THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Infection Rates of Schistosoma Haematobium among Primary School Children in Garsen Constituency, Tana River County, Kenya and the Types of Snail Vectors

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Abstract:
Schistosomiasis is a parasitic disease caused by blood flukes (trematodes) of the genus Schistosoma. Both urinary schistosomiasis caused by Schistosoma haematobium and intestinal schistosomiasis caused by S. mansoni occur in various regions of Kenya, including the coastal region. River Tana which flows through Garsen, offer breeding sites for Bullinus snails which are the fresh water snail vectors for S. haematobium. A study was conducted at Garsen constituency to assess the infection rates and intensity of S. haematobium infections among the school going children, and also determined the main water contact activities influencing infection in the area and the vector involved in transmission.The study involved collection and examination of urine samples using a microscope for diagnosis as well as quantification of eggs for determination of intensity. Questionnaires and interviews were used to collect qualitative data. ANOVA test was used to analyse infection rates among the age sets and the water contact activities. Chi square computation was used to analyse snails collected at different sites. T test was used to compare the difference in infection rates and intensities between male and female pupils. An overall prevalence of 21% was obtained with male pupils recording the highest prevalence of 27.5%. A total egg count of 3798 eggs per 10ml of urine was recorded among 63 pupils who were positive. 67% of the positive pupils had heavy infection intensities. Swimming was the predominant activity among the pupils along the river, while Bullinus nasutus were the predominant vector.

Keywords: *Infection rate, Schistosoma haematobium, microscopy, vector*

1. Introduction

Schistosomiasis or Bilharzia is a tropical water borne disease which is caused by blood flukes or trematodes of the genus *Schistosoma.* After malaria and intestinal helminthiasis, schistosomiasis is the third most prevalent tropical disease in the world (Hotez and Fenwick, 2009), thus remains an important public health problem globally especially in sub Saharan Africa (World Schistosomiasis Risk Chart, 2010). Schistosomiasis is a neglected parasitic disease, although it has a low mortality rate, it can damage internal organs and in children impair growth and development (WHO, 2004).

Two species common in Africa of main concern to humans are; *S. haematobium* transmitted by *Bullinus* snails and causes urinary Schistosomiasis and *S. mansoni* transmitted by *Biomphalaria* snails and causing intestinal and hepatosplenic Schistosomiasis (Ross *et al.*, 2007). Resent estimates suggest that 779 million people are at risk of contracting schistosomiasis infection worldwide, while an estimated 200 million people are infected with the disease.

Of the 200 million people with schistosomiasis worldwide 85% live in Africa where the disease is endemic. 70 million of this population may have haematuria associated with *S. haematobium* infection, 18 million suffer major bladder wall pathology and 10 million suffer from hydronephrosis (Deribe *et al.,* 2011). It is estimated that kidney failure due to *S. haematobium* causes 150,000 deaths per year and the portal hypertension due to *S. mansoni* causes 130,000 fatalities annually. Up to one third of school age children may be actively infected although not always aware of their status (Chidozie and Daniyani, 2008). In Kenya *S. haematobium* is endemic at the coastal plains, scattered foci in Eastern, Central and western Kenya around Lake Victoria (Warren *et al*., 1979).

2. Materials and Methods

2.1. Study Site

The study was conducted in Garsen sub County of Tana River County which falls in the ASALS in the coastal region of Kenya. Its geographical co-ordinates are 2^0 16' 11' South and 40^0 7' 12' East. The major physical feature is an undulating plain which is interrupted by low hills while River Tana runs across the area from the fur North to the South of Tana River

County. Rainfall is low, and erratic with mean annual range between 300 mm-500 mm per year. Rains occur in the months of April to May and October to December with seasonal flooding occurring during this period. Average annual temperature is between 25^{0}C to 30^{0}C which favors development of snails in the vegetations along the river (Schade, 2011).

2.2. Study Population

The study population comprised of primary school going children from five selected schools within Garsen Sub County namely, aged 8 -16 years in class 3 – 7. The schools were selected in relation to distance from the irrigation scheme along the River Tana. The first four schools had close proximity estimated to be 1 kilometer from TARDA irrigation scheme and River Tana, while the last school was far from TARDA irrigation scheme estimated to be 30 kilometers away hence was used as a control.

2.3. Collection of Urine Sample

Collection of urine was done between the months of September to November in 2012. Urine samples were obtained between 1100 hours and 1300 hours. This was the period when maximum numbers of eggs are found in urine (Odegaard*et al.,* 2012). The pupils were given clean, labeled containers in school to collect single terminal urine of at least 10 ml and return the containers immediately. The urine samples were examined immediately by gross observation and by use of reagent strips for presence of haematuria and macrohaematuria. The samples that tested positive with the reagent strips were separated from those that were negative. All the urine samples were preserved at the collection site by adding two drops of approximately 0.1ml of 1% V/V sodium hypochlorite. Samples from each school were packed in cooler boxes and transported to Malindi at Pathcare laboratories, where they were stored refrigerated as they awaited samples from the other schools. All the samples were then transported by Pathcare in their special vehicles that had coolants to KEMRI laboratories in Kwale for microscopic examination to determine the presence of Schistosoma eggs using the nucleopore filtration method (Fieldmier and Poggensee, 1993, Clive, 2012).

3. Results

A total of 300 urine samples from children sampled in five primary schools in Tana River County namely; Kulesa, Garsen, Reuben Mwewe, Gamba and Gadeni primary schools were analyzed for *Schistosoma haematobium* eggs. An overall prevalence of 21% was obtained. 51% of those sampled were male pupils and had the highest infection rates of 27.5%. Females had a point prevalence of 14.3%. One sample t-test analysis indicated significantly higher *Schistosoma haematobium* egg count in the male than female participants evaluated (t =3.633; df = 9; *P* = 0.005). The prevalence on haematuria was 30% in males and 31% in females.

Age set (Years)	**No. of pupils sampled**		**Positive with *S. haematobium* eggs**		**Positive with haematuria**		**Infection rate as a %**
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	
8-10	3634		9	3	10	5	17.1
					30	17	
11-13	8776		28	12	6	23	**24.5**
14-16	3037		5	6			16.4
TOTAL	**153 (51%)**	**147 (49%)**	**42 (27.5%)**	**21 (14.3%)**	**46 (30%)**	**45 (31%)**	**21**

Table 1: Infection Rates of Schistosoma Haematobium among the Three Age Sets

11 – 13 years age category had a higher infection rates (F = 2.715; df = 8,263; P = 0.007), compared to age group 14-16 years.

Distance	**School**	**No. of pupils**	**Positve**	**Negative**	**Infection rate(%)**
>500M	Kulesa	68	26	42	**38.2**[a]
500 – 700M	Ruben Mwewe	57	12	45	21.1[a]
2 – 3km	Garsen	56	10	46	17.9[b]
3 - 4km	Gadeni	54	8	46	14.8[b]
>7km	Gamba	65	7	58	10.8[a,b]
Total		300	63	237	21

Table 2: Infection Rates of Schistosoma Haematobium in Schools

Infection rate of *S. haematobium* in different schools. Values with different letters in superscript indicate significant differences of infection rates between different schools (F=2.364, df=4, P= 0.053).

3.1. Intensity of Schistosoma Haematobium in the Childrensampled.

This study demonstrated high total count of 3798 *Schistosoma haematobium* eggs per 10ml of urine among the children sampled, which reflected mean of 60.3 eggs per 10ml of urine per child. Majority of the eggs shed (66.8%) were from heavy infections. The male pupils recorded the highest total egg count of 2396 than their female counterparts who had a total egg count of 1402. One sample t-test analysis indicated significantly higher *Schistosoma haematobium* egg count in the male than female participants evaluated in different schools sampled ($t = 3.492$; $df = 19$; $P = 0.003$).

Turkey Post-Hoc multiple comparisons test indicated that there was no statistically significant difference in intensity rates between the age group 11-13 years and the other age groups. ($F = 1.121$; $df = 2$, $p = 0.329$).

Egg counts per 10ml Of urine	**8-10 n=70 (+ 12)**	**11-13 n=163 (+40)**	**14-16 n=67(+11)**	**Totals n=300(+63)**
Light infection 0-49 eggs	95 (10.5%)	396 (17.1%)	70 (13%)	561(14.8%)
Moderate infection (50-100eggs	0 (0%)	528 (23%)	172(31.9%)	700(18.4%)
Heavy infection (>100 eggs	850 (90%)	1390 (60.1%)	297 (55.1%)	2537(66.8%)
Total eggs	**945(24.9%)**	**2314(60.9%)**	**539(14.2%)**	**3798**

Table 3: Intensities of Schistosoma Haematobium According to the Age Categories

Letter n represents the total number of pupils in the age group, (+) indicates the positive individuals. The eggs are total counts per 10ml of urine.

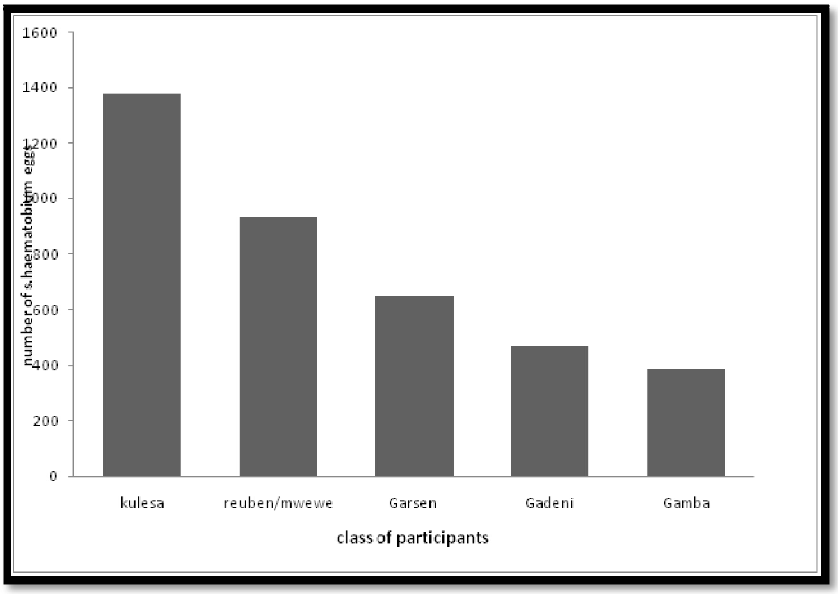

Figure 1: Total Number of Schistosoma Haematobium Eggs According to the Different Primary Schools Sampled

Kulesawas significantly higher ($F=0.002$, $df=2$, $P= 0.009$) compared to Gambain total egg count, but there was no significant ($P= 0.998$) when compared with Reuben Mwewe.

Activity	**Number of participants n= 300**	**Number infected n= 63**	**% infected**
Crossing the river	7	1	14.3
Swimming	115	31	27*
Bathing	36	7	19.4
Washing clothes	42	3	7.1
Fetching water	15	2	13.3
Watering animals	29	6	20.7
Irrigating	56	13	23.2

Table 4: Water Contact Activities Potentially Influencing Transmission of S. Haematobium

Percentage represents the infection rate of each activity. Swimming was significantly higher (F=3.5, df=1, P=0.032), compared to other water contact activities.

Activity (a) Occupation of parents	Number of pupils involved n= 300	Number of pupils infected n= 63	% infected
Farmers	136	36	**26.5**
Pastoralists	74	14	18.9
Businessmen	38	5	13.2
Civil servants	52	8	15.4
(b) Source of water			
Bore hole	95	15	15.8
Tap water	56	3	5.4
River Tana	121	38	**31.4**
Rain water	28	7	25

Table 5: Occupation of Parents and Source of Water of the Respondents

Letter (n) represents the total population. Percentage represents the infection rates. Pupils of farmers and those that use water from River Tana were highly infected at 26.5% and 31.4% respectively.

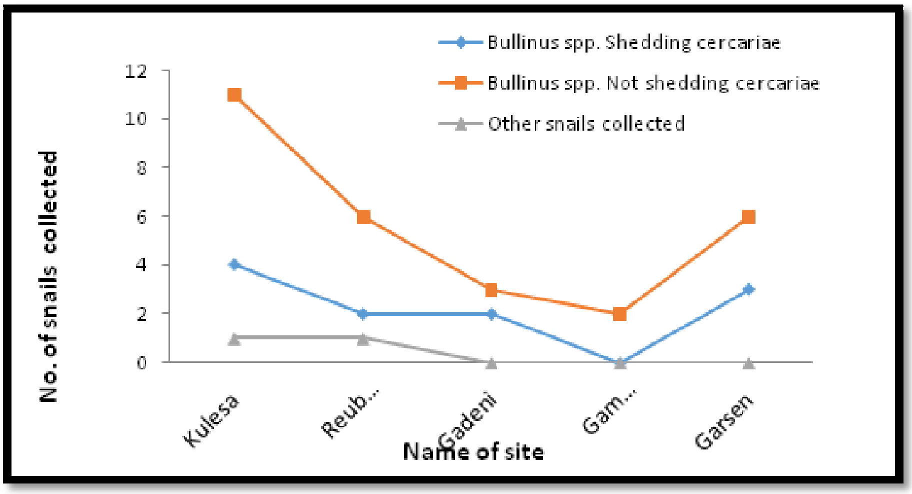

Figure 2: Number of Snails Obtained from the 5 Sites Sampled

The number of snails at Kulesa site had a significant difference, compared to the other sites ($\chi 2$ =13.160; df = 5; P = 0.022). There was no statistical difference in the number of infective Bullinus nasutus snails shedding cercarie at different sites (x2=0.000, df=5, P= 1.000).

4. Discussion

4.1. Infection Rates of Schistosoma Haematobium in Primary School Pupils in Garsen Area

The results of microscopic examination of urine samples for *S. haematobium* eggs revealed the occurrence of urinary schistosomiasis among school pupils at a rate of 21% in the five primary schools selected for the study. This point prevalence is slightly below the national prevalence of approximately 24% and similarly, slightly close to the prevalence calculated in the study county at 24.5% by Kihara in 2013. In contrast, this prevalence is significantly lower to the prevalence of 40 – 60% reported in the Coastal area of Kenya (Matonge *et al.,* 2013). This massive decrease can be linked to several factors; (i) Implementation of the awareness campaign and health education of the population. (ii) Efforts to clean up the canals in the irrigation schemes (King *et al.,* 1988); (iii) Free distribution of praziquantel in public hospitals to infected individuals (Kihara, 2013);

The results of this study indicated that male pupils were more infected at the rate of 27.5% than females who had 14.3%, which demonstrated a significant difference (t= 3.633; df= 9, P = 0.005), among the male and female pupils. Previous studies associate this difference to the boys being sedentary, that is, they remain in one position for a longer period which gives them compensation to infestation with the schistosomes (Hotez and Fenwick, 2009). Activities that indulge males in one position include, frequent bathing in rivers than girls who are restricted by various cultural norms and this could result in the lower infection rates due to reduced contact with infected water. Male children frequently help their parents in farming, padding of canoes and fishing in areas considered infested environments of schistosomes such as flood plains along the river (Brooker, 2009). Pupils in age group 11 to 13 years had the highest infection rate of 24.5%, while 14 to 16 had the lowest infection rate of 16.4%. The results are closer to the pattern commonly found where there is a peak in the age group 9 – 14 years and a gradual decrease of the infection gradually as the age increases (Kihara*et al.,* 2011). The high infection rateof schistosomiasis among the children of 8 to 13 years observed could be attributed to high contacts with cercarie contaminated water through swimming, playing and home chaos as reported previously (Kihara*et al.,*2011). Infection rate was lowest in age group 14 to 16 years (16.4%), which corresponds with other studies done by Matonge*et al.,* 2013 at the coast, in which they attributed the lower infection rate to better hygiene practices in this age category and increase in use of shoes by the pupils

Among the schools investigated, Kulesa primary school had the highest incidence levels at 38.2%, followed by Reuben Mwewe primary which had 21.1%, while Garsen followed closely with 17.8% infection rate. This is an indicator that the area had high transmission rates where uncontrolled water contact activities took place and several open water bodies were widely available for domestic and recreational use as reported previously (Blank *et al.,* 2006). Relatively low incidence levels were observed in Gamba andGadeni primary schools at 10.8% and 14.8% respectively. This could be due to reduced access to the cercarie contaminated water from River Tana which is approximately 3 - 7 KM from the two schools (Boelee and Madsoen, 2006). In addition, from the interviews conducted it was observed that the children are forbidden to work in the rice farms within the area. The few affected pupils in these two schools were most likely of parents who were farmers in the area and got access to the infected waters while assisting in farming activities.

4.2. Snail Species Transmitting Urinary Schistosomiasis Identified in the Study Area

In the present study, live *B. nasutus* and its shells were collected in the five strategic points sampled and therefore was the predominant species in the study area. There were fewer live snails than the shells collected in the sites probably because the region was experiencing heavy rains from late October to December 2012, which could have washed away the snails when the river flooded. Shells were found along the dry sections of the river, an indication that snails existed in the area and could have died. 41 live snails and their shells were collected in the five sites. Most of the *B. nasutus* snails collected did not shed cercarie when they were exposed to sunlight while placed in fresh water. This could be due to the fact that *B. globusus* are considered more efficient shedders of cercarie than *B. nasutus* (Clennon *et al.,* 2007).

The highest number of snails and shells were collected in the site close to Kulesa primary and this could be due to high human activities that were being conducted close to the sites which correlated to the high rate of infection among the student. The site close to Gadeni primary school located around the middle of the rice farms had relatively fewer snails and shells due to the clean drainage canals that allowed smooth movement of water which could therefore not harbor the snails (Kariuki*et al.,* 2004).

5. Conclusion

The study concludes that *S. haematobium* infection is still rampant in Garsen sub county as indicated by the infection rates of 21%. The age group 11 – 13 years had significantly high infection rates of 24.5% while the least infected age category was 14 – 16 years. Infection rate in schools decreased with increase in distance from River Tana as observed in Kulesa Primary School which was >500M from River Tana, had higher infection rate than Gamba which was <7KM from River Tana. Majority of the pupils (62%), had heavy infections shedding >100 eggs per 10ml of urine, which means that majority of these population with heavy infection are assumed to harbor a high number of worms. The common predisposing factor in the study area was found to be contact with the waters of River Tana through swimming and carrying out domestic and farm work. *Bullinus nasutus* species are the main intermediate host of *S. haematobium* in the study area. 23.1% of *Bullinus nasutus* snails were found to shed cercarie.

6. Recommendation

The high prevalence of *S. haematobium* infections in school children suggested that there is need for the public health sector of Tana River County to carry out large scale screening and treatment program for the whole community. Administration of praziquantel can be integrated into the ongoing programme of distribution of albendazole in primary schools in the county. The highest percentage of the population, (66.8%) had heavy infections, thus urgent treatment should be given to individuals with heavy infection loads to reduce the worm burden within the population. The county government of Tana River should ensure supply of clean and safe water to all households within the county especially those in remote areas to avoid use of River Tana water which pauses risk of infection.

7. Limitations of the Study

The study are covered the area along River Tana and rice irrigation scheme of TARDA, focusing on primary schools in Garsen sub- county, that means the data may not reflect the infection rate of *S. haematobium* in the entire County. The ethnic clashes between the Pokomo and Orma communities in 2012 led to many pupils transferring from the area to schools outside the county thus majority of the pupils were not captured.

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