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The Epidemiology of *Schistosoma haematobium* in Rural Surrounding Area of Duiem district, White Nile, Sudan

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ABSTRACT

We carried out a survey to determine the infection of *Schistosoma haematobium* in the Northern endemic parts of Duiem district, White Nile of Sudan, in three selected villages namely Al-Oshara, Al-Hussien and Al-Goz. The survey was conducted during three seasons from July 2011 to June 2012 identified as winter, summer and autumn season. School children of age between 5-19 years was included in the investigation. The urine samples were collected and examined for detection of *Schistosoma haematobium* eggs. The incidence rate of infection in school children was calculated seasonally. The snails *Bulinus truncatus* were collected and screened for trematoda infection. The seasonal fluctuation of snails' infection and their transmission pattern was recorded. The overall incidence of *Schistosoma haematobium* was 19.9%. The highest rate of infection was in Al-Hussien village in the summer season being 40.9%. The lowest rate was recorded in Al-Goz village in winter season being 3.1%. In age group of 10-14 the incidence rate was higher than age group 15-19 being 21.1 and 20.1 % respectively. Also, the incidence rate was higher in males 24.3% than females 14.7%. The highest infection rates of snails were 17.3% found in Al-Hussien village in the summer dry season.
KEY WORDS: *Schistosoma haematobium*, Sudan, Rural area, Determination, Evaluation

INTRODUCTION

Schistosomaisis is a parasitic disease caused by trematoda worms of the genus Schistsoma (Walter et al., 2006). Six species of schistosomaisis, *Schistosoma haematobium*, *Schistosoma mansoni*, *Schistosoma japonicum*, *Schistosoma intercaltum*, *Schistosoma mekongi* and *Schistosoma malaysian* infect humans causing disease as they reside in the abdominal veins of their vertebrate definite hosts (Abdalla, 2011). Schistosomaisis is second major parasitic problem of the world effecting 200 million people are at risk to this infestation (Arshad *et al*., 2011).

It has estimated that about 500.000 deaths occurred every year due to schistosomaisis (Chitsluo *et. al*., 2000 and Capron *et. al*., 2002). Approximately two-thirds of the schistosomaisis cases are due to infection caused by *Schistosoma haematobium* (Hotez and Kamath, 2009). Possible consequences of *Schistosoma haematobium* infection include haematuria, dysuria, nutritional deficiencies, lesions of the bladder, kidney failure, an elevated risk of bladder cancer and in children growth retardation (Chu et al., 2010).

Schistosomaisis is hosted during part of its premature development by fresh water snails belonging to the families Planorbidae and Pomatipsidae. In Africa, the snail intermediate hosts belong to the family Planorbidae, and species of Bulinus host bladder parasites of man and of animals' (Brown, 1980). Infection occurs during contact with fresh water containing schistosome cercariae (Beason and Mc Dermott, 1980).

Schistosoma haematobium has been endemic in Sudan for several decades, particularly of areas situated in the Nile banking or in its agricultural schemes. However, conditions for snail propagation are ideal along the slow moving White Nile south of Khartoum. The disease seems to be wide spread there before 1652 before being recognized (Hartwig and Patterson, 1984). A considerable number of studies had been carried on *Schistosoma haematobium* in White Nile areas of Sudan (Amin, 1978; El-Hussien 1989; Saeed, 1992; Ahmed, 1994; Majdi, 2001 Abdalla, 2002). In Sudan, although Schistosomiasis is spreading in new areas, there are no proper programmes of control adopted neither by the government nor by the international organizations. The only method used in Sudan is chemotherapy, if available, in hospitals (Abdalla et al., 2011). In endemic areas of White Nile, there is no data from the administration of Medical Services, school reporting system and routine health information system which can be systematically collected and reported on a regular basis. So the knowledge available concerning Schistosomaisis in the area is fairly necessary.

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Three villages of El. Duiem district in the White Nile of the Sudan were carried out during different seasons of the year 2011-2012 to investigate the epidemiology of *Schistosoma haematobium* in the area with respect to seasonal occurrence, age and sex of patients. Besides, the seasonal fluctuation of *Bulinus truncatus* snail infection and their transmission pattern was recorded in the same year. El.Duiem district is approximately in the centre of the White Nile State in Sudan. The White Nile borders this study area on the East. On the North and South it lies on the fringe of agricultural schemes, neighboring the majority of their villages. To study the effective of water canal on transmission of *Schistosoma haematobium* two endemic villages to parasitic infections namely Al-Oshara and Al-Hussin were chosen for this study, due to foundation of a main canal for irrigation, drinking and recreational homes; poor sanitation and absence of any control programmes of disease. The population of Al-Oshara and Al-Hussien village is about of 550 and 3800 respectively. On the other side, to study the effective of using of Nile water, another village was chosen namely Al-Goz, which situated on the White Nile side. The population of Al-Goz village is of 6500, all people using only the Nile water from the main river.

MATERIALS AND METHODS

1- Infection detection in school children

The samples of urine or snail were collected during different seasons of the year during three seasons from July 2011 to June 2012 identified as winter, summer and autumn season. Only the school children at the age of 5- 19 years in each village were chosen to collect urine sample in each season of the study period. We chosen school children in that age because the high coverage rate of sample can be achieved in this age which used as indicator for the general prevalence. Above that, the hospital of Duiem District statistics constitutes the high percentage of infected humans at 5 - 24 age. The incidence rate of infection was calculated seasonally from the infection of initially negative individuals who became positive out of the whole chosen population. Samples from children which were found positive were treated and discarded out of the group to be replaced with negative ones. Information were collected regarding name, sex, age and disease related to complaints. Urine samples were collected between 8:00 am and 10:00 am. Each child was given a labeled urine container to fill it with urine. All specimens were taken to the laboratory immediately and centrifuged at 1000 rpm. for three minutes. Then the supernatant was discharged and the deposit was examined under the microscope at (10×10) for eggs.

2. Infection detection in snail

The snails *Bulinus truncatus* were collected from the different canals of villages during each season, using the scooping method. The scoop (30×40 cm) with mesh size 1.5 mm was mounted on a handle 2m long. Snail sampling was done by taken 10 dips perpendicular to the edge of the canals. The snails were collected in plastic bowls containing canal water. They were then transferred to the laboratory. In the laboratory the snails were identified, washed and screened under artificial light for trematoda infection. Twenty *Bulinus truncatus* snails were placed in a beaker with 250 ml de-chlorinated water and expose to daylight for four hours. Beakers were subsequently examined for the presence of cercariae. If cercariae were seen, the procedure was repeated for each individual snail. In case no cercariae were seen the procedure was repeated the following day. The number of infected snails were recorded.

3. Statistical analysis

Data analysis was carried out using a scientific calculator and statistical package. The main values for infection rates were compared using one away Anova and comparison of means further treated by Scheffe test to assess the hetrogeneity or homogeneity levels.

RESULTS

1. Incidence of *Schistosoma haematobium* infection in school children

Data collected from all surveys in the different seasons conducted in all the villages of study area showed that only 250 of 1257 school children passed *Schistosoma haematobium* eggs in the urine, making the overall incidence of urinary schistosomaisis in the study area to be 19.9%.

Table.1. Incidence of *Schistosoma haematobium* infection in school children

Number examined	Number infected	Infected (rate%)
1257	250	19.9

2. Incidence of *Schistosoma haematobium* infection in the selected villages

The highest rate of incidence was recorded in El-Hussien village being 37.4%, although it was decreasing rapidly to 8.5% in Al-Goz village, while in Al-Oshara village the incidence rate slightly increased to 16.5%.

Table.2. Incidence of *Schistosoma haematobium* infection in the selected villages

Village 's name	Number examined	Number infected	Infected (rate%)
Al-Oshara	431	71	16.5
Al-Hussien	377	141	37.4
Al-Goz	449	38	8.5
Total	1257	250	19.9

3. Incidence of *Schistosoma haematobium* infection during different seasons in the selected villages

The highest incidence detection was 40.9% in the summer season in El-Hussien village and 39.9% in the rainy season. The incidence rates were significantly different being 8.8 and 3.1% in Al-Goz in the rainy and winter dry season respectively. However, the highest incidence recorded through the summer season was in two villages El-Hussien and Al-Goz, while in the latter village the incidence rate slightly increased in the rainy season to 20.2% which was more than during the summer season (20%) but it was not significantly different.

Table.3. Seasonal incidence of Schistosoma haematobium infection in school children in the study area

Village 's name	Season							
	Winter		Summer		Rainy		Total	
	No. examined	Infected rate (%)	No. examined	Infected rate (%)	No. examined	Infected rate (%)	No. examined	Infected rate (%)
Al-Oshara	143	13(9) bB	120	24(20) aB	168	34(20.2) aB	431	71(16.5) aC
El.Huissien	111	35(31.5) cA	93	38(40.9) bA	173	68(39.3) bA	377	141(37.4) bA
Al-Goz	163	5(3) cC	105	17(16) aC	181	16(8.8) bC	449	38(8.5) bC
Total	417	53(12.7) cA	318	79(42.8) aA	522	118(22.6) aB	1257	250(19.9) aB

* Values with different letters are significantly different.

4. Age-related pattern of incidence in school children (n=1257)

Schistosoma haematobium incidence in the age group 15-19 years was 44.9% in El-Hussien village, although it was decreasing rapidly to 5.8% in age group 5-9 in Al-Goz village. However, the highest rate was 44.9% and 40% in the age group 15-19 and 5-9 years in El-Hussien village respectively with no significantly differences, followed by 35.1% in the age group 10-14 years in El-Hussien village.

Village 's name	Age group							
	5-9		10-14		15-19		Total	
	No. examined	Infected rate %	No. examined	Infected rate %	No. examined	Infected rate %	No. examined	Infected rate %
Al-Oshara	109	13(11.9) cB	243	46(19) aB	79	12(15.2) aB	431	71(16.5) aC
El-Huissien	83	33(40) bA	245	86(35.1) cA	49	22(44.9) aA	377	141(37.4) bA
Al-Goz	121	7(5.8) cC	247	23(9.3) bC	81	8(9.9) aC	449	38(8.5) bC
Total	313	53(16.9) aC	735	155(21.1) aB	209	42(20.1) aB	1257	250(19.9) aB

* Values with different letters are significantly different.

5. Age-related *Schistosoma haematobium* incidence in the study area during different seasons

Schistosoma haematobium incidence highest rate was recorded in summer season in the age group 5-9 in El-Hussien village being 84.7%, followed by incidence rate of 71.4% in same age group in same village. The lowest incidence rate of *Schistosoma haematobium* was 0% in winter season in age group 5-9 in Al-Goz village. Also it was increased to 2% in the same season in the same village. However,

there were considerable statistical differences between the rates of incidence in age group in the different seasons.

Table.5. Age-related *Schistosoma haematobium* incidence in the study area during different seasons

Village 's name	Season	Age group (years)	No. examined	Infected rate (%)
Al-Oshara	Winter	5-9	35	3(8.6)bB
		10-14	76	8(10.5)aC
		14-19	32	2(6)cC
	Summer	5-9	26	7(26.9)aA
		10-14	78	14(17.9)cB
		14-19	16	3(18.8)bB
	autumn	5-9	48	3(6.3)cC
		10-14	89	24(27)aA
		14-19	31	7(22.6)bA
El-Husssien	Winter	5-9	7	5(71.4)aB
		10-14	93	23(24.4)cC
		14-19	11	7(63.7)bA
	Summer	5-9	13	11(84.6)aA
		10-14	52	18(34.6)bB
		14-19	28	9(32.1)cC
	autumn	5-9	63	17(27)cC
		10-14	100	45(45)bA
		14-19	10	6(60)aB
Al-Goz	Winter	5-9	37	0(0)cC
		10-14	88	2(2.3)bC
		14-19	38	3(7.9)aC
	Summer	5-9	16	2(12.5)cA
		10-14	67	12(17.9)aA
		14-19	22	3(13.6)bA
	autumn	5-9	68	5(7.4)bB
		10-14	92	9(9.8)aB
		14-19	21	2(9.5)aB

* Values with different letters are significantly different.

6. Sex-related incidence rates in the study area (n=1257)

Schistosoma haematobium incidence rate in relation to sex is different in most seasons. Usually males had higher incidence than females being 24.3 and 14.7% in the total study area. The incidence in males was 40%, it was decreased to 32.9% in females in El-Hussien village. Thus, the highest rate was 40% in males of El-Hussien village, whereas, the lowest rate was 8.5% in females of Al-Goz village.

Table.6. Sex-related *Schistosoma haematobium* incidence rates in the study area (n=1257)

Village 's name	Sex					
	Males		Females		Total	
	No. examined	Infected rate %	No. examined	Infected rate %	No. examined	Infected rate %
Al-Oshara	238	47(19.7) aB	193	24(12.4) bB	431	71(16.5) aC
El-Hussien	243	97(40) aA	134	44(32.9) bA	377	141(37.4) bA
Al-Goz	199	21(10.6) aC	250	17(6.8) bC	449	38(8.5) bC
Total	680	165(24.3) cA	577	85(14.7) bB	1257	250(19.9) aB

* Values with different letters are significantly different.

7. Relation between *Schistosoma haematobium* incidence according to sex and fluctuation season (n=1257)

The incidence in school children in relation to sex was different in most seasons. Males had higher incidence than females in most seasons. The highest incidence was recorded in the autumn season in El-Husssien village being 51.6 and 37.5% in males and females respectively. In the autumn season in Al-Goz village the infection rates in females exceeded those of males being 9.8 and 6.8% respectively.

Table.7. Relation between *Schistosoma haematobium* incidence according to sex and fluctuation season (n=1257)

Village 's name	Season	Sex	No. examined	Infected rate (%)
Al-Oshara	Winter	Male	87	10(11.5)aC
		Female	56	3(5.4)bC
	Summer	Male	71	15(21.1)aB
		Female	49	9(18.4)bA
	autumn	Male	80	22(27.5)aA
		Female	88	12(13.6)bB
El-Husssien	Winter	Male	84	27(32.1)aC
		Female	27	8(29.6)bB
	Summer	Male	66	22(33.3)aB
		Female	27	6(22.2)bC
	autumn	Male	93	48(51.6)aA
		Female	80	30(37.5)bA
Al-Goz	Winter	Male	67	5(7.5)aB
		Female	96	0(0)bC
	Summer	Male	73	12(16.4)aA
		Female	32	5(15.6)bA
	autumn	Male	59	4(6.8)bC
		Female	122	12(9.8)aB

* Values with different letters are significantly different.

8. Infection rate of *Bulinus truncatus* snails during all seasons in the study area (n=2911)

Results recorded from all snail samples collected to detect the infection in intermediate host snails, showed that of 2911, 116 snails were infected making the overall incidence of snails' infection in the study area as 4.0%.

Table.8. Infection rate of snails (*Bulinus truncatus*) during all seasons in the study area

Snails examined	Snails infected	Infected rate%
2911	116	4%

9. Seasonal fluctuation infection with *Schistosoma haematobium* in *Bulinus truncatus* n=(2911)

In the three villages the highest rates of infected snails were recorded in the summer season being 17.3, 10.4 and 6.7% in El-Hussien, Al-Oshara and Al-Goz respectively. No infection was detected in the winter season in Al-Goz village being (0%). The remaining rates were variable being 9.7% and 4.9% in autumn and winter seasons respectively.

Table.9. Seasonal fluctuation of infection with *Schistosoma haematobium* in *Bulinus truncatus*

Village 's name	Season	No. examined	No. infected (Rate %)
Al-Oshara	winter	533	17(3.2)
	summer	211	22(10.4)
	autumn	550	9(1.6)
El-Husssien	winter	561	28(4.9)
	summer	110	19(17.3)
	autumn	615	13(2.1)
Al-Goz	winter	123	0(0)
	summer	75	5(6.7)
	autumn	133	3(2.3)
Total		2911	116(4.0)

DISCUSSION

It is obviously relation between to modernization of agricultural and irrigation practices and the expansion of cultivated lands in the developing world, with resultant spread of both snail and the parasite. The results of this study will contribute to the relocation of the baseline situation for the proper planning and implementation of control programme in this area. The overall incidence of *Schistosoma haematobium* in the study area was 19.9%, while Ahmed (1994) and Abdalla (2002) found the overall prevalence of 31.6 and 35.8% respectively. Comparing these workers findings with the present study there is a marked difference which could be due to the fact that they did a cross-sectional study that coincided with the high incidence season. This mainly due to many factors which the dependence on Nile water directly in one village may have reduced the infection rate (the overall

incidence in Al-Goz village was 8.5%). On other hand, lack of safe water in more villages with the conditions highly favorable for snails intermediate hosts is probably the most important.

The incidence of infection changes according to geographical location of villages, being high (37.4 and 16%) is probably explained by its location on the Nile side, with fairly available safe water. The present study showed that the overall pattern of infection rate among males (24.3%) was higher than females (14.7%) in school children, suggested that males are involved in its risk water contact activities such as swimming and bathing compared to females. This results were similar to what had been stated by Farooq *et al.,* 1966 and Chindwana, (1987). Besides, from another studies in the Sudan we found that Ahmed (1994) reported incidence of 66.8 and 64.2% among males and females respectively in the White Nile area, Musa (1998) found the incidence of 9.2 and 2.3% in El-Seyal irrigation scheme, Naser (2000) reported the incidence of 80.6 and 18.1% among males and females respectively in El-Gummuiya Agriculture Scheme, Khartoum. Dribe *et al.,* (2011) found the incidence of 95% and 52% among males and females respectively in the South Darfour. All these studies agreed on the high infections in males due to differences in daily activities. In Al-Goz village the higher rate of infection among females was in one season only explained to the water exposure factors in the rainy season. This result was similar to some studies; El-.Hussien (1989) found incidence of infection with *Schistosoma haematobium* of 63.2 and 67.6% among males and females respectively in Kosti Province, Sudan.

According age relation to incidence in this study was shown that the overall incidence of *Schistosoma haematobium* was 21.1% in age group between 10-14 years represented the highest incidence in the study area. This results confirms the other studies in the Sudan. Hilali (1992) showed an incidence of 48.7, 50.5 and 26.1% among age group (5-10), (11-15) and (16-20) years respectively in El-Managil area, Abdalatif (1994) found 19.9% incidence, 29.9 and 25.0% among age groups (6-10), (11-15) and (16-20) years respectively in El-Obied and El-Rahad ,Dribe (2011) reported the highest incidence of 73.0% in age group (10-14) in South Darfour. In all these studies there is an increasing in incidence rate reaching its peak at the age (10-14) years. This can be explained by the fact that those within this age group are less restricted and more active and have frequent water contact than the younger ones. Also, the study showed more infections in the summer seasons (42.8%). This may be explained by the fact that the significant increasing in the frequency and duration of human water contact during summer season, which was observed by Chindwana (1987) and Elias (1992).

Bulinus truncatus, the intermediate host of *Schistosma haematobium* are widely distributed in the canals of the study area. The snails are found close to the banks and in the middle of the canals in the different villages where there is aquatic vegetation (Madsen, 1988; Elias, 1992). The highest numbers of infected snails (10.4, 17.3 and 6.7%) were collected during the summer season, whereas, a low number of infected snails (3.2, 4.9 and 0%) were collected during the winter season. These results confirm to Hilali (1992) in El.Managil. However, it seems that the seasonal variation in infection of the snails is mainly related to temperature, changes in water level, speed of water current, the competition and density of aquatic vegetation (Madsen, 1988; Hilali, 1992 and Elias, 1992).

In conclusion, the villages of the study area were endemic with *Schistosoma haematobium* especially the village's people were drinking and practicing activities from canal water. The existence of the main irrigation canals in the study area, where water current is slow favoring snail colonization. This investigation helps on establishing a baseline data to control planning.

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