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Persistence of *Schistosoma Haematobium* and Geohelminthes Infection in Residents of Two Villages in Msambweni District of Coast Province, Kenya

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Abstract Urinary Schistosomiasis and soil transmitted helminths (STH) infections are serious problems in developing countries owing to climatic, environmental, and behavioral factors of the people that favor transmission. A cross-sectional survey involving 1,232 people aged 5-78 years in two villages in Vingujini Sub-Location, Msambweni District of Coast Province in Kenya was conducted to determine prevalence of *Schistosoma haematobium* and soil transmitted helminths infections. Urine and stool samples were collected from 1,232 people in two villages in Vingujini Sub-Location. The samples were examined for eggs of Schistosoma haematobium and intestinal helminths respectively. Hematuria was determined using urine dip strips. Hemoglobin levels were determined for all participants to establish the relationship between hookworm disease and anemia. The overall occurrence of helminth infections were; 44% for *Schistosoma haematobium*, 29.6% for hookworm disease, 0.5% for Ascaris and 24.6% for trichuriasis (N = 1,232). Only 32.7% were free from any of the four types of parasitic infections screened. Infection with schistosome was highly correlated with *Trichuris* infection ($r = 0.96$, $p = 0.006$) and also highly correlated with age ($f = 95.17$, $p > 0.01$). Infections with *Schistosoma haematobium* ($f = 95.17$, $p > 0.01$), hookworm disease ($f = 11.51$, $p = 0.010$) and trichuriasis ($f = 26.46$, $p > 0.01$) were also age correlated. High intensities of *Schistosoma haematobium* were associated with hematuria ($f = 639.99$, $p > 0.01$). Prevalence of hookworm disease was not correlated with anemia, but there was a relationship between intensity of hookworm infection and anemia ($r = -0.091$, $P< 0.01$). Individuals with heavy and medium intensity of hookworm infections were more likely to suffer from anemia than individuals with low intensities or the non-infected ($f = 5.5$, $p < 0.01$). The current study has established high (44%) prevalence of urinary schistosomiasis, hookworm (29.6%) and Trichuris (24.6%) infections in Msambweni compared to national prevalence for schistosomiasis (23%), and global prevalence for hookworms (10-20%). Infections with Ascaris were low. Majority of Schistosome infected subjects were also infected with hookworms or at least one STH. The data suggests that measures of intensity are required for increasing effectiveness of current control programs and stresses the need for enhanced public health interventions against these diseases.

Keywords: *Schistosoma haematobium, hookworms, Trichuris, Msambweni, Kenya*

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1. Introduction

The occurrence of human parasitic infections is a serious problem in developing countries. Parasitism, especially chronic parasitism has adverse effects on human growth and development, including cognitive development, site specific injuries, granulomatous reactions and fibrosis in specific organs due to repeated tissue inflammation [1] and anemia [2]. Other effects include periportal liver fibrosis, portal hypertension with haematomesis and splenomegaly caused by *Schistosoma mansoni* and *S. japonicum*. There is also caloric under-nutrition caused by hookworm infestation, cystitis and urethritis with ulceration and haematuria caused by *Schistosoma haematobium* which can progress to bladder cancer in chronic situations [1]. Parasitic infections also lead to increased susceptibility to co-infection, fatigue, poor exercise tolerance and decreased work output [3].

Some helminths infections such as Ascariasis and Trichuriasis are known to cause the highest intensity infections in school children [3]. High intensities of hookworm infections however occur in both children and adults of both sexes and pose a health threat to adolescent girls, women of reproductive age who have a high blood demand as a result of menstruation and child bearing. Several programs have been put in place to deal with the problem of parasitic diseases in Kenya. Despite this, more than six million people, or approximately 23% of the total Kenyan population are infected with urinary and/ or intestinal schistosomiasis. In Msambweni area, surveys have established that the prevalence of *Schistosoma haematobium* in school age children ranges from 60% to 85% with an overall area prevalence of 40% to 50% [4]. To control morbidity within these affected populations control programs based on oral drug administration have been developed and partially implemented at the Kenya coast region including Msambweni district [5]. Treatment of the most heavily infected segment of the population, i.e. school age children, is recommended as the best practical means of reducing contamination of local water by *Schistosoma* eggs [5,6]. Although treatment has been shown to reduce *Schistosoma haematobium* egg output by more than 90% among treated subjects over the short term [6], the actual impact of long-term, population-based treatment on transmission of schistosomiasis is not fully evaluated. This study investigated the occurrence of schistosomiasis and geohelminthes in residents of two villages which are highly endemic for *Schistosoma haematobium* in the coast province of Kenya. The study was conducted during the period of June to September 2009.

2. Materials and Methods

2.1. Study Area

Vingujini location is situated in the Msambweni District of Coast Province, approximately 50 km south of the city of Mombasa, in Kenya, along the Indian Ocean coastline. The area has a monsoon-type climate. Seasonal There are two rainy seasons, long heavy rains in April to June and lighter short rains in October to November. The total annual rainfall ranges between 1000 to 1600 mm. The mean monthly temperature range is 26.3°C- 26.6°C, Relative humidity is about 95 % owing to the close proximity to the ocean. The area is on the coastal plain; sometimes referred to as the 'coral rag'. This is a narrow strip of corals, sand and alluvial deposits extending 3- 20 km from the seashore. It lies 0-30 meters above sea level. Vingujini Sub Location comprises of seven villages namely Vingujini, Bomani, Mwaembe, Mwagundu, Sawasawa, Tumbe and Kisimachande. The five villages; Mwaembe, Mwagundu, Sawasawa, Tumbe and Kisimachande border the ocean line while Bomani and Vingujini are located further inland. The two villages, Mwagundu and Bomani were purposively selected for this study; Mwagundu lies along the beach line (0-5 km) while Bomani village lies furthest from the beach line (12-20 km). In addition, Bomani village has characteristics of a modern slum, with overcrowding and poor drainage facilities while Mwagundu is rural with households spread apart. The economic activities in both villages are mostly small scale trading and farming. In both villages, rainfall causes seasonal flooding which provides necessary conditions for breeding of snail vectors for *Schistosoma haematobium*. Residents use this source of water for laundry and children play and swim in it, exposing them to *Schistosoma haematobium* infection.

2.2. Study Design

The study was based on a test-and-treat program for the whole population above 5 years in Mwagundu and Bomani. A prior demographic survey showed that the population above 5 years in Mwagundu village was 689, 342 (49.64%) female and 347 (50.36%) male. The population in Bomani above 5 years was 1,399 of whom 727 (51.97%) were female while 672 (48.03%) were males. The estimated total population of Vingujini sub-location was 12,662 [7]. Sample collection was done at convenient primary schools in the two villages.

2.3. Measurement of Helminth Infections and Hemoglobin Levels

2.3.1. Examination of Stool

Fresh fecal specimens were collected from the study subjects in clean clearly labeled plastic sealable sample containers. Collected fecal specimens were taken to the Msambweni district hospital laboratory and examined for parasites. Macroscopic examination to identify helminth worms such as ascaris was carried out followed by saline and iodine slide preparations examined microscopically for motile helminth larvae and also eggs and cysts. Kato Katz technique was used to quantify the parasites.

2.3.2. Examination of Urine

Urine specimens were collected from the same study subjects between 10.00 am and 2.00 pm, to coincide with the period when excretion of *S. haematobium* eggs is highest [8]. The hematuria status of each sample was observed grossly and tested using urine dip strips. Polycarbonate membrane filters of 13 mm diameter and 12 µm pore size were used for filtration of *Schistosoma haematobium* eggs from 10 ml of urine. The entire filter was examined microscopically for eggs of *Schistosoma haematobium* and the number of eggs in the preparation recorded per 10 ml of urine.

2.3.3. Determination of Hemoglobin Levels

Hemoglobin levels were determined for each participant using a HemoCue® hemoglobinometer. Hemoglobin values were read and recorded to one decimal point.

2.4. Data Analysis

Data was analyzed using Microsoft excel (2007) and minitab14. Data on the number of people infected with schistosomiasis and geohelminthes was pooled in five age groups of 5-15, 16-25, 26-40, 41-60 and >60. Mean infections were determined for schistosomiasis, geohelminths infections and for co-infections with schistosomes and geohelminths. Data transformations were done to normalize and analysis of variance (using general linear model and one way) done on weighted means to determine differences in the mean infections between the villages, sex and age groups. Pair wise correlations were done using Turkey's test at 95% confidence interval. Correlation between infection with *Schistosoma haematobium* and soil transmitted helminths was examined using Pearson coefficient.

3. Results

3.1. Prevalence of Parasitic Infections

A total of 1,232 individuals were involved in the study. 495were from Mwagundu village of whom 258 (52.12%) were female and 237 (47.88%) male. A total of 737 individuals from Bomani village were involved in the study; 409 (55.50%), female and 328 (44.50%) males. The overall occurrence of parasitic infections were, 43.99% for *Schistosoma haematobium*, 29.63% for hookworm disease, 0.49% for Ascaris and 24.59% for trichuriasis Only 32.71% were free from any of the helminths screened. The occurrences levels of urinary Schistosomiasis and soil transmitted helminths in the two villages are represented in Table 1.

There was no significant difference in infection with Schistosomiasis between the two villages and similarly, for hookworm and ascariasis. However infection with trichuriasis was slightly higher in Bomani than Mwagundu. (f = 4.9, p = 0.045, df = 1).

Table 1. Percentage occurrence of schistosomiasis and soil transmitted helminths in Mwagundu and Bomani

village	Bomani				Mwagundu			
disease	Trichuriasi	Ascariasis	Hookworm	Schistosomiasi	Trichuriasis	Ascariasis	Hookworm	Schistosomiasis
Male	29.27 ±3.63		33.54 ±4.66	44.82 ±7.01	24.89 ±3.45	1.22 ±0.13	29.96 ± 4.43	43.04 ±6.45
female	24.45 ±3.25	1.22 ±0.75	28.85 ±4.35	42.30 ±6.58	18.60 ±3.59		25.68 ±5.09	46.51 ±6.43
Population	26.59 ±3.18^{b}	0.68 ±0.41	30.94 ±3.31	43.42 ±6.23	21.62 ±2.98^{a}	0.68 ±0.06	27.68 ±4.10	44.85±6.15

Values with different superscript letters indicate significantly difference (F = 4.9, p≤ 0.045, df = 1).

3.2. Co-infection with Schistosomiasis and Soil Transmitted Helminths

Of the 542 individuals infected with Schistosomiasis from the 2 villages, 152 (28.04%) were co-infected with hookworm disease, 3 (0.55%) with ascariasis and 168 (31%) with trichuriasis. 257 people were co-infected with Schistosoma and at least one soil transmitted helminth. This represents 47.42% of all Schistosome infected individuals, and 20.86% of the population sampled (N = 1232). Infection with schistosomes was highly correlated with *Trichuris* (r = 0.96, p = 0.006, df = 4) (Table 2).

Table 2. Percentage co-infections of *Schistosoma haematobium* and soil transmitted helminths

Disease	Trichuriasis	Ascariasis	Hookworm disease
Male	35.34 % ±4.39	0.40 % ±0.08	31.33% ±3.24
female	27.30 % ±4.86	0.68 % ±0.08	25.26 % ±2.22
Population	31.00 % ±4.60	0.55 % ±0.07	28.04 % ±2.68

3.3. Prevalence and Intensity of Helminths Infection in Different Age Groups and Sex

Table 3 (a) gives a summary of percentage prevalence of helminth infections in different age groups. The results show that there was a significant relationship between infection with Schistosomiasis and age of individuals (f = 95.17, p<0.01), and also between hookworm and trichuriasis with age, (f = 11.51, p = 0.010) and (f = 26.46, p>0.01) respectively. Individuals of age group 5-25 had significantly higher prevalence of schistosome infections than all the other ages. Infections with trichuriasis were highest in age group 5-15 years.

Table 3b shows the weighted percentages of the helminth infections for each age group and sex. These results reveal that individuals of age group 5-15 years accounted for 27.11 percent of the 43.99% of schistosomiasis occurrence in the area. Those of age groups 41-60 and >60 accounted for only 1.54% and 0.65% of respectively. Hookworm infections were lowest in age group >60 years. Schistosome infections were higher in females than males (P = 0.013, df = 1).

Table 3 (a). Percentage prevalence of helminth infections by age

Age group	>60	41-60	26-40	16-25	5-15
Schistosomiasis (±10.7)	11.26^{b}	11.11^{b}	26.11^{b}	55.20^{a}	61.51^{a}
Hookworm (±4.32)	43.66^{c,b}	42.11^{c,b}	33.63^{a,b}	22.17^{a}	25.23^{a}
Ascariasis (±0.243)		1.17^{a}			0.74^{a}
Trichuriasis (±5.12)	11.28^{b}	15.79^{b}	10.18^{b}	16.74^{b}	38.31^{a}

Values with different letters in superscript indicate significant differences (P< 0.05) within each group.

Table 3 (b). Prevalence of helminth diseases by age in males and females

Age group		>60	41-60	26-40	16-25	5-15
Schistosomiasis	P*	0.65	1.54	4.78	9.90	27.11
	F*	0.32	0.89	3.25	5.19	14.12
	M*	0.33	0.65	1.54	4.71	12.99
Hookworm	P*	2.52	5.84	6.17	3.98	11.12
	F*	1.62	3.49	3.33	2.11	4.38
	M*	0.89	2.35	2.84	1.87	6.73
Ascariasis						
	F*		0.16			0.24
	M*					0.08
Trichuriasis	P*	0.65	2.19		3.00	16.88
	F*	0.41	1.38	0.81	1.38	8.03
	M*	0.24	0.81	1.06	1.62	8.85

Results with* are in weighted percentages for; P-population, F- females, M-males

The intensity of schistosomiasis and hookworm disease were estimated as eggs/10 ml of urine for *Schistosoma haematobium* and eggs per gram (epg) of feces for hookworm. Individuals of age 5-15 years shed the highest number of schistosome eggs (160.7 ± 12.5 eggs/10 ml of urine), (F = 29.39, P = 0.00), while age group 41-60 years shed the lowest number of eggs (2.94 ± 1.54) (Table 4 a and b).

Table 4 a. Mean eggs shed per individual for *Schistosoma haematobium* and hookworm infected individuals

Age group	Schistosomiasis (eggs/10 ml urine)	Hookworm (eggs/gram of faeces)
5-15	160.70 ±12.5[a]	222.3±47.9 [a]
16-25	88.00±14.3[b]	176.0±52.0 [a]
26-40	11.40±4.59[c]	263.3±62.7 [a]
41-60	2.94±1.54[c]	454.0±130[a,b]
>60	14.40±14.1[b,c]	855±345 [b]

Values with different letters in superscript indicate significant difference (P< 0.05).

The number of hookworm eggs shed increased consistently with age from age group 16-25, (f = 7.32, p = 0.00). Age >60 years shed the highest mean eggs per gram of feces, 855±345.) Age 16-25 years shed the lowest mean eggs per individual (176.0 ± 52.0 eggs per gram of feces).

3.4. Overall Intensity of Schistosomiasis and Hookworm Disease in the Two Villages

12.66% of the individuals sampled accounted for 86.2% of all the schistosome eggs shed. This group had the highest intensity of the disease shedding more than 200 eggs per 10 ml of urine. 22.4% of the individuals had light infections of *Schistosoma haematobium* shedding less than 50 eggs per 10 ml of urine (Table 5).

Table 5. Proportion of eggs shed by individuals with different intensities of schistosomiasis and hookworm disease

disease	Eggs shed/ intensity of disease	Number of individuals with the intensity and the percentage proportion of total sampled.	Proportion of eggs shed by the group
Schistosomiasis	Heavy >200 eggs/10 ml of urine	156 (12.66%)	86.2%
	Moderate 51-200 eggs/10 ml of urine	109 (8.84%)	10.9.%
	Light 1-50 eggs/10 ml of urine	276 (22.40%)	2.9%
	None	691 (56.09%)	0.0%
hookworm	Heavy >4000 eggs/gram of faeces	7.31% (n = 90)	82.82%
	Moderate 2000-3999 eggs/gram of faeces	3.65% (n = 45)	8.68%
	Light 1-1999 eggs/gram of faeces	26.9% (n = 332)	8.5%
	None	62.1% (n = 765)	0.0%

In hookworm disease, 7.31% (n = 90) of the population had heavy infections shedding >4000 eggs per gram of feces. This small group however accounted for 82.82% of all the hookworm eggs in the population (Table 5).

Figure 1 show a relationship between age and the number of eggs of schistosomes shed. More individuals of age group 5-15 years and 16-25 years had higher intensities of schistosomiasis compared to the other age groups (df = 4, p< 0.05).

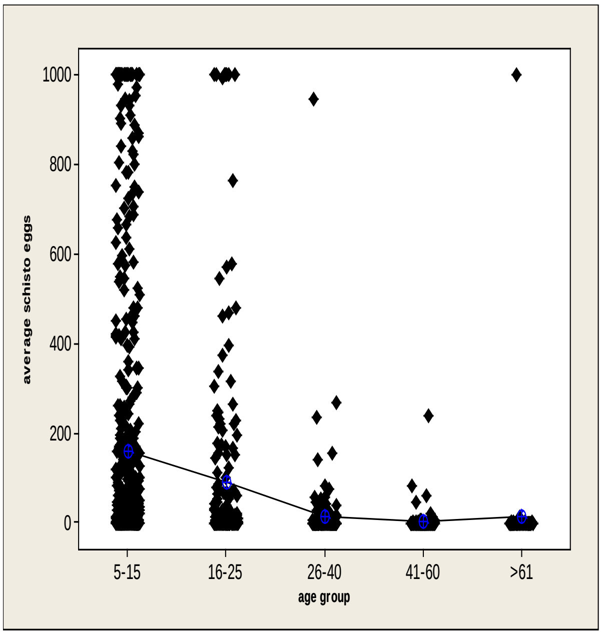

Figure 1. Eggs of *Schistosoma haematobium* shed by individuals of different age groups. The line indicates the mean eggs shed per individual.

3.5. Schistosoma Haematobium and Haematuria

Individuals with schistosomiasis who had higher intensities of the disease or eggs per 10 ml of urine, had a significantly higher incidence of hematuria (Table 6). Of the 542 schistosome infected individuals, 73 showed hematuria. Out of the haematuria cases 78.08% occurred in individuals with heavy infections (shedding more than 200 eggs per 10 ml of urine), despite the fact that this groups were only 28.8% of the schistosome infected individuals.

Table 6. Hematuria in groups with different *Schistosome* intensity

Intensity	Proportion of sample	Proportion of hematuria
Heavy >200	28.8% (n = 156)	78.0%[a]
Moderate 51-200	20.1% (n = 109)	12.4%[b]
Light 1-50	51.0% (n = 276)	9.6%[c]

n = Number of individuals with the particular intensity of infection (f = 639.99, df = 2, p = 0.00).

3.6. Hookworm Infection and Hemoglobin Level

26.61% of the sampled individuals had hemoglobin level below 11.0g/dl. The mean hemoglobin level in hookworm infected individuals was 11.89g/dl.±0.1. The overall mean hemoglobin levels range was 7.6-17.4g/dl). The mean hemoglobin levels decreased with an increase in hookworm egg counts (r = -0.091, $P < 0.01$) (Table 7).

Table 7. Hemoglobin levels in different intensities of hookworm disease

Hookworm eggs shed	Anaemic individuals (Hb < 11 g/dl)	Mean Hb
Heavy >4000	37.50%	11.081±0.226[a]
Moderate 2000-3999	30.36%	11.872±0.109[a]
Light 1-1999	27.74%	12.036±0.311[b]
None	25.74%	12.108±0.076[b]

Values with different letters in superscript indicate significant difference (P< 0.05).

4. Discussion

The current revealed that infection with *Schistosoma haematobium* is high in Msambweni. This is evidenced by a prevalence of 43.99% compared to the national prevalence of 23% [6]. Prevalence of hookworm disease and trichuriasis was 29.63% and 24.59% respectively. These prevalence are higher than the global prevalence of between 10-20% for hookworms according to W.H.O. The prevalence of schistosomiasis was however lower compared to the prevalence of 50-70 % reported in previous years in the coastal region of Kenya [6]. This decrease can be attributed to the control programs implemented in the region since 1984 [6,9].

The prevalence of ascariasis was 0.49% which is relatively low compared to other regions globally. Ascariasis is the most common STH in the world [11] with prevalence reported at 16% in Latin America and the Caribbean, 25% in sub-Saharan Africa, 7% in Middle East and northern Africa, 27% in south Asia, 36% in east Asia and Pacific islands, 39% in China and 14% in India.

The current study revealed that many people infected with schistosomiasis were also infected with at least one STH (47.42%) of all schistosome infected individuals, and 20.86% of the screened population. The highest co-infections were of schistosomes and trichuriasis 168 (31%), followed by hookworms, 152 (28.04%) and the lease was, with ascariasis 3 (0.55%) of the 542 individuals infected with *S. haematobium*. Individuals who were infected with *Schistosoma haematobium* were more likely to be infected with hookworm and *Trichuris* than those not infected (r = 0.96, p = 0.006). Studies done in Tanzania have also revealed that children infected with two or more species of helminths generally carry heavier infections of each species than children carrying single species [9]. Interactions between schistosomiasis and soil transmitted helminths in children are associated with high risk of anemia [2].

Infection with Schistosomiasis was highly correlated to age. Individuals of age group 5-25 had significantly higher schistosome infections than other ages (f = 95.17, p>0.01). Age was also highly significant factor in infections with hookworm disease and trichuriasis. A study done in Blantyre, Malawi in 2006 revealed that people in age group 5-25 were more likely to come into contact with open water sources through swimming, playing and other activities, thereby exposing them to schistosome infection [10]. Infection with *Schistosoma haematobium* and Trichuris was significantly lower in of age group > 60. However highest infection with hookworm disease was seen amongst age group > 60 and 41-60 years. These results are in agreement with previous reports. While heavy hookworm burdens still occur among children in some tropical areas [11], in most of the world studied the peak prevalence and infection intensities for hookworm infections occur in middle aged, or ≥50 years [12]. In the current study, infection with hookworms was lowest among individuals of age group 16-25 years (Table 3 a). This could be attributed to better hygiene practices and wearing of shoes by this age group compared to other ages [13].

In the current study higher intensities of schistosomiasis (measured as eggs per 10 ml of urine) was associated with higher incidence of hematuria (Table 7). For example, 78.08% of all hematuria occurred in individuals with heavy infection, (shedding more than 200 eggs per 10 ml of urine), and this constituted 28.8% of the schistosome positive individuals. The group which had moderate infection, shedding 51-200 eggs per 10 ml of urine contributed 12.4% of all hematuria cases. More than half of the s*chistosome* infected individuals (51%) had light infection (1-50 eggs per ml of urine) and this group contributed only 6% of all hematuria cases.Previous studies have associated human *S. haematobium* infection with high risk for urinary tract injury, which is manifested as hematuria, proteinuria and pathologies of the ureters and bladder [14].

Our study recorded high prevalence hookworm disease in the study population. The study also reveals that higher hookworm intensity was associated with low levels of hemoglobin ; 37.50% of those with >4000 eggs per gram of feces had hemoglobin levels of less than 11.0 g/dl of blood, while only 27.74% of those with light infections (1-1999 eggs per gram of feces) had similarly low hemoglobin levels. Those with light infections had a mean of 12.036 ± 0.311g/dl while those non-hookworm infected had 12.11 ± 0.76 g/dl of haemoglobin concentration. Past studies in Peru by Renee and others [15], revealed that the correlation of hookworm infections with anaemia is strengthened by co-infection with moderate and heavy trichuriasis.

Our study, recorded a significantly higher prevalence of trichuriasis in Bomani village compared to Mwagundu (p = 0.045). This may be attributed to the fact that Bomani is an unplanned urban slum with overcrowding, poor drainage systems, inadequate sanitation facilities such as toilets thereby facilitating faecal-oral transmission. Mwagundu on the other side represents a rural setting with households largely separated. This is consistent with previous studies which have demonstrated a high prevalence of these infections in children of slums, shanty towns and squatter settlements [16].

5. Conclusions

It is concluded that Msambweni continues to suffer higher prevalence of Schistosoma haematobium, and hookworms infestations, approximately 44% and 30 % respectively, which are remarkably higher than the rest of the country and also globally, despite the control programs that have implemented in the region. High intensities of both helminths occur in approximately a third of the population and posses a significant risk in the susceptible groups in terms morbidity. The emergence of unplanned urban settlements with overcrowding, lack of sanitation and clean water services is likely to cause a threat to residents in terms of transmission of trichuriasis, the prevalence of which was recorded at approximately 25%. The levels of ascaris infections are relatively low perhaps owing to the predominantly sandy soils which do not favor development of ascaris larvae. Schistosomiasis and hookworm infestations were present in all age groups from 5 years to >60 year. The highest schistosomiasis prevalence was recorded in age 5-25 years while that of hookworm infestations was higher in ages 41- >60 years. The interactions of these helminths in co-infections may be compounded with the effects of trichuriasis leading to severe morbidity consequences as observed in the level and proportion of anaemia and haematuria cases particularly in susceptible groups. Assuming that intensity of infection reflects the number of worms harbored by an individual, the distribution of number of worms in this area is overdispersed. This is evidenced by the distribution of the number of eggs shed in these diseases, for example 12.66% of the population accounted for 86.2% of the *schistosome* eggs shed, while 12.66% of the population shed 86.2% of all hookworm eggs shed. Our study has revealed that infection with schistosomiasis is correlated to infection with soil transmitted helminthes.

6. Recommendations

The study recommends an urgent need for regular screening of whole populations and treating of schistosomiasis positive cases in adherence to the WHO [5], guidelines for areas where infection is between 40-50% and also ensuring treatment of at least 75% of school-aged children for both schistosomiasis and soil transmitted helminths. In addition, there is need to evaluate the long term effect of the control programs already in place for their overall effect on transmission of the helminths. It is noted that despite the control programs implemented from 1984 schistosomiasis and STH infections persist in the area. This may call for enhancement of the control program to ensure coverage and continuity of treatment. It is suggested that an integrated approach could be implemented including drug treatment as well education of transmission factors to enable the population change risk behavioral practices. Provision of services such as clean /piped water for domestic use as well sanitation infrastructure by the government authority could contribute in reduce transmission and the subsequent morbidly associated with these helminthes. We recommend that future disease surveys include a measure of intensity. Also, new reliable methods should be devised to assess intensity and severity of helminthes and perhaps other parasitic diseases especially those that have proved difficult to quantify through the currently developed diagnostic methods. This is because prevalence data alone do not provide information of the numbers of worms harbored. Research on interactions between schistosomiasis and soil transmitted helminths is scanty. Possible interactions between these parasites need to be investigated further.

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