Journal of Infection and Public Health (2016) 9, 136—142

http://www.elsevier.com/locate/jiph

Renal related disorders in concomitant *Schistosoma haematobium—Plasmodium falciparum* infection among children in a rural community of Nigeria

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Received 4 April 2015; received in revised form 27 May 2015; accepted 23 June 2015

KEYWORDS
Schistosoma haematobium;
Plasmodium falciparum;
Concomitant infection;
Abnormal urinary blood;
Proteinuria

Summary Schistosomiasis and malaria are two common parasitic diseases that are co-endemic in resource-poor communities of sub-Saharan Africa. This study aims to assess the effects of single and concomitant *Plasmodium falciparum* and *Schistosoma haematobium* infections on two indicators of renal injury in school children in a rural community of Nigeria. A cross-sectional epidemiological survey was carried out on a total of 173 schoolchildren between ages 6 and 18 years (mean age 11.4 ± 2.6 years). Urine and blood samples were collected by standard methods for concurrent microscopic diagnosis of *S. haematobium* and *P. falciparum* infections. Urinary blood (hematuria) and protein were determined using a urinalysis dipstick. The prevalence of single infections was 75.1% and 78.2% for *S. haematobium* and *P. falciparum*, respectively. A total of 57.1% individuals were infected with the two parasites. The prevalence of hematuria was significantly higher in the co-infection status (63.8%) than in single *S. haematobium* (52.2%) and *P. falciparum* (43.7%) infection statuses ($p = 0.04$), while no significant variation was recorded in proteinuria in the three

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http://dx.doi.org/10.1016/j.jiph.2015.06.013

infection statuses ($p = 0.53$). The proportion of children with renal injury associated with the co-infection of these parasites is very high, particularly in young children, who seem to have a higher prevalence of hematuria.

Introduction

Multiple parasitic infections are common in sub-Saharan Africa countries with concurrent infection patterns influencing the pathogenesis of each parasite [1]. Antagonistic or synergistic interactions of parasites in animal models have been suggested to show similar phenomena in humans [2]. In Africa, malaria and schistosomiasis are the first and second most important parasitic diseases with public health implications, respectively [3,4], with cases of concomitant occurrence in many epidemiological studies conducted in the region [2,5,6].

There have been convincing reports about the additive morbidity effects of co-infection of *Plasmodium falciparum* and *Schistosoma haematobium* compared with the single infection of each parasite. Increased anemia and organomegaly in concurrent infections of the parasites have been documented [5,7]. In addition, a recent study examined the effect of concomitant infection of the two parasites on hematologic profiles [6].

Operational research in sub-Saharan Africa has widely adopted the use of hematuria and proteinuria as diagnostic indicators of urogenital schistosomiasis being the morbidity indicators of infection by *S. haematobium* [8—10]. Likewise, in malaria parasite infections, the two urinalysis parameters have been assessed, and it can be concluded that while *P. falciparum* infection is closely associated with proteinuria, its association with hematuria is inconclusive [11,12]. At the time of this report, no study has unraveled the effects of co-existence of *P. falciparum* and *S. haematobium* on hematuria and proteinuria in endemic areas of sub-Saharan Africa. Therefore, this study assessed the synergistic effects of the concomitant occurrence of the two parasites on abnormal urinary blood and protein excretion among school children in a low resource rural community in Nigeria.

Methods

Study area and data sources

The study was conducted in Ijaka-Isale village in the Yewa North Local Government Area (LGA), Ogun State, Nigeria, an adjacent, neighboring community to Ijaka-Oke in the same LGA. The village shares a similar sociodemographic and socioeconomic status with Ijaka-Oke [6]. The community population size is approximately 1000 and shares similar sociocultural practices, such as water storage in open earthen vessels for mosquito breeding [6], with Ijaka-Oke. Yewa River flows downstream from Ijaka-Oke to the community.

Study design

The study was conducted on school pupils in Ijaka-Isale. The population structure of the subjects was similar to that of Ijaka-Oke with ages ranging from 6—18 years (mean age 11.4 ± 2.6 years). The cross-sectional and descriptive study adopted similar sampling procedures as reported by Morenikeji et al. [6]. Using 50.0% prevalence of schistosomiasis and malaria, 0.8 precision, and 90.0% statistical power, the minimum sample size was 150. A non-randomized sampling procedure was used to recruit the subjects.

Inclusion and exclusion criteria

All children who had lived in the area for at least one year and whose parents or guardians gave written informed consent were included in the study. Those showing evidence of acute or chronic illness were excluded from the study. Visitors were also not included in the study. Children positive for *S. haematobium* were administered Praziquantel at a dose of 40 mg/kg of body weight, while children who tested positive for malaria parasites were