>18</td>
</tr>
<tr>
<td>13</td>
<td>69</td>
<td>14.5</td>
</tr>
<tr>
<td>14</td>
<td>61</td>
<td>12.8</td>
</tr>
<tr>
<td>15</td>
<td>56</td>
<td>11.7</td>
</tr>
<tr>
<td>16</td>
<td>50</td>
<td>10.5</td>
</tr>
<tr>
<td>17</td>
<td>23</td>
<td>4.8</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td>1.9</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The age distribution of the school children given in percentages. These are a total of 467 children whose age was recorded at the beginning of the study.
3.2 Level Of education of the Study subjects

The children involved in the study were from class one to class eight. Children with mental disability were excluded from the questionnaire and from the study but were examined and treated. Those who did not participate in both examinations due to absence from school were excluded from the final analysis.
Figure 6: Distribution of study subjects by level of education
3.3 Knowledge about bilharzia

The first question asked was about the child’s knowledge on bilharzia as a disease. This was necessary to ensure that when the questions on the subjective symptoms were asked the child would be answering from his understanding of the problem, rather than from guessing the answer. Almost all the children who participated in the study were aware of the disease (98.5% in the first examination and 99.8% in the second examination).
Table 2: Results of the first examination before treatment

<table>
<thead>
<tr>
<th>The first exam</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg-positive</td>
<td>79.9</td>
</tr>
<tr>
<td>Knowledge of Bilharzia</td>
<td>98.5</td>
</tr>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td>73.3</td>
</tr>
<tr>
<td>Blood in Urine 2 Weeks</td>
<td>72.6</td>
</tr>
<tr>
<td>Pain When Urine 2 Weeks</td>
<td>70.6</td>
</tr>
<tr>
<td>Heat Sense While Urinate</td>
<td>68.7</td>
</tr>
<tr>
<td>Lower Abdominal Pain</td>
<td>61.7</td>
</tr>
<tr>
<td>Reagent Strip haematuria (Plusminus and Up)</td>
<td>77.9</td>
</tr>
<tr>
<td>Reagent Strip proteinuria (Plusminus and Up)</td>
<td>76.9</td>
</tr>
<tr>
<td>Color of Urine(pink, Red or Brown)</td>
<td>32.3</td>
</tr>
<tr>
<td>Egg Load per 10 ml.Ml Urine</td>
<td></td>
</tr>
<tr>
<td>Arithmetic Mean for All</td>
<td>348</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>854</td>
</tr>
<tr>
<td>Geometric Mean for All</td>
<td>43.2(1.636)</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.091</td>
</tr>
</tbody>
</table>
3.4 Prevalence of schistosomiasis and subjective symptoms before treatment

Table 3 shows the results of the first examination. It indicates that egg-positive prevalence was 79.9% (Urine filtration method). During the first examination the number of children who knew about bilharzia was 98.5%. Self-diagnosis was 73.3%. Blood in urine in the last 2 weeks was 72.6% while pain during urination was 70.6%. Heat sensation during urination in the last 2 weeks was 68.7% and lower abdominal pain in the last two weeks also was observed to be 61.7%. These were the results of the self reported subjective symptoms which were obtained through a questionnaire administered to the students before obtaining the urine sample. The questionnaire were administered to one child at a time at a distance so that the children may not be influenced by the answer of the other child.

3.5 Prevalence and intensity in the first examination (before the treatment)

Prevalence of egg-positive among 412 school-children was as high as 79.9% before treatment. Intensity of infection was 43 eggs/10ml of urine (geometric mean) for all the 412 children and 111 eggs for 329 egg-positive children. Prevalence of severe infection (1000 or more eggs per 10ml of urine) was 11%, and that of moderate infection (50-999 eggs) was 44%, meaning more than a half of children were heavily (moderately or severely) infected.
Overall prevalence rates of morbidity indicators in the first examination are listed in Table 3. Prevalence was 78% for micro-haematuria, 32% for gross-haematuria, and 77% for proteinuria. For self-reported diagnosis and symptoms, prevalence was 73% for self-diagnosed urinary schistosomiasis, 73% for blood in urine, 71% for pain in urination, 69% for heat sense while urinating, 62% for lower abdominal pain.

In all 279 children were right in their positive diagnosis and only 23 had a false positive before treatment. 60 children which is 14.6% had correctly diagnosed themselves as negative and 12% had a false negative. False positive was much less in that it was only 23 children which is 5.6% before treatment.
<table>
<thead>
<tr>
<th>Morbidity indicator</th>
<th>Level of schistosome infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative (0)</td>
</tr>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td>27.7</td>
</tr>
<tr>
<td>Self-reported haematuria</td>
<td>28.9</td>
</tr>
<tr>
<td>Self-reported Pain in Urination</td>
<td>39.8</td>
</tr>
<tr>
<td>Self-reported Heat Sense in Urination</td>
<td>45.8</td>
</tr>
<tr>
<td>Self-reported Lower Abdominal Pain</td>
<td>36.1</td>
</tr>
<tr>
<td>Micro haematuria</td>
<td>18.1</td>
</tr>
<tr>
<td>Micro proteinuria</td>
<td>27.7</td>
</tr>
<tr>
<td>Gross haematuria</td>
<td>2.4</td>
</tr>
</tbody>
</table>
SDUS = self-diagnosed schistosomiasis SRH = self-diagnosed haematuria SPU = self-diagnosed pain in urination
SHSU = heat sensation SRLB = Lower abdominal pain MH = microhaematuria MP = microproteinuria GH = gross haematuria

Figure 7: Prevalence of morbidity indicators by level of Intensity
Table 3 shows prevalence of schistosome infection and morbidity by level of intensity before treatment. It also shows prevalence rates of morbidity indicators by level of intensity of schistosomiasis infection. The level of intensity and prevalence of morbidity indicators were strongly correlated.

For example, prevalence of micro-haematuria increased with the level of intensity from 18% for egg-negative, to 81% for mildly infected, 98% for moderately infected, and 100% for severely infected. Prevalence of both self-diagnosis of urinary schistosomiasis and self-reported haematuria showed similar intensity-related increase with micro-haematuria. There is a distinct pattern of increase in self-reported morbidity indicators with increase in intensity of infection from negative to mild and then moderate and finally severe.
3.6 Sensitivity Specificity and Predictive Values (Positive and Negative)

Table 4 Sensitivity Specificity and Predictive Values

Table 4 Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of morbidity indicators for schistosome infection before treatment (%)
(n = 412)

<table>
<thead>
<tr>
<th>Morbidity indicator</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Diagnosis Urinary Schistosomiasis</td>
<td>84.8</td>
<td>71.1</td>
<td>92.4</td>
<td>55.7</td>
</tr>
<tr>
<td>Self-reported haematuria</td>
<td>83.6</td>
<td>69.9</td>
<td>92</td>
<td>51.8</td>
</tr>
<tr>
<td>Self-reported Pain in Urination</td>
<td>78.4</td>
<td>60.2</td>
<td>88.7</td>
<td>41.3</td>
</tr>
<tr>
<td>Self-reported Heat Sense in Urination</td>
<td>74.5</td>
<td>53</td>
<td>86.6</td>
<td>34.4</td>
</tr>
<tr>
<td>Self-reported Lower Abdominal Pain</td>
<td>68.1</td>
<td>63.9</td>
<td>88.2</td>
<td>33.8</td>
</tr>
<tr>
<td>Micro haematuria</td>
<td>93</td>
<td>81.9</td>
<td>95.3</td>
<td>74.7</td>
</tr>
<tr>
<td>Micro proteinuria</td>
<td>89.4</td>
<td>72.3</td>
<td>92.7</td>
<td>63.2</td>
</tr>
<tr>
<td>Gross haematuria</td>
<td>39.8</td>
<td>97.6</td>
<td>29</td>
<td>98.5</td>
</tr>
</tbody>
</table>
Table 4 shows sensitivity, specificity, PPV and NPV of morbidity indicators for schistosome infection before treatment. Prevalence of all the morbidity indicators among egg-positives were significantly higher than that among egg-negatives (Chi square test, all \( p<0.001 \)). Micro haematuria showed the highest sensitivity (93%) and PPV (95%). It also marked the second highest specificity (82%) and NPV (75%) next to gross haematuria (98% and 99%, respectively).

Sensitivity and PPV of gross haematuria were the lowest among the morbidity indicators (40% and 29%, respectively). Microproteinuria showed a similar but slightly lower sensitivity, specificity, PPV and NPV than micro haematuria. Among self-reported diagnosis and symptoms, self-diagnosis showed the best results followed by self-reported haematuria. Sensitivity of other three subjective symptoms was around 70% and their specificity was around 60%.

During treatment some of the children who were actually positive were absent. This created an epidemiological group of positive not treated. There were 30 children who had been diagnosed as positive by microscopic method who missed treatment. In all there were 4 groups. These included the negative treated positive treated and positive not treated and negative not treated.
Table 5 shows out of 32 children who were negative on first treatment, 3.1% were positive during second examination. 22.7% of the 299 positive treated still indicated a positive status. 37.3% of the 51 children who were grouped among the negative not treated were positive in the second examination. Among the positive not treated 90% were positive in the second examination.

The micro haematuria and microproteinuria showed drastic reduction in prevalence between first and second examinations. For micro haematuria the prevalence went down from 93.6% for those who were positive and were treated to 13.4%. For micro-proteinuria for the same group it went down from 90.0% to 18.1%. Likewise for the egg positive who were treated 299 were in this group giving a 100%, this went down to 22.7% after treatment. However, this drastic reduction is as a result of treatment but the proportion of decrease does not appear in the same proportion in self diagnosis of urinary schistosomiasis. For those who were negative and were treated the prevalence in self diagnosis went up from 34.4% in the first examination to 40.6% in the second.
Among the positive treated the prevalence went down from 84.9% to 42.1%. This is just about half. It is not as low a reduction as it was in the other cases. There is generally an increase in the prevalence of the subjective symptoms in the second examination after treatment. In the self reported blood in urine and among negative not treated it reduced from 83.3% to 80.0% and increased in the positive not treated from 25.5% to 37.3%.

In the case of self reported pain during urination in the negative treated this increased from 34.4 to 46.9% while in the positive treated it went down from 78.9% to 54.5%. In the subjective symptom lower abdominal pain in the positive treated the prevalence went down from 68.2% to 53.2%. In reality one would expect a much higher reduction after treatment in the self reported symptoms in proportion similar to the reduction observed in the case of the other diagnostic methods.

In self diagnosis after treatment and looking only at children who had been treated 34 of them correctly diagnosed themselves as positive which was 10.3% while the false positive after treatment went up to 105 children which was 31.7% compared to only 5.6% false positive before treatment.
### 3.7 Changes In Prevalence

Table 5 Changes in prevalence of morbidity indicators of the four groups between the first and second examinations

<table>
<thead>
<tr>
<th>Measurement</th>
<th>n</th>
<th>The first exam</th>
<th>The second exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>34.4</td>
<td>40.6</td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>84.9</td>
<td>42.1</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>23.5</td>
<td>33.3</td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>83.3</td>
<td>76.7</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>73.3</td>
<td>43.4</td>
</tr>
<tr>
<td>Blood in Urine in Last Two Weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>34.4</td>
<td>46.9</td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>83.6</td>
<td>44.1</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>25.5</td>
<td>37.3</td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>83.3</td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>72.6</td>
<td>46.1</td>
</tr>
<tr>
<td>Pain in Urination in Last Two Weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>43.8</td>
<td>56.3</td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>78.9</td>
<td>54.5</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>37.3</td>
<td>47.1</td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>73.3</td>
<td>80</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>70.6</td>
<td>55.6</td>
</tr>
<tr>
<td>Heat sense while urinating in last two weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>46.9</td>
<td>59.4</td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>73.2</td>
<td>55.5</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>45.1</td>
<td>51</td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>86.7</td>
<td>76.7</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>68.7</td>
<td>56.8</td>
</tr>
<tr>
<td>Lower abdominal pain in these two weeks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>37.5</td>
<td>50</td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>68.2</td>
<td>53.2</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>35.3</td>
<td>47.1</td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>66.7</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>61.7</td>
<td>53.4</td>
</tr>
</tbody>
</table>
Changes in prevalence of schistosome infection and morbidity indicators of the four groups between the first and second examination

Table 6 Intensity of infection in the first and second examination

<table>
<thead>
<tr>
<th>Self-diagnosis and subjective symptoms</th>
<th>Log (egg/10ml urine +1)*</th>
<th>The first urine exam</th>
<th>The second urine exam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>mean</td>
<td>SD</td>
</tr>
<tr>
<td>Intensity for All</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>32</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>2.08 (119)</td>
<td>0.79</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>51</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>1.72(51)</td>
<td>0.86</td>
</tr>
<tr>
<td>Total</td>
<td>412</td>
<td>1.64(43)</td>
<td>1.09</td>
</tr>
<tr>
<td>Intensity for Positives Alone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Treated</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Treated</td>
<td>299</td>
<td>2.08(119)</td>
<td>0.79</td>
</tr>
<tr>
<td>Negative Not Treated</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Not Treated</td>
<td>30</td>
<td>1.72(51)</td>
<td>0.86</td>
</tr>
<tr>
<td>Total</td>
<td>329</td>
<td>2.05(111)</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* Figures in parentheses are anti-log values of geometric mean egg counts per 10ml of urine
3.8 Changes in Intensity

Table 6 shows the intensity of infection in the first and second examination as per the treatment categories. Those that were negative and requested to be treated were 32. In the first urine since these were negative there was no intensity to be calculated. In the second treatment the geometric mean egg count was very low at 0.015 and Standard deviation of 0.084. The positive treated were 299 with geometric mean of 2.08 and standard deviation 0.79. After treatment the mean went down to 0.23 and 0.7 respectively and standard deviation of 0.57. Among the total children examined 83 were negative and 32 of them requested for treatment. The 51 children who were not treated and were negative in the first examination had a geometric mean of 0.61 egg counts at the second examination after treatment and a standard deviation of 0.89.

Those children who were positive but were absent during treatment and attended the second examination had a geometric mean of 1.72 in the first examination with a standard deviation of 0.86. This however went slightly lower during the second examination to 1.58 and S.D 0.91. Among the total number of 412 children the general geometric mean was 1.64 and a standard deviation 1.09 before treatment and 0.36 mean and standard deviation of 0.73. This table also shows that among the positives only the negative, treated one was positive in the second examination with a mean egg count of 0.48.
In the 299 positive treated the mean egg count was 2.08 with a standard deviation of 0.79. In the second examination 68 were positive with a geometric mean of 1.02 egg count and a standard deviation of 0.79. Those that were negative and not treated 19 were positive in the second examination with a mean intensity of 1.64 and standard deviation of 0.66. The positive who were not treated were 30 in number and during the first examination the mean egg count for this group was 1.72 and a standard deviation of 0.86 in the second examination. 27 were still positive with a mean egg count of 1.76 and standard deviation of 0.77. Out of the total positive 329 the mean egg was 2.05 and a standard deviation of 0.80 while after treatment 115 were positive with a dropped intensify of mean egg count of 1.29 standard deviation 0.83.

Table 7 shows the prevalence of morbidity indicators by level of intensity of infection after treatment using the egg count categories. At the egg-negative level, there were 262 children out of the total 331 who were treated, and for self diagnosis of urinary schistosomiasis it was 40.1%, rising to 43.1%, at mild level 80% at moderate level and 100% at severe. Self reported haematuria was 43.1%, 43%, 80.0%, and 100% at the same categories respectively.
Self-reported pain in urination in the last two weeks the prevalence was slightly higher at negative egg count 53.1%, 56.9%, 80.0% and 100% respectively. Self-reported heat sensation during urination was 54.2% in the negative egg count rising to 56.9%, 90.0% and 100% respectively. Lower abdominal pain one of the symptoms 51.9% at negative egg count rising to 53.4%, 70.0% and 100% respectively. In relation to intensity of infection by egg count per 10ml of urine and self-reported symptoms was not statistically significant after treatment.

For the 331 who were all treated the prevalence of self-reported symptoms were self-diagnosis was 42.0%, self-reported haematuria was 44.4%, pain during urination 54.7% self-reported heat sensation during urination was 55.9% and self-reported abdominal pain was 52.9% generally.

Comparing the reagent strip with the intensity of infection at the same egg count categories micro haematuria was 8.0% at negative level, rising to 22.4% at mild 80.0% and 100% at moderate and severe respectively. Microproteinuria was 12.2%, 29.3%, 80.0% and 100% respectively. Gross haematuria was 1.1%, 5.2%, 40.0% and 100% respectively. Among the 331 persons treated in general 13.0% prevalence of microhaematuria 17.5% microproteinuria and 9.1% gross haematuria were observed. The reagent strip haematuria, microproteinuria and gross haematuria the relationship with intensity of infection were statistically significant.
Table 7: Level of Schistosome Infection among 331 Treated

<table>
<thead>
<tr>
<th>Morbidity Indicator</th>
<th>Level of Schistosome Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative (0)</td>
</tr>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td>40.1</td>
</tr>
<tr>
<td>Self-reported haematuria</td>
<td>43.1</td>
</tr>
<tr>
<td>Self-reported Pain in Urination</td>
<td>53.1</td>
</tr>
<tr>
<td>Self-reported Heat Sense in Urination</td>
<td>54.2</td>
</tr>
<tr>
<td>Self-reported Lower Abdominal Pain</td>
<td>51.9</td>
</tr>
<tr>
<td>Micro haematuria</td>
<td>8</td>
</tr>
<tr>
<td>Micro proteinuria</td>
<td>12.2</td>
</tr>
<tr>
<td>Gross haematuria</td>
<td>1.1</td>
</tr>
</tbody>
</table>
3.9 Infection among the Treated

Table 7 shows the level of infection and intensity among the 331 children after treatment. All the prevalence of the subjective symptoms in relation to intensity of infection are not statistically significant. The micro haematuria and micrproteinuria as well as gross haematuria which are results of the reagent strips are highly significant.

3.10 Prevalence of morbidity indicators among egg-positives and egg-negatives: Sensitivity, specificity, PPV, and NPV of morbidity indicators for schistosome infection before treatment

Prevalence of morbidity indicators among 83 egg-negatives and 329 egg-positives were calculated. Table 9 shows the sensitivity, specificity, PPV, and NPV of morbidity indicators for schistosome infection before treatment. Prevalence of all the morbidity indicators among egg-positives were significantly higher than that among egg-negatives (Chi square test, all p<0.001).

Micro haematuria showed the highest sensitivity (93%) and PPV (95%). It also marked the second highest specificity (82%) and NPV (75%) next to gross haematuria (98% and 99%, respectively). Sensitivity and PPV of gross haematuria were the lowest among the morbidity indicators (40% and 29%, respectively).
Microproteinuria showed a similar but slightly lower sensitivity, specificity, PPV and NPV than micro haematuria. Among self-reported diagnosis and symptoms, self-diagnosis showed the best results followed by self-reported haematuria. Sensitivity of other three subjective symptoms was around 70% and their specificity was around 60%.

3.11 Treatment

Among 329 egg-positives, 299 children (91%) received treatment, and the other 30 missed treatment because of their absence from school. Among 83 egg-negatives, 32 (39%) wanted to have medicine and were treated. In total 331 out of 412 children (80%) received treatment. Consequently, the following four groups were conformed: 'negative treated' (32 children, 8% of 412 children), 'positive treated' (299, 73%), 'negative not treated' (51, 12%), and 'positive not treated' (30, 7%).

3.12 Changes of prevalence of infection and prevalence of morbidity between the two examinations

Prevalence of infection and morbidity indicators for the four groups as well as for all the 412 children in the first examination and the second examination is listed in Table 3.
Overall, prevalence of infection dropped from 80% to 28%, intensity of infection dropped from 43 eggs to 2 eggs per 10ml of urine for all the 412 children and from 111 to 18 eggs for egg-positive children alone. Prevalence of heavy infection (50 and more eggs/10ml) reduced from 53% to 8.5%. Prevalence of heavy infection among treated was 3% (11/331) while 30% (24/81) among not treated.

Overall prevalence of all the morbidity indicators dropped. Reduction of self-reported diagnosis and symptoms, however, was much lower than the reduction of prevalence of indicators of urine examination (infection, haematuria, proteinuria and gross haematuria). More than 40% of children answered having schistosomiasis and self-reported haematuria in the second examination. More than a half of children felt that they still had pain in urination, heat sensation while urinating, and lower abdominal pain even in the second examination.

Children who were positive in the first examination but failed to be treated naturally showed the highest prevalence of infection in the second examination (90%) among the four groups. More than a half of positive not treated were heavily infected. Negative not treated had the second highest prevalence of infection, where 16% were heavily infected.
Among positive treated, 23% were still infected and 4% of 299 positive treated were heavily infected. Naturally, reduction of prevalence of infection and morbidity was high among 299 ‘positive treated’ children. Prevalence of infection reduced from 100% to 23%, intensity among positives reduced from 119 eggs to 9 eggs per 10 ml of urine. Gross haematuria reduced sharply from 40% to 4%, and micro haematuria reduced from 94% to 13%. Comparing with these indicators, reduction of self-diagnosis from 85% to 42% were not sharp. Reduction of prevalence of self-reported symptoms was even less sharp.

Only one child out of 32 negative treated became egg positive in the second examination. Prevalence reduced by treatment in terms of gross haematuria (6% to 0%), micro haematuria (44 to 9%), and microproteinuria (47 to 13%), but strangely increased after treatment in terms of self-diagnosis (34 to 41%), self-reported haematuria (34 to 47%), pain in urination (44 to 56%), heat sense in urination (47 to 59%), and lower abdominal pain (38 to 50%). Prevalence of self-reported diagnosis and symptoms of negative treated was higher than that of negative not-treated, whereas prevalence of infection and gross and micro haematuria showed the reverse tendency.

Among 30 egg-positives who did not receive treatment, three children were egg
negative in the second examination. Because of being infected morbidity indicators were high in both the examinations. However prevalence of morbidity indicators was higher in the first examination than in the second examination except pain in urination which increased from 73% to 80%. Among 51 egg-negative children who did not receive treatment (negative not treated), 19 (37%) were newly egg-positive in the second examination with average intensity of infection among positives being 43 eggs/10ml. Micro haematuria increased from 2% to 22%, and all the other morbidity indicators increased.

The relations of level of intensity of schistosome infection with morbidity after treatment are listed in Table 7. Prevalence of morbidity indicators among 331 children who received treatment are listed by level of intensity of infection. Prevalence of all the morbidity indicators increased with level of intensity. It is significant for micro and gross haematuria and proteinuria but it is not significant for self-reported diagnosis and symptoms. This is because prevalence of haematuria and proteinuria differed much between egg-negative and mildly infected children, whereas that of self-reported diagnosis and symptoms did not differ much.
Table 8 Sensitivity specificity positive predictive value (PPV) and negative predictive value (NPV) of morbidity indicators for schistosome infection (egg-positivity) after treatment

<table>
<thead>
<tr>
<th>Morbidity indicator</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>p (chi square)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td>49.3</td>
<td>59.9</td>
<td>24.5</td>
<td>81.8</td>
<td>ns</td>
</tr>
<tr>
<td>Self-reported haematuria</td>
<td>49.3</td>
<td>56.9</td>
<td>23.1</td>
<td>81</td>
<td>ns</td>
</tr>
<tr>
<td>Self-reported Pain in Urination</td>
<td>60.9</td>
<td>46.9</td>
<td>23.2</td>
<td>82</td>
<td>ns</td>
</tr>
<tr>
<td>Self-reported Heat Sense in Urination</td>
<td>62.3</td>
<td>45.8</td>
<td>23.2</td>
<td>82.2</td>
<td>ns</td>
</tr>
<tr>
<td>Self-reported Lower Abdominal Pain</td>
<td>56.5</td>
<td>48.1</td>
<td>22.3</td>
<td>80.8</td>
<td>ns</td>
</tr>
<tr>
<td>Micro haematuria</td>
<td>31.9</td>
<td>92.0</td>
<td>51.2</td>
<td>83.7</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Microproteinuria</td>
<td>37.7</td>
<td>87.8</td>
<td>44.8</td>
<td>84.2</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Gross haematuria</td>
<td>11.6</td>
<td>98.9</td>
<td>72.7</td>
<td>80.9</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

n = 331 who received treatment, ns; not significant
Figure 8: Sensitivity and Specificity of morbidity indicators
Figure 9: Positive and Negative Predictive values of morbidity indicators
Table 9  Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of morbidity indicators for heavy schistosome infection (50 and over) before treatment (%)

<table>
<thead>
<tr>
<th>Morbidity indicator</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>p (chi square)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-diagnosis of Urinary Schistosomiasis</td>
<td>90.2</td>
<td>46.8</td>
<td>66.9</td>
<td>80.0</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Self-reported haematuria</td>
<td>88.4</td>
<td>46.3</td>
<td>66.2</td>
<td>77.0</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Self-reported Pain in Urination</td>
<td>81.3</td>
<td>42</td>
<td>62.5</td>
<td>65.3</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Self-reported Heat Sense in Urination</td>
<td>76.8</td>
<td>41.0</td>
<td>60.8</td>
<td>59.7</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Self-reported Lower Abdominal Pain</td>
<td>70.1</td>
<td>48.4</td>
<td>61.8</td>
<td>57.6</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Micro haematuria</td>
<td>98.7</td>
<td>46.8</td>
<td>68.8</td>
<td>96.7</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Microproteinuria</td>
<td>96.9</td>
<td>46.8</td>
<td>68.5</td>
<td>92.6</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Gross haematuria</td>
<td>53.6</td>
<td>93.1</td>
<td>90.2</td>
<td>62.7</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>
The sensitivity of self diagnosis is higher when intensity of infection is above the 50 eggs and over. This has also been indicated in the previous table where there was a distinct pattern of increase with the increase in intensity.
CHAPTER 4 Discussion

4.1 Introduction

Several observations have been documented in this study which are in agreement with observations made in similar studies. However, there is a distinct observation in that self-diagnosis of the primary school boys before treatment is closely in agreement with diagnosis by the microscopic and reagent strip methods. This is also the case with the morbidity indicators which included blood in urine, pain during urination heat sensation and lower abdominal pain. After treatment, there is a notable variation between self-diagnosis and the diagnosis by the other conventional methods, the microscopic and the reagent strips. This indicates that despite the reduction in egg excretion after treatment, morbidity is not cleared within the three months. Also about 27% of the children indicated a low intensity of infection 3 months after treatment.

The wider variation between self-diagnosis and the other methods after treatment is due to perceived morbidity or illness.

This chapter discusses the prevalence of schistosomiasis as observed by the different methods and using microscopic method as a gold standard looks at the sensitivity specificity and the predictive values of the tests before and after treatment.
4.2 Prevalence of schistosomiasis by microscopic method

The prevalence observed here by the microscopic method was 79.9%. This seemingly high prevalence is in agreement with other studies carried out in the region. In the coastal region in the neighbouring district of Kilifi (Kombe, 1992) observed a prevalence of 72% and in another group 68.6%. In the adjacent school in Kinango division of Kwale, a prevalence of 67.4% were also observed (Muhoho, 1994). Other studies carried out in the area prevalence of 68.2% with 50 egg average intensity (Shimada; 1987).

Further North in Pokomo and Hola where relatively less work has been undertaken prevalence of up to 100% have been recorded (WHO 1987). In Msambweni a division in Kwale, prevalence among school children was 64% nearest the coast and 78% in the inland villages (Muchiri 1996). In Mwea irrigation settlement scheme a baseline survey revealed a prevalence of 69% and 48% in a study and control village respectively (Katsivo, 1986). The subjects of this study are the age group with highest burden of disease in the community. However there is a high degree of day to day variation of egg excretion within subjects both in whole population and in the 5-19 age group (Savioli, 1990).

With regard to the urinary schistosomiasis the primary school age children are
even further exposed to the infection due to their life style and recreation activities such as swimming in the infected waters of the rivers or ponds. In some cases the boys are also assigned the duty of carrying water for the domestic use although in most cases this is the duty of the girls. Fishing, bathing and cloth laundry are also activities that are associated with water contact.

4.3 Prevalence of schistosomiasis by reagent strips

According to the reagent strips haematuria from plusminus (trace) upward the prevalence was 77.9% while proteinuria was 76.9%. These results also conform to the observation on microscopic method. The current range of sensitivity of the available strips is 5-15 intact red blood cells per microliter and 0.015 mg- 0.03 mg of haemoglobin per 100 ml of urine. (WHO; 1983). It should be remembered here that the reagent strips examination only involved haematuria and proteinuria. The recommended volume of urine to be examined is 10ml.

The colour discrimination between negative and the first level of proteinuria usually 10-25 mg of protein/ 100ml of urine is not clearly defined. False positive reaction may occur in urine containing an alkaline, quinine or a quinine derivative. False negative have been observed in strongly acid urine.
Sensitivity and specificity of reagent strips in children 14 years or younger for haematuria was 80% and 85%, and for proteinuria 87% and 37% respectively (WHO 1987). For those 15 years and older for haematuria sensitivity and specificity was 57 and 89% while proteinuria was 32% and 59% respectively.

According to research work done in Pemba Island (Savioli, 1990) single highly positive semi-quantitative value for haematuria were a more useful diagnostic indicator than a single egg count to select patients with heavy infection.

4.4 Prevalence of schistosomiasis by self-diagnosis and subjective symptoms

The prevalence according to self diagnosis was 73.3%. The morbidity indicators as per self-reported subjective symptoms were: blood in urine which had a prevalence of 72.6%, pain during urination which recorded 70.6% prevalence and heat sensation 68.7% and lower abdominal pain was 61.7%. It is worthy of note that the self diagnosis almost is in agreement with the prevalence indicated by the microscopic method. It was sometimes difficult during the study to express the subjective symptom on heat sensation during urination.
This I believe is due to the high frequency of occurrence and the prevalence of urinary schistosomiasis among the study subject made it difficult for them to note the difference or increase in temperature of the urine due to the infection. These results were before treatment and therefore it would be noted that the self-diagnosis and the microscopic method prevalence are not much apart. It was observed (Ansell, 1997) the prevalence of reported schistosomiasis correlated strongly with the prevalence of infection as determined by microscopy and that self-reported schistosomiasis is a useful method to estimate the prevalence of infection in schools and might be used to identify infected individuals.

In this study 279 children were right in their positive diagnosis before treatment (67.7%) while only 5.6% had a false positive. However after treatment the false positive increased to 31.7%. This explains the perceived illness by the children despite the reduction in egg excretion.

The observations of this study are strongly in agreement with the fact that self-diagnosis is a useful tool to estimate prevalence in a community and could also be used to identify individuals who are infected for the purpose of chemotherapy either individually or for mass treatment.
4.5 Sensitivity and Specificity of morbidity indicators before treatment

Prevalence of all the morbidity indicators among egg-positives were significantly higher than that among egg-negatives (Chi square test, all p<0.001). Micro haematuria showed the highest sensitivity (93%) and PPV (95%). It also marked the second highest specificity (82%) and NPV (75%) next to gross haematuria (98% and 99%, respectively).

Sensitivity and PPV of gross haematuria were the lowest among the morbidity indicators (40% and 29%, respectively). According to this study the sensitivity of diagnosis is higher with increased intensity of infection as expressed by the egg load per 10ml of urine sample. Gross haematuria which is determined visually by the change of the colour of urine to either brown or red correlate strongly with the intensity of infection.

This observation is also in agreement with the findings on the study on self diagnosis through interview that the sensitivity of diagnosis by interview increased almost linearly with the prevalence of infection (Ansell, 1997). Micro proteinuria showed a similar but slightly lower sensitivity, specificity, PPV and NPV than micro haematuria. Among self-reported diagnosis and symptoms, self-diagnosis showed the best results followed by self-reported haematuria. Sensitivity of other three subjective symptoms was around 70% and their specificity was around 60%.
4.6 Prevalence and Sensitivity after Treatment

The sensitivity, specificity, PPV, and NPV of morbidity indicators for schistosome infection after treatment were calculated for 331 children who received treatment. Prevalence of gross and micro haematuria, and proteinuria among egg-positives were significantly higher than that among egg-negatives (Chi square test, all \( p<0.001 \)), whereas prevalence of self-reported diagnosis and symptoms did not differ significantly between egg-positives and egg-negatives. Sensitivity of self-reported diagnosis and symptoms were higher than results of urine examination (haematuria and proteinuria), and their specificity and PPV were lower than the results of urine examination. There was no big difference of NPV between the two groups of morbidity indicators.

Among self-reported diagnosis and symptoms, self-diagnosis of urinary schistosomiasis showed the best results followed by self-reported haematuria. Sensitivity of other three subjective symptoms was around 70% and their specificity was around 60%. (Ansell 1997) observed the prevalence of reported schistosomiasis correlated strongly with the prevalence of infection by microscopy. This result agree with the findings of our study in the relation before treatment. After treatment the reduction in prevalence is not proportional to the reduction in symptoms.
It has been indicated that individual differences are great ranging from spontaneous regression of pathology without treatment to persistence of pathology lasting for years after therapy even without reinfection. In _Schistosoma haematobium_ infection bladder abnormalities and urinary tract obstruction frequently resolve after treatment (Richter, 2000).

There is a distinct relation between the increase in prevalence of self-reported symptoms and self-diagnosis with the increase in intensity of infection as shown in Table 6 indicating intensity of infection in the first and second examination as per the treatment categories. Those that were negative and requested to be treated were 32. In the first urine since these were negative there was no intensity to be calculated. In the second treatment the geometric mean egg count was very low at 0.015 and standard deviation of 0.084. The positive treated were 299 with geometric mean of 2.08 and standard deviation 0.79. Observation of a study in Machakos, Kenya (Kloos, 1997) intensity of infection and water contact declined relatively slowly with distance from the stream. After treatment the mean went down to 0.23 and 0.7 respectively and standard deviation of 0.57. Among the total children examined 83 were negative and 32 of them requested for treatment. The 51 children who were not treated and were negative in the first examination had a geometric mean of 0.61 egg counts at the second examination after treatment and a standard deviation of 0.89.
Those children who were positive but were absent during treatment and attended the second examination had a geometric mean 1.72 in the first examination with a standard deviation of 0.86. This however went slightly lower during the second examination to 1.58 and S.D 0.91. Among the total number of 412 children the general geometric mean was 1.64 and a standard deviation 1.09 before treatment and 0.36 mean and standard deviation of 0.73. Among the positives only one from the negative treated became one was positive in the second examination with a mean egg count of 0.48. In the 299 positive treated the mean egg count was 2.08 with a standard deviation of 0.79. In the second examination 68 were positive with a geometric mean of 1.02 egg count and a standard deviation of 0.79. Those that were negative and not treated 19 were positive in the second examination with a mean intensity of 1.64 and standard deviation of 0.66.

The positive who were not treated were 30 in number and during the first examination the mean egg count for this group was 1.72 and a standard deviation of 0.86 in the second examination. 27 were still positive with a mean egg count of 1.76 and standard deviation of 0.77. Out of the total positive 329 the mean egg was 2.05 and a standard deviation of 0.80 while after treatment 115 were positive with a dropped intensify of mean egg count of 1.29 standard deviation 0.83.
In using haematuria trace up and proteinuria 1+ up observed that the sensitivity and specificity of urostick did not change after treatment and remained at 70.7% and 81.2% from 69.6% and 84.4% respectively (Kiliki, 1991). Our observation differs with this finding possibly due to the period of re-examination after treatment which was a longer interval than the three months which was the interval for this study.

Untreated individuals can harbour live schistosomes for a long time as indicated by figures derived from a mathematical model vary from 3 to 4 years for *S. haematobium* and from 5.7 to 23 years for *S. mansoni* (Vermund, 1983). In Puerto Rico Orduna and Silva (1995) investigated liver and spleen scintigrams taken over an 8-9 year period of 15 male children treated with oxamniquine in the acute phase of the disease and reported among other results that spleen associated pathology increased from 40% in the acute phase to 47% 8 years after treatment in spite of negative parasitological data. Although the drug of choice currently is praziquantel which has a higher efficacy it is possible that some of the children in the study due to delayed treatment or also due to high intensity of infection with heavy egg load might require more time for the symptoms to clear.

It is also known that pathology may progress even in the absence of the patent infection through unknown immunological mechanism. The effect of schistosomiasis in this area in terms of morbidity is not well known especially among the primary
school age. The effect of chemotherapy on different intensities of infection is also not very well understood.

4.7 Reliability of Data

Every effort was made to ensure accuracy in the collection of data in the field within the logistical and time limits proposed for this study. By all means we expect therefore, that the data is reliable, accurate and represents the situation as it was at the time of study. A few experiences however, have to be mentioned which were both scheduled and unexpected.

4.7.1 Gender effect

This study was conducted among 476 boys in 4 primary schools. It lacks gender sensitivity and this is a limitation. The reason for this was that this study was conducted alongside a bigger study which aimed at testing morbidity in urinary schistosomiasis using an equipment which is normally used for patients with prostrate problems which is a problem for older men.

The equipment used would measure the velocity of urination by plotting the time and speed of urine flow. The equipment was thus strictly designed for men with a narrow mouth suitable the penis. However according to studies carried out
among both sexes girls are likely to make more mistakes in diagnosing blood in urine than boys due to their menstrual cycle. In a study on parasitic infection in Pemba Island (Albonico 1997) recorded a higher prevalence of hookworm and haematuria in boys than in girls. Accordingly any prevalence that is determined among boys will therefore be most probably a representation of upper limits within any community.

4.7.2 Absenteeism

Absenteeism from school was a common experience during the course of study. This was often temporary and revisits were not possible due to the limitations in time of study and the period allocated for the visit of the particular school. However absenteeism affected the study by the loss of data of about 50 boys were not able to participate in both examination before and after treatment. These were excluded from the analysis.
4.7.3 Microscopy

The investigator made much effort to ensure quality control in specimens handling especially the proper mixing of the urine specimen before filtration. Drying up of the slides prepared with Nuclepore filters was often observed and to avoid gross errors in the reading of slides saline drops were used to wet the filter membranes. Where the colour of urine was either red or brown which in most cases was indicative of high infection rate, only very small volume was initially filtered and checked microscopically before the remaining urine was discarded. If any egg is noted then the remaining urine is discarded otherwise if no egg is observed then the remaining urine is filtered and the egg count is calculated as per 10ml of urine. Due to pressure of work the slides were processed and examined the next day to avoid effect of fatigue when examining specimens.

Urine specimens collected from some pupils were often too little in quantity to permit volume measurements 10ml each. Persons who provided urine insufficient, the count was still done on the deficient volume and the number of ova in this inadequate quantity of urine multiplied by an appropriate factor that raised the volume to 10ml.
To avoid spillage of specimens from their containers particularly during transportation from the collection sites, screw-top wide mouthed containers were used. Contamination of specimens by the interchange of bottle tops was avoided particularly during testing for haematuria.

4.3 Knowledge of bilharzia

Almost all the children who participated in the exercise had knowledge about bilharzia. (98.5% in the first examination and 99.8% in the second examination) However most children were referring to schistosomiasis as “kisonono”. The proper word for it in Kiswahili should be “Kichocho”. Kisosnono in other areas would mean gonorrhea. This prompted me to try and understand the symptom as perceived by the community. It was interesting to note that when asked why they thought they had kisonono they quickly indicated that they could see it. After further probing I realized what they perceived as kisonono was the red or pink or abnormal colour of urine which is visible when an infected child looks at his urine. It is possible therefore that amongst the children who are sexually active and adults some venereal infection might be assumed to be schistosomiasis and be subjected to the same attitude and health seeking behaviour common for chronic debilitating illness.
CHAPTER 5: SUMMARY OF CONCLUSIONS

The key points that this study has highlighted are:

- That the prevalence of infection with *S. haematobium* is high in this area as confirmed by the 3 different diagnostic methods used. These were microscopic the reagent strips and the self diagnosis.

- The intensity of infection was also high with more than 55% having an intensity of 50 egg per 10ml of urine to above 1000 eggs.

- There was a distinct relation between the increase in prevalence of self reported symptoms and increase in intensity of infection. Where the categories of egg intensity was from negative, mild moderate and severe according to WHO categorizations.

- The self diagnosis after treatment had a much lower sensitivity than before treatment. There was a kind of consistence between the self-diagnosis and the self-reported symptoms after treatment.
The infection is dynamic in the area in that, during the period of 3 months some children who were negative became egg-positive.

This data therefore suggest that praziquantel may reduce the eggload and also the micro haematuria but the morbidity may take much longer time than the 3 months interval between the first and second examination.

Despite the low sensitivity of the self diagnosis after treatment it still was more sensitive to morbidity indicators than the microscopic method as well as reagent strips after treatment. I therefore conclude in this study the following;

Self-diagnosis in an endemic area is a reliable method to estimate the prevalence of urinary schistosomiasis for purpose of mass chemotherapy or for the individual treatment.

That morbidity indicators take much longer than 3 months to clear after treatment with a single dose of praziquantel
There is a distinct relation between increase in the recognition of self reported symptoms and intensity of infection before treatment.

That self diagnosis and self-reported subjective are more sensitive to determine morbidity after treatment than the conventional microscopic method as well as the reagent strips.
CHAPTER 6: RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH WORK

6.1 RECOMMENDATIONS

There should be a national control programme which should address the control of Schistosomiasis in the endemic areas of the country. The programme should include:

- School health programme on health education
- Community control programme through education and environmental management and reduction of water contact
- Regular chemotherapy in schools in endemic areas to interrupt the transmission patterns and reduce morbidity
- Praziquantel the drug which has been proven to be effective should be made available in the health facilities in the endemic areas.

Self reported symptoms should be used to diagnose and treat urinary schistosomiasis where no laboratory exist.
6.2 SUGGESTIONS FOR FUTURE RESEARCH WORK

There is need for more research to determine the following;

☐ The exact period that it takes a single dose of Praziquantel to clear the symptoms of urinary schistosomiasis.

☐ The re-infection patterns of schistosomiasis in relation to water contact pattern and environment need to be understood.

☐ The perception of the community in relation to "kisonono" and "kichocho" in sexually active members so that other venereal infections are not confused with urinary schistosomiasis.

☐ There is need to follow closely the frequency of occurrence of haematuria in self diagnosis in relation to infection and intensity of schistosomiasis.

☐ Self diagnosis among female students in consideration of the routine menstrual blood.
REFERENCES


Proceedings of the symposium on epidemiology and control of Schistosomiasis. (KEMRI - JICA publication)


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Studies on Schistosomiasis

Kenya-Japan Medical Project

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Date: ____________________________  No. ____________
APPENDIX 3

QUESTIONNAIRE ON SELF-DIAGNOSIS

CHILD ID NO:
CLASS:
AGE:

1) Do you know about bilharzia?
   1 Yes
   2 No

2) Do you think you have bilharzia now?
   1 Yes
   2 No

3) In the last 2 weeks have you noticed any blood in your urine?
   1 Yes
   2 No

4) In the last 2 weeks have you experienced lower abdominal pain?
   1 Yes
   2 No

5) In the last 2 weeks have you experienced pain during urination?
   1 Yes
   2 No

6) In the last 2 weeks have you sensed heat sensation during urination?
   1 Yes
   2 No
Abstract for presentation to the 23\textsuperscript{rd} African Health Science Congress to be held at Fairway Hotel Kampala, Uganda 22 - 26\textsuperscript{e} April 2002

\textbf{Self diagnosis of school boys for \textit{Schistosoma haematobium} before and after treatment in Kwale district, Kenya.}

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Diagnostic methods for urinary schistosomiasis involving observation of schistosoma ova by microscopy, detection of microscopic haematuria by chemical reagent strips or the use immunological tests and the use of ultrasound to detect morbidity as a result of schistosomiasis are expensive. They require laboratory setting and qualified personnel thus they are becoming increasingly difficult to attain especially in developing countries with limited resources and hence the need for faster and cheaper and sustainable approaches. This study aimed at assessing the reliability of using self-diagnosis to estimate the prevalence of \textit{S. haematobium} infection and determine its comparability with microscopic and reagent strips before and after treatment.

412 boys aged between 6 and 19 years from 4 primary schools in Kinango division of Kwale district, where no previous intervention had been undertaken, were involved in this study. Using a questionnaire, the boys were first interviewed on their knowledge of bilharzia, whether they felt pain or had some heat sensation during urination, whether they saw blood in urine during urination and if they had lower abdominal pain in the past two weeks. Thereafter urine samples were collected and examined for microscopic haematuria using reagent strips and then microscopy was done for egg count. All children found positive for \textit{S. haematobium} by microscopy were treated and re-examined by the same process, 3 months later.
Before treatment 98.5% of the children knew about bilharzia with 73.3% of them declaring that they had the infection. 70.6% felt pain during urination while 72.6% saw blood in urine. As many as 68.7% had some heat sensation on urination and 61.7% complained of lower abdominal pain during the same period. 77.9% and 76.9% had at least one plus and above of haematuria and proteinuria respectively as determined by reagent strips, while by microscopy 79.9% of the samples tested were positive for S. haematobium ova.

After treatment, 99.8% of the children knew about bilharzia, and 43.4% said they had the infection. 56.6% had pain, 46.1% had blood in urine, 56.8% had heat sensation and 53.4% had complained of lower abdominal pain. 18.2% and 22.6% had at least one plus or above of haematuria and proteinuria respectively by reagent strip. 27.9% were positive for schistosome ova by microscopy.

The sensitivity of self diagnosis was significantly high before treatment but less so after treatment.