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Research Note

Prevalence of *Schistosoma haematobium* infection among inhabitants of Lowveld, Swaziland, an endemic area for the disease

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Abstract. We carried out a parasitological survey of *Schistosoma haematobium* infection among the residents of Lowveld Siphofaneni, Swaziland, an area which is devoid of sanitation. Subjects with positive infection were confirmed by the detection of *S. haematobium* ova in their urine. The intensity of the infection was estimated by calculating the total number of *S. haematobium* ova present in 10 ml urine specimen (geometric mean intensity; GMI). Overall, the prevalence of *S. haematobium* infection was 6.1% (18/295) with a GMI of 20.7 (95% CI = 9.1~32.2). Female (10.5%, 16/153) had significantly higher prevalence than that in male (1.4%, 2/142) (ORs = 8.2, 95% CI = 1.8-36.2, $P < 0.01$); conversely, male had higher GMI (60.0) than that (17.3) in female. The age group of ≤5 yrs (15.3%, 9/59) had significantly higher prevalence than that in age group of ≥19 yrs (2.6%, 3/115) (ORs = 0.2, 95% CI =0.04-0.57, $P < 0.01$). The highest GMI of 27.9 (95% CI = 7.6~48.2) was also seen in age group of ≤5 yrs.

Schistosomiasis is one of the major health problems in tropical and sub-tropical countries, of the world's 207 million estimated cases of schistosomiasis, 93% occur in Sub-Sahara Africa (SSA). There are two major forms of schistosomiasis found in SSA. Approximately two-thirds of the schistosomiasis cases are due to infection caused by *Schistosoma haematobium* (Hotez & Kamath, 2009). Possible consequences of *S. haematobium* infection include haematuria, dysuria, nutritional deficiencies, lesions of the bladder, kidney failure, an elevated risk of bladder cancer and in children growth retardation.

Schistosoma haematobium has been endemic in the Kingdom of Swaziland (KS) for several decades, particularly of areas situated in the eastern Lowveld districts of the country (Logan, 1983). Logan (1983) indicated that previous surveys of *S. haematobium* infection among schoolchildren during 1958-1964 showed that the average infection rate was 61.2%. In KS, there are three main sources of information on schistosomiasis, e.g., self-referral to the National Bilharzia Control

Programme (NBCP), school reporting system, and routine health information system. Only data from the NBCP and primary schools in endemic areas are systematically collected and reported on a regular basis. However, its magnitude and impact are largely not well documented to date. Moreover, the status of the *S. haematobium* infection among residents in some remote districts located in Lowveld KS, which are not covered by NBCP, remains unclear to date. The present study intends to investigate on the status of the *S. haematobium* infection among residents in remote districts, which are not covered by NBCP, in Lowveld Siphofaneni to help KS establish a baseline data.

The KS is a landlocked country in southern Africa, bordered to the north, south, and west by South Africa, and to the east by Mozambique. Annual rainfall is highest on the Highveld, which the altitude is around 1200 meters, in the West, between 1000 and 2000 mm depending on the year. The further east, the less rain, with the Lowveld, which the altitude is around 250 meters, was recorded from 500 to 900 mm per annum. Variations in temperature are also related to the altitude of the different regions. The Highveld temperature is temperate and, seldom, uncomfortably hot while the Lowveld may record temperatures around 40°C in summer.

According to advices by NBCP, some remote districts of Lowveld Siphofaneni town were selected in the present study due to poor sanitation, endemic area to parasitic infections, no deworming project has been established, and unsafe water supply etc. Inhabitants (mean age ± standard deviation: 20.5 ± 18.1 years) residing in these districts of Lowveld Siphofaneni in Eastern KS were selected to participate in the present study after informed consent was obtained from participants or parents/guardians. In total, 295 urine samples were obtained, of which 142 urine samples from male and 153 urine samples from female were randomly collected from apparently healthy people. The mean ages were similar in both genders (male: 16.2 ± 1.6 yrs *vs* female: 23.7 ± 19.0 yrs). A single terminal urine sample was collected from each participant between 10.00 and 14.00 hours, reportedly the maximum ova excretion occurs. Ten milliliters of each of the well-mixed urine samples was poured into a quantitative centrifuge tube specific for urinary cells/ parasites counting (cat. no. SY9504, Shih-Yung Medical Instruments Co., Ltd., Taipei City, Taiwan) centrifuged at 2000 rpm for 3min. The supernatant was discarded but about 0.6 ml residual urines were still retained in the bottom of tube and then 50 µl of the urinary solution was dropped into a counting chamber (cat. no. SY 9502); thereafter the number of *S. haematobium* ova present in the chamber under the microscope at 100 x magnification was calculated, finally the number will be multiplied by 12 to represent a total number of ova present in 10ml urine specimen. The mean number of ova per 10ml urine present in all of positive samples was defined as geometric mean intensity (GMI), and any samples that contained less than 50 ova / 10 ml was regarded as light infection; however the figure was equal to or more than 50 ova /10 ml were regarded as heavy infection as suggested by World Health Organization (Opara *et al*., 2007). Ethical approval for the study was obtained from the Ministry of Health & Social Welfare, KS**.** In the present study, the subjects were categorized into 4 age groups (≤5-yr-old group, 6~12-yr-old group, 13~18-yr-old group and ≥19-yr-old group). Statistical analysis was performed using SPSS software system (SPSS Inc., Chicago, IL, USA). Crude odds ratios (ORs) with their 95% confidence intervals (CIs) were estimated and when *P* values less than 0.05 were considered to be statistically significant.

Present results indicated that the overall prevalence of *S. haematobium* infection was 6.1% (18/295), with a GMI of 20.7 (95% CI = 9.1~32.2) in inhabitants living in Siphofaneni remote areas (Table 1). The present overall prevalence was

Table 1. Prevalence with geometric mean intensity (GMI; No. of ova/10 ml urine) and crude odds ratios (ORs) with 95% confidence interval (CI) for *Schistosoma haematobium* infection among inhabitants in neglected remote districts of Lowveld Siphofaneni in Kingdom of Swaziland, southern Africa

Variable	Mean (S.D) age (years)	No. and (%) of subjects		GMI (95% CI))	ORs (95%CI)	*P* value
		Examined	Found positive			
GENDER						
Male	16.2 (16.1)	142	2 (1.4)	60.0 (ND)	†referent	
Female	23.7 (19.0)	153	16 (10.5)	17.3 (5.7~29.0)	8.2 (1.8-36.2)	< 0.001
AGE (years)						
≤5	3.3 (1.3)	59	9 (15.3)	27.9 (7.6~48.2)	‡referent	
6–12	8.8 (2.0)	78	5 (6.4)	14.9 (5.5~24.4)	0.4 (0.1-1.2)	0.09
13–18	15.0 (1.8)	43	1 (2.3)	12.0 (ND)	0.1 (0.02-1.09)	0.03
≥19	39.1 (15.9)	115	3 (2.6)	17.3 (1.6~33.0)	0.2 (0.04-0.57)	< 0.01
All subjects	20.5 (18.1)	295	18 (6.1)	20.7 (9.1~32.2)	ND	ND

ND, Not determined.
†Compared with the prevalence among the female subjects.
‡Compared with the prevalence among the subjects aged 6-12, 13-18, and ≥19 years.

lower than a survey recently conducted in Sudan (80.6%, 208/318), northeastern Africa (Ahmed *et al*., 2009). Moreover, the prevalence (10.2%, 14/137) in children under 12 yrs was also much lower than that in children with similar ages in South Africa (68%) (Saathoff *et al*., 2004), or Mali (38.3%) (Clements *et al*., 2009), West Africa; however the prevalence was close to that (19.5%, 38/192) previously conducted in schoolchildren in north-east Lowveld of Swaziland during 1983 (Logan, 1983), or Nigeria (15.1%) (Morenikeji *et al*., 2009), West Africa or Tanzania (13.2%), East Africa (Stothard *et al*., 2009). Nevertheless, the real overall prevalence may be underestimated due to the possibility of missing out on the detection of the eggs in urine from infected individual who might not be shedding the eggs when their urine samples were present with microhaematuria. In endemic areas, haematuria is a common early sign, in non-treated populations exposed to *S. haematobium*, microhaematuria has been found in 41-100% of infected children, gross haematuria in between none and 97% (Gryseels *et al*., 2006).

Present result also indicated that the age group of ≤5 yrs (15.3%, 9/59) had significantly higher prevalence than that in age group of 6~12 yrs (6.4%, 5/78), 13~18 yrs (2.3%, 1/43), and age group of ≥19 yrs (2.6%, 3/115) (ORs = 0.4, 0.1, 0.2, 95% CI = 0.1-1.2, 0.02-1.09, 0.04-0.57, *P* = 0.09, 0.03, < 0.01, respectively). The GMI largely decreased as age increases as seen in age group of ≤5 yrs (27.9, 95% CI = 7.6~48.2), age group of 6~12 yrs (14.9, 95% CI = 5.5~24.4), age group of 13~18 yrs (12.0), and age group of ≥19 yrs (17.3, 95% CI = 1.6~33.0) (Table 1). However, the prevalence observed in pre-schoolchildren (under 5 yrs of ages) in this study was similar to 19.8% reported in Nigeria (Opara *et al*., 2007), or 11.2% reported by Bosompem *et al*. (2004) among infants in Ghana. It might be explained by that infection and transmission in pre-schoolchildren might occur when those children accompany their mothers to undertake water-related activities e.g., swim and bathe. Other factors that may account for the high prevalence of infection observed in pre-schoolchildren include the absence of a community-based control programme and the absence of mass or targeted health education (Gryseels *et al*., 2006). In contrast, school-aged children of 6~12 years tended to be the target of

chemotherapy-based control programmes performed by NBCP in KS thus leading to reduced infection rate. In Africa, given most schistosomiasis control programmes defined the age 5~19 years as the target population for nationwide control through the school systems, excluding the under fives (Opara *et al*., 2007), thus the results of present study have also shown that pre-school children are a source of transmission of schistosomiasis in neglected communities located in endemic districts and should be integrated into any control intervention in KS.

Female (10.5%, 16/153) had significantly higher prevalence than that in male (1.4%, 2/142) (ORs = 8.2, 95% CI = 1.8-36.2, $P < 0.01$); conversely, male had higher GMI (60.0) than that in female (17.3) (Table 1). Regrettably, we did not examine the clinical syndrome of genital-urinary system among those *S. haematobium*-infected women. However, it is now recognized that up to 75% of the women excreting *S. haematobium* ova in the urine may have schistosome ova in the uterine cervix, vagina, ovaries, fallopian tubes, or vulva that may lead to a significant cause of poor reproductive health, including sexual dysfunction and infertility (Wright *et al*., 1982; Kameh *et al*., 2004; Kjetland *et al*., 2008). The possible interaction between schistosomiasis and HIV/AIDS is currently receiving increasing attention, substantial evidences indicated that female genital schistosomiasis (FGS) due to *S. haematobium* infection could be an important risk factor for the bi-directional transmission of HIV based on the unique clinical and immunological features that characterize the egg granuloma: chronic lesions frequently located in the vulva, vagina and cervix of afflicted women (Feldmeier *et al*., 1995). Kjetland *et al*. (2006) also found that women with FGS had an almost three-fold risk of having HIV that undertaken in a rural Zimbabwean community. Since like many SSA countries, KS is severely affected by the HIV and AIDS pandemic (Gouws *et al*., 2008), thus thorough systematically epidemiological studies to detect and treat FGS among Swazi women with *S. haematobium* infection are urgently required; at least it might help block transmission of HIV due to FGS in KS.

Although we did not investigate on the snail host in Siphofaneni districts, the snail host of *Bulinus globosus* for *S. haematobium* can be found throughout KS in slowing-moving or still water (Pitchford, 1958), and since the largest Usutu River flows through and warmer temperature (20.4ºC) suitable for parasite development in the snails in Lowveld Siphofaneni even during winter (Pitchford, 1958), it seemed likely that inhabitants particularly children and women are highly susceptible to *S. haematobium* infection through contact with water contaminated by cercaria thus leading to increased opportunity of newly or repeatedly acquired *S. haematobium* infection in Lowveld Siphofaneni. Considering individuals infected with urinary schistosomiasis they may suffer severe pathological defects, including carcinoma of the bladder, periportal thickening, portal enlargement, glomerulonephritis, pulmonary hypertension (Hotez & Kamath, 2009), and even transmission of HIV (Kjetland *et al*., 2006). In the present study we found that most of the participants had a light infection of *S. haematobium*, as many had GMI less than 50. However, if they were not treated properly, such light infections will lead to severe consequence.

Altogether, the present report will be useful in planning an integrated schistosomiasis control programme in the neglected remote districts which were not covered by NBCP, KS. In addition, it is also recommended that regulations be enacted so that the following can be enforced, everybody irrespective of age be treated with praziquantel, water control and environmental sanitation conducted, and molluscicides used for snail elimination.

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