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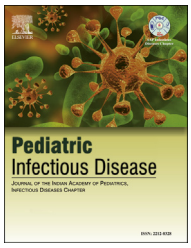

Original Article

Schistosoma haematobium and *Plasmodium falciparum* single and concomitant infections; any association with hematologic abnormalities?

Olajumoke A. Morenikeji [a,*], *Omotayo S. Atanda* [a], *Ituna E. Eleng* [a], *Oyetunde T. Salawu* [b]

[a] *Parasitology Research Unit, Department of Zoology, University of Ibadan, Oyo State, Nigeria*
[b] *Department of Biosciences and Biotechnology, Babcock University, Ilishan-Remo, Ogun State, Nigeria*

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ABSTRACT

Aim: To assess the association between single infection and co-infection status of the two parasites with hematologic profiles in school children.
Methods: A cross-sectional epidemiological survey was carried out on a total of 202 school children between ages 6–18 years (mean age 11.5 ± 2.6 years). Urine and blood samples were collected by standard methods for concurrent microscopic diagnosis of *Schistosoma haematobium* and *Plasmodium falciparum* infections respectively. The following hematologic parameters; hematocrit, hemoglobin, neutrophils, leukocytes, lymphocytes and eosinophils were determined.
Results: The prevalence of single infection was 52.0% and 59.9% for *S. haematobium* and *P. falciparum* respectively, while 28.2% individuals were infected with the two parasites. The prevalence of abnormal hematologic profiles in the subjects was not associated with infection status (single or co-infection) ($P > 0.05$). There were however higher risk of developing low hemoglobin concentration with *P. falciparum* (Prevalence = 71.0%, OR = 6.0, CI = 3.2–11.0) with children with *S. haematobium* infection being weakly predisposed to developing abnormal neutrophils (Prevalence = 53.3%, OR = 1.3, CI = 0.7–2.3). Low hemoglobin associated risk in single infection with *S. haematobium* (OR = 2.0, CI = 1.1–3.6) was increased with co-infection with *P. falciparum* (OR = 4.0, CI = 1.8–8.7). There seemed to be no difference in abnormal leukocytes and eosinophils associated risk in the three infection categories.
Conclusions: There were variations in *Schistosoma* and malaria parasite induced hematologic pathologies and more studies are needed to unravel the underlying mechanisms in such variations.

* *Corresponding author*. Tel.: +23 48055275915.
E-mail address: jumokemorenikeji@yahoo.co.uk (O.A. Morenikeji).
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1. Introduction

Plasmodium falciparum and *Schistosoma haematobium* are two important parasites that have raised serious public health concern in sub-Saharan Africa. In the last decade, it was estimated that 85% and 90% of malaria parasite and *Schistosoma* infected populations live in sub-Saharan Africa.[1,2] While malaria is often associated with acute disease (although chronic infections are not uncommon), schistosomiasis is an insidious chronic infection with the adult worms capable of surviving for several years within the human host.[3] These parasitic infections are poverty associated and therefore oftentimes coexist in communities with poor socio-cultural development; a feature notable among many regions of sub-Saharan Africa. Besides poverty, environmental contamination of water bodies, lack of preventive measures as well as immunological interactions have been implicated as some of the factors responsible for the observed overlap in the epidemiology of the two infections.[4]

The overlapping in the distribution of malaria parasite and *Schistosoma* spp may result in high co-infection rate; an observation that had been established in malaria and intestinal helminth infections.[5,6]

Malaria has been implicated in anemia which is often caused by mechanisms such as hemolysis, increased spleenic clearance of infected and uninfected red blood cells and cytokine induced dyserythropoeisis.[7] Although little is known about the effect of *Schistosoma* infection on hematopoietic status, the visible presentation of hematuria in *Schistosoma* infected individuals could result in synergistic effect especially in concomitant infection with *P. falciparum*. With the current controversies on the effect of *Schistosoma* infection on susceptibility to malaria,[8–10] the importance of effect of co-infection of the two parasites on hematopoietic status cannot be overemphasized.

While there have been several studies on malaria and schistosomiasis epidemiology in Nigeria and other parts of sub-Saharan Africa,[11,12] there have been dearth of information on effect of concomitant occurrence of the causal organisms on hematopoietic status in endemic areas. This study therefore seeks to assess the impact of concomitant occurrence of malaria and schistosomiasis as risk factor for abnormal hematologic profiles in pupils residing in a rural community of Nigeria.

2. Methodology

The study was carried out in Ijaka-Oke community located in Yewa North Local Government Area (LGA) of Ogun State, Nigeria. Ijaka-Oke is a small village with less than 2000 dwellers. Yewa River, one of the major water bodies in the LGA passes through the village and this serves as source of water supply for all domestic purposes in the area. The village is surrounded by thick forest and cultural practices of the people such as water storage in open earthen container and stagnant waste water around dwelling places serve as mosquito breeding sites.

The study was conducted among primary school pupils of age ranging 6–18 years. A non-randomized school based, cross-sectional and descriptive study was adopted. Sample size was determined by the method of Naing et al.[13] A prevalence of 50.0% (for *S. haematobium* and *P. falciparum*) was used to compute the sample size.[14] The precision adopted was 0.8 (due to resource limitation/low population level of target subjects). The minimum sample size calculated for the study was 150 participants. A statistical power of 90.0% was used. The study was conducted between February and May, 2013. *S. haematobium* prevalence study was conducted on 202 participants. All subjects (167) without visible hematuria were screened for malaria parasite infection. The proportions of individuals in the later category with *Schistosoma* and malaria parasite infections were included in the analysis of hematologic parameters. Participants showing symptoms related to underlying chronic *S. haematobium* infection (gross hematuria) were administered Praziquantel at a dose of 40 mg/kg and then excluded from the study. Also, all the subjects with visible signs of ailment were excluded from the study.

Volunteered participants were given a clean, dry, screw-capped universal bottle carrying the same identification number as entered in the record book. Freshly passed mid-day urine samples collected between 10 and 2 pm were inspected macroscopically for gross hematuria. From the same sample, 10 mL of urine was measured and centrifuged at 4000 rpm for 4 min.[15] The supernatant was discarded and the sediment placed on clean microscope slide and covered with a coverslip. The slide was observed under the ×10 magnification. Urine samples showing elliptical eggs with terminal spine were considered positive for *S. haematobium* infection.[16]

Thick and thin blood smears were made from the blood samples collected through venipuncture and stained using 10% Giemsa stain. The presence of either ring forms or gametocytes is conclusive diagnosis of *Plasmodium* infection.[17] Blood samples that were used for the determination of hematologic parameters were stored at 4 °C and were transported to the laboratory. The following parameters were determined; the percentage cell volume in the blood (hematocrit), the hemoglobin level in the red blood cells, the total leukocyte counts, the percentage of neutrophil in the blood, the percentage of lymphocyte and the eosinophil level. The cut off values[18] for these parameters are presented in Table 1. A control group of subjects without malaria and

Table 1 – Cut off values for each of the hematologic parameters.

Blood Parameters		Age group (years)	
		6–12	13–18
Hematocrit (%)	Low	<35.0	<33.0
	Normal	35.0–45.0	33.0–51.0
Hemoglobin (g/dL)	Low	<11.5	<12.0
	Normal	11.5–15.5	12.0–16.0
Neutrophil (%)	Low	<32.0	<34.0
	Normal	32.0–61.0	34.0–64.0
Leukocyte (WBC/μL)	Normal	4.0–12.0	4.5–13.0
	High	>12.0	>13.0
Lymphocyte (%)	Normal	28.0–48.0	25.0–45.0
	High	>48.0	>45.0
Eosinophil (%)	Normal	0–3.0	0–3.0
	High	>3.0	>3.0