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Intestinal schistosomiasis among preschool children along the shores of Lake Victoria in Uganda

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ABSTRACT

Schistosomiasis, a disease caused by *Schistosoma* trematode parasites, affects hundreds of millions of people and accounts for more than 40% of the global health burden due to neglected tropical diseases. In Uganda, intestinal schistosomiasis is endemic in 73 out of 112 districts and about 55% of the population of 36 million individuals are at risk. There is scanty information on the status and burden of schistosomiasis in preschool children less than six years of age in Uganda. This study aimed to assess the status of *Schistosoma mansoni* infections in children aged 1–5 years in Uganda. *S. mansoni* prevalence and intensity of infection were examined in 3058 children from 5 districts along Lake Victoria shoreline, eastern Uganda. For each child one stool sample was collected on three consecutive days. The Kato–Katz technique was used to prepare stool smears on slides for microscopic examination. Short interviews with a standardized pre-tested questionnaire prepared in the local language (Lusoga) were administered to each caregiver to identify risk factors associated with *S. mansoni* infection. An overall *S. mansoni* prevalence of 39.3% (95% CI: 38.0–41.1%) was estimated out of the 3058 stool samples examined. The geometric mean intensity of *S. mansoni* among the infected children was 273 (95% CI: 241–305) eggs per gram of faeces. Both prevalence and intensity of infection increased linearly with age ($P < 0.0001$) and were highest in the age group 49–60 months. Majority (61%) of the children, especially in the age group 12–24 months (84.2%; 95% CI: 75.6–90.1%), were lightly infected. Short interviews with caregivers revealed that preschool children, 1–5 years old, get exposed to *S. mansoni* infested waters through bathing, playing or swimming. It is important that the Uganda national control programme for schistosomiasis takes preschool children into consideration and that health education on transmission of schistosomiasis is delivered to the endemic communities regularly.

1. Introduction

Schistosomiasis (commonly known as Bilharzia) is a disease caused by blood-fluke (trematodes) parasites of the genus *Schistosoma*. Schistosomiasis affects hundreds of millions of people and accounts for more than 40% of the global health burden due to neglected tropical diseases (Hotez and Kamath, 2009). The most prevalent form, intestinal schistosomiasis, is caused by *Schistosoma mansoni*, which infects an estimated 207 million people with more than 90% of the cases occurring in sub-Saharan Africa (Steinmann et al., 2006; Hotez and Kamath, 2009). The disease is distributed throughout Africa and endemic in 54 countries. In Uganda intestinal schistosomiasis is endemic in 73 out of 112 districts and about 55% of the population of 36 million individuals are at risk (Loewenberg, 2014). The disease is particularly severe in communities living along the shores of Lake Albert and the eastern part of Lake Victoria (Dunne et al., 2006; Kazibwe et al., 2010; Kabatereine et al., 2004, Standley et al., 2009; Stothard et al., 2009). *S. mansoni* infection is spread by freshwater snails of the genus *Biomphalaria* (Morgan et al., 2001) and Lake Victoria inhabits two vector species of *Biomphalaria*; *Biomphalaria choanophala* and *Biomphalaria sudanica*. Transmission occurs when schistosome larvae, cercariae, found in faecally contaminated freshwater, penetrate the human skin. Swimming, bathing and wading in contaminated water can, therefore, result in *S. mansoni* infection. In

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endemic areas, all ages with freshwater exposure are equally at risk of infection.

Several studies on the epidemiology of intestinal schistosomiasis in various parts of Uganda have tended to focus on school-age children (6–15 years of age) and adults in high-risk occupational groups like fishermen (Kabatereine et al., 2004, 2006; Odongo-Aginya et al., 2002; Tukahebwa et al., 2013). The Uganda national control programme for schistosomiasis has also focused on mass drug treatment of similar age groups, leaving out the preschool children (PSC) untreated. Recent studies from other endemic areas in Africa, Uganda inclusive, however, show that PSC are also at high risk of *S. mansoni* infection (Odogwu et al., 2006; Stothard et al., 2011). Children as young as 6 months have been found to be infected with *S. mansoni* (Sousa-Figueiredo et al., 2010) in Uganda.

There is still limited information on the prevalence and intensity of *S. mansoni* in PSC in Uganda. The aim of the present study was to investigate the occurrence and estimate the magnitude of *S. mansoni* infections and its associated risk factors among PSC with a broad coverage of Lake Victoria shoreline in eastern Uganda. This information will throw more light on the campaign to include PSC in the ongoing preventive chemotherapy of schistosomiasis in various endemic communities in Uganda.

2. Materials and methods

2.1. Study area and population

The study was carried out along the north-east shoreline of Lake Victoria, eastern Uganda (Fig. 1). Five districts previously studied and known to be endemic for schistosomiasis *mansoni* with reference to school-age children and adults (Odogwu et al., 2006; Sousa-Figueiredo et al., 2010; Tukahebwa et al., 2013) were surveyed; these include; Bugiri, Buikwe, Jinja, Mayuge and Namayingo. A random sample of 35 communities was selected from the five districts from a list of fishing communities using a table of random numbers. Farming and fishing are the major activities carried out by most people living on the shoreline. All children in the age bracket (1–5 years) who were present on the days of survey were included in the study, with consent of caregivers.

2.2. Survey of risk factors

Short interviews with a standardized pre-tested questionnaire prepared in the local language (Lusoga) were administered to each parent or caregiver to identify risk factors associated with *S. mansoni*. The questionnaire consisted of variables including caregivers' knowledge, attitudes and practices towards schistosomiasis, how long they have lived in the communities, sanitary facilities, frequency of water contact and reasons for water contact (questionnaire submitted in supplementary material).

2.3. Sample collection and detection of S. mansoni

This study was conducted from December 2012 to March 2013. Following community sensitization on the ongoing study and written consent, caregivers whose children were to participate in the study were given orientation on how to handle and submit the stool samples of their children. Stool containers (polythene sheets) labelled with the child's identification number and name were given out to the respective parents. For each child one stool sample was collected on three consecutive days. The Kato–Katz technique was used to prepare stool smears on slides for microscopic examination (Katz et al., 1972). Two slides were prepared and examined for each sample; totalling six slides for each child. A small amount of faeces was pressed through a fine nylon or steel screen to remove large debris, the sieved stool filled into a 41.7 mg hole in a template placed on a slide. The specimen on the slide was covered by a piece of cellophane soaked in glycerol with malachite green used as a cover slip. The two faecal smears were each examined under a microscope and eggs on each slide were counted and recorded by two different experienced field technicians. To ensure the accuracy of the egg counts a 10% of the slides from each field technician were chosen at random and re-read by a senior technician. There were no discrepancies.

2.4. Ethical consideration

The study was approved by the Research and Ethics Committee, College of Health Sciences, Makerere University, and cleared by the Uganda National Council of Science and Technology. Permission to conduct the study in the region was obtained from the President's office/Residential District Commissioner. At the beginning of the study, caregivers were explained the objectives of the study in the local language and were asked to decide the participation of their children. Written consent was provided for each child by their parents/caregivers for inclusion in the study.

2.5. Data analysis

Data were entered in EpiData software version 3.1 (EpiData Association; Odense, Denmark) and double-checked against the original data sheets. Data analysis was performed using Stata/IC release 12.0 (StataCorp; College Station, TX, USA). *S. mansoni* infection was defined as the presence of one or more eggs in at least one of the six Kato–Katz thick smears examined. Prevalence and intensity of *S. mansoni* infection were determined in frequencies and eggs per gram of stool (epg), respectively. Intensity of infection was calculated by multiplying the mean for the six slides by a factor of 24 to obtain eggs per gram stool. The eggs were found to be over dispersed and was thus log-transformed and intensities reported as geometric mean intensity (GMI) of epg among infected children and classified as light (1–99 epg), moderate (100–399 epg), and heavy infections $\geq$400 epg (Montresor et al., 1998; World Health Organization, 1993). Various proportions of interest were calculated and comparisons made using the Pearson χ^2 test. Univariate logistic regression analysis was used to assess the association between each risk factor and *S. mansoni* infection using chi square test. Crude and adjusted ORs (odds ratio) and CIs (confidence interval) were also calculated (Fleiss, 1981). To determine the independent risk factors associated with infection, multiple logistic regression analysis was performed using adjusted odd ratio at 95% confidence interval (Breslow and Day, 1980). All variables that showed significant difference with $P < 0.2$ in the univariate analyses were used to develop the multiple logistic regression "STEPWISE" models. *P*-values of less than 0.05 were considered statistically significant.

3. Results

3.1. S. mansoni prevalence and intensity of infection

A total number of 3058 children (1–5 years of age), 1513 girls and 1545 boys, were examined for *S. mansoni* infection. The overall prevalence of *S. mansoni* was 39.3%and varied significantly among districts ($\chi^2 = 9.97$; $P = 0.041$); highest in Jinja district (53.4%) and lowest in Bugiri district (35.0%). The prevalence also varied significantly ($\chi^2 = 387.206$; $P = 0.0001$) among the study communities within the districts; ranging from 0% in Sityohe and Kwomutumba to 66.7% in Lugala. The prevalence of schistosomiasis increased linearly with increasing age in girls ($\chi^2 = 207.7$; $P = 0.0001$) and boys ($\chi^2 = 219.4$; $P = 0.0001$) (Table 1 and Fig. 2). The overall GMI among