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Research Article

Urinary Schistosomiasis and Malaria -Associated Anaemia among Children in Dogo Community, Moro Local Government Area of Kwara State

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ABSTRACT

Urinary Schistosomiasis and malaria remain endemic in rural Nigerian communities, contributing significantly to the burden of anaemia among children. Despite control efforts, persistent co-infection and their impact on child health require localized investigation to inform effective interventions. This study investigates the prevalence of urinary schistosomiasis, malaria, their co-infection, and the relationship with anaemia among children aged 5–15 years in Dogo Community, Moro Local Government Area, Kwara State. One hundred children (47 males, 53 females) were randomly selected and screened. Urinary schistosomiasis was diagnosed via urine filtration microscopy detecting Schistosoma haematobium eggs, while malaria was identified through Giemsa-stained thin and thick blood smears targeting Plasmodium falciparum. Haemoglobin concentration was measured to assess anaemia status. Results reveal that 25% of participants tested positive for malaria, with females constituting 68%. Urinary schistosomiasis prevalence was 22%, predominantly among males (68.2%). Co-infection was detected in 5% of children, all males, who exhibited anaemia defined by haemoglobin levels below 11 g/dL. Notably, 37% of uninfected children maintained normal haemoglobin values, whereas the remainder had subnormal levels. Chi-square revealed a significant association between infection status and anaemia at 5% level of significance. These findings indicate that urinary schistosomiasis and malaria are significant contributors to anaemia and remain significant public health problems in the study area, with distinct gender disparities. The burden of co-infection and its link to anaemia underscore the urgent need for integrated control measures through mass drug administration, health education, and improved sanitation, to reduce the prevalence and impact of these diseases.

Keywords: Anaemia; Children; Malaria; Nigeria; Urinary schistosomiasis

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INTRODUCTION

Schistosomiasis and malaria are fatal parasitic infections that are prevalent and known to increase the burden of anaemia, but existing reports were scanty on the association between anaemia and children who were co-infected with both parasites. Malaria and helminthes infection are the most prevalent parasitic diseases in developing countries and their epidemiologic co-existence is frequently observed, particularly in Africa

(Afolabi *et al*., 2021). In many regions of Sub-Saharan Africa, intestinal helminthic infections overlap geographically with *Plasmodium falciparum* malaria where much of the morbidity associated with both disease results from anaemia (Brooker *et al*., 20007; Degarege *et al*., 2016). Anaemia is one of the widest spread and common health conditions affecting individuals living in tropics (Wiwanitkit, 2007; Kinyoki *et al*., 2021). Similarly, Ofori and Forson, (2024) reported that schistomes cause anaemia by chronic blood loss, as eggs penetrate the wall of the bowl (in intestinal schistosomiasis) and the urinary tract (in urinary schistosomiasis).

Malaria causes anaemia by destruction and removal of parasitized red blood cells and shortening of the life span of non-parasitized red cells, and decreasing the rate of erythrocyte production in bone marrow (White, 2018). Although the distinct mechanisms by which malaria and schistosomes used to reduce haemoglobin (Hb) levels are well documented, their combined presence and interaction to enhance the risk of anaemia received little attention. The two most common tropical parasitic diseases in sub-Saharan Africa are schistosomiasis and malaria, with both being a serious public health problem. The co-infection of malaria and helminth parasites in Africa is as a result of their high proportions, overlapping distribution, transmission methods and other risk factors (M'bondoukwé *et al*., 2018; Afolabi *et al*., 2021). There are three prevalent schistosome species in Nigeria: *Schistosoma haematobium, S. mansoni, and S. intercalatum*. Approximately two-thirds of the schistosomiasis cases are due to infection caused by *S. haematobium*, which represents an important cause of severe urinary tract disease. Ola *et al*. (2025) confirmed that Urinary schistosomiasis (also called urogenital schistosomiasis) and malaria infections are endemic in Nigeria. Co-infections of these parasites lead to reduced learning, reduced school achievements and poor development in children (Brooker *et al*., 2007). Epidemiological studies have highlighted that individuals co-infected with more than one parasite species are at risk of increased morbidity, increased severity of the infecting parasite species and increased susceptibility to other infections (Venter *et al*., 2022). In sub-Saharan Africa, anaemia and malnutrition are the most frequent conditions encountered in field surveys and parasitic infections are among the major causes of these conditions. Mechanisms through which parasitic infections cause anaemia and malnutrition include damage to intestinal mucosa which results in impaired digestion and absorption of nutrients, intestinal blood loss, interference with processes leading to production of blood cells in the bone marrow, and impaired immune development (Fauziah, 2022). The control of schistosomiasis and malaria infections has become a concern for many governments and has the support of donors (including international organizations) following the London Declaration of 2012. Identifying areas where these infections occur, and studying their co-infection, risk factors and implication on anaemia and nutritional status will increase the efficiency and proper implementation of control or elimination programs (Linehan *et al*., 2011). Based on previous studies, urinary schistosomiasis is prevalent in Kwara State, and work has been done on its co-infection with malaria and its effect on anaemia and nutritional status. Therefore, in this study, we evaluate whether there is a significant co-infection of urinary schistosomiasis and malaria and its risk of anaemia and malnutrition amongst school children in the areas around Moro LGA in Kwara State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Kwara State, North-Central Nigeria, which comprises three senatorial districts and sixteen Local Government Areas. The region experiences a tropical climate with distinct dry and rainy seasons and a population of approximately 3.2 million (Adeleke, 2024). Research focused on Dogo Community in Moro LGA, characterized by proximity to water bodies facilitating schistosomiasis transmission, endemic malaria, limited healthcare infrastructure, and dependence on surface water for domestic and agricultural use. The predominant ethnic groups in the study area are Nupe and Yoruba.

Study Population, Design and Sampling

School-age children (5–15 years) who had lived in the community for at least six months were recruited after obtaining parental consent. Excluded from the study were children with chronic illnesses unrelated to malaria/schistosomiasis, recent treatment within four weeks, or lack of parental consent. A cross-sectional design was employed to determine prevalence and co-infection patterns of urinary schistosomiasis and malaria-associated anaemia. A multistage sampling technique was used: random selection of wards, schools/communities, then systematic random sampling of participants from enrollment or household lists. The sample size was calculated using Cochran's formula for prevalence studies as follows:

$$n = \frac{Z^2 \times P\,(1-P)}{e^2}$$

Where:n = required sample size

Z= Z-value for 95% confidence level (1.96)

P = estimated prevalence rate (0.07)

e = margin of error (0.05)
Substituting values:

$$n = \frac{1.96^2 \times 0.07 \times (1 - 0.07)}{0.05^2} = 100.01 \approx 100$$

Laboratoy examination for *Schistosoma haematobium* eggs

10 mL of urine was filtered through a 12 µm polycarbonate membrane. The membrane was then stained with Lugol's iodine and examined microscopically at 10× and 40× magnifications to count *Schistosoma haematobium* eggs, identified by their oval shape with a terminal spine. (Cheesbrough, 2010).

Laboratory Analysis for Blood Samples

Malaria diagnosis involved venous blood collected in EDTA bottles, tested using rapid diagnostic tests (RDTs) based on HRP2 or LDH antigens, with results available within 15–20 minutes (WHO, 2022). Additionally, thin and thick blood smears stained with Giemsa were examined microscopically: thick smears for parasite detection at 100x oil immersion and thin smears for species identification after methanol fixation (Ba *et al*., 2015). Anaemia assessment was performed by measuring haemoglobin concentration through the cyanmethaemoglobin method. This involved mixing 4 mL of Drabkin's solution with 0.02 mL of well-mixed venous blood, allowing the mixture to stand for 10 minutes for complete conversion, and reading absorbance spectrophotometrically at 540 nm (Cheesbrough, 2010). Ethical approval was obtained from the Kwara State Health Ministry. Participation was voluntary with confidentiality maintained.

Data Analysis

Data were summarized using means, standard deviations, frequencies, and percentages. Associations between anaemia and infection status were assessed using the Chi-square test or Fisher's exact test where necessary. Differences in mean haemoglobin levels between two groups were analyzed using the independent t-test, while comparisons across infection groups (non-infected, malaria-only, schistosomiasis-only, co-infected) were performed using one-way ANOVA. The relationship between haemoglobin concentration and parasite load was evaluated using Pearson's correlation coefficient. All analyses were conducted using SPSS version 25.0 (IBM Corp., Armonk, NY), with statistical significance set at $p < 0.05$.

RESULTS

Table 1 presents the demographic and infection characteristics of the study participants. A total of 100 children were included in the study, comprising 47 males (47.0%) and 53 females (53.0%). The overall prevalence of *Schistosoma haematobium* infection and *Plasmodium falciparum* malaria was 22.0% and 25.0%, respectively. In addition, 5.0% of the children were co-infected with both parasites. The mean age of all participants was 10.0 ± 2.89 years, ranging from 5 to 15 years. There was no statistically significant difference in mean age between male and female participants (p = 1.00; p> 0.05). The mean haemoglobin (Hb) concentration for males was 10.0 ± 2.89 g/dL, while for females it was 11.5 ± 1.44 g/dL, indicating a statistically significant difference between sexes (p = 0.002; p< 0.05).

Table 2 illustrates the overall prevalence of anaemia among all study participants, both infected and non-infected, which was 39.0%, based on WHO (2013) cutoff values and definitions for anaemia. Notably, all children (100%) co-infected with *P. falciparum* and *S. haematobium* were found to be anemic. Among the 25 participants positive for malaria, 17 (68.0%) had haemoglobin concentrations below 11 g/dL. Similarly, anaemia was prevalent in 14 (63.4%) of those infected with *S. haematobium* as shown in Table 2.

Table1. Prevalence and co-infection of malaria and urinary schistosomiasis

Gender	Total study participant	Malaria Positive	*Schistosoma*	Co-infection	Non-infected
Male	47	8(32%)	15(68.2%)	5(100%)	20(42%)
Female	53	17(68%)	7(31.8%)	0(0%)	28(48%)
Total	100	25(100%)	22(100%)	5(100%)	48(100%)

Table 2. Overall prevalence of anaemia in children with malaria, urinary schistosomiasis or co-infection in children from the study community

Types of infection	Age (year)	No of children	Haemoglobin concentration (g/dL)		
			Hb<7	Hb<11	Hb>11
Malaria	10.0±3.24	25	3 (12.0%)	17 (68.0%)	8(66.60%)
Schistosomiasis	10.0±2.73	22	3(13.63%)	14(63.64%)	7(31.82%)
Co-infected	10.0±3.57	5	3 (60.0%)	5 (100%)	0(0.00%)

Values of age are shown in mean±SD.

Relationships between *S. haematobium* egg counts and Hb level in children

Figure 1 presents the relationship between *Schistosoma haematobium* infection and haemoglobin concentration among the children. The result shows a negative correlation (r = –0.20, p = 0.046), indicating that as the number of *S. haematobium* eggs per 10 mL of urine increases, the haemoglobin (Hb) concentration significantly decreases. This suggests that heavier infection intensities are associated with lower haemoglobin levels, highlighting the impact of *S. haematobium* infection on anaemia prevalence among the study population.

Relationship between hb level of co-infected non-infected male and females

Figure 2 illustrates the relationship between malaria parasitaemia and haemoglobin concentration. The correlation is also negative (r = –0.09), though weaker and not statistically significant. This implies that as malaria parasite density rises, there is a slight but observable decline in haemoglobin concentration. While the effect is less pronounced than that of *S. haematobium*, the pattern suggests that malaria parasitaemia may contribute to reduced haemoglobin levels among infected children.

Haemoglobin concentration comparison in co-infections, single infection and non-infected children

The mean haemoglobin level of all co-infected children was (6.6±1.82) g/dL. One way ANOVA showed that, the mean haemoglobin level in co-infected children was significantly lower than non-infected group (9.5±2.59). As compared to the non-infected and single infected cases, there was significantly low mean haemoglobin concentration in co-infected children (P=0.009 p<0.01). However, the mean haemoglobin concentration of co-infected children (6.6 ± 1.82 g/dL) was lower than that of children infected with malaria alone (9.6 ± 2.6 g/dL) or schistosomiasis alone (9.9 ± 2.4 g/dL), this difference was statistically significant when comparing co-infected children with another infected group combined (p = 0.009) (Figure 3).

Haemoglobin concentration did not differ significantly between malaria-positive and malaria-negative children (p = 0.39), but was significantly lower in schistosomiasis-positive children compared with schistosomiasis-negative children (p = 0.046).

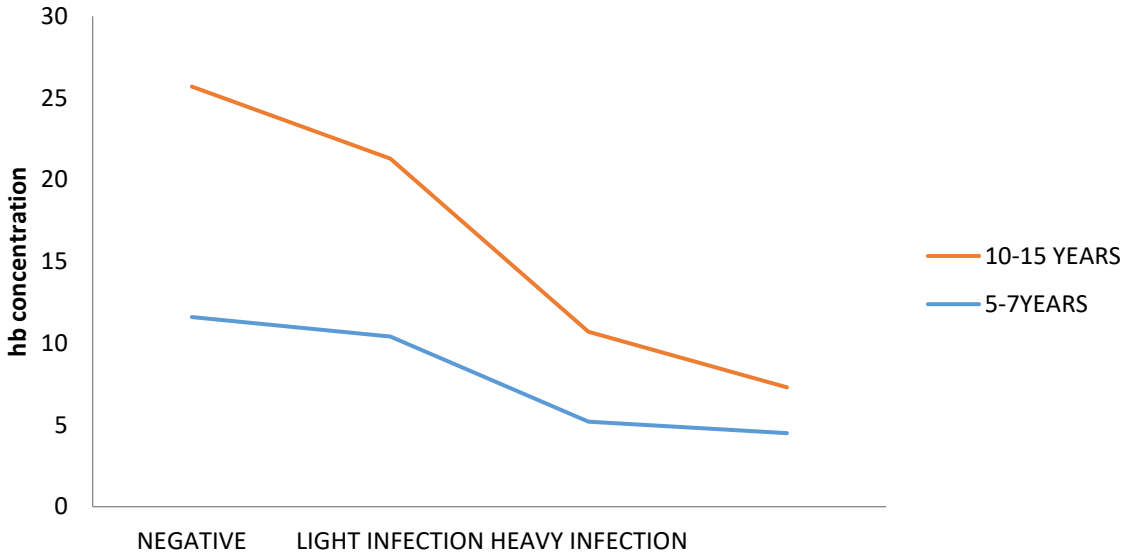

Figure 1. Relationship between *S. haematobium* infection status and Hb concentration

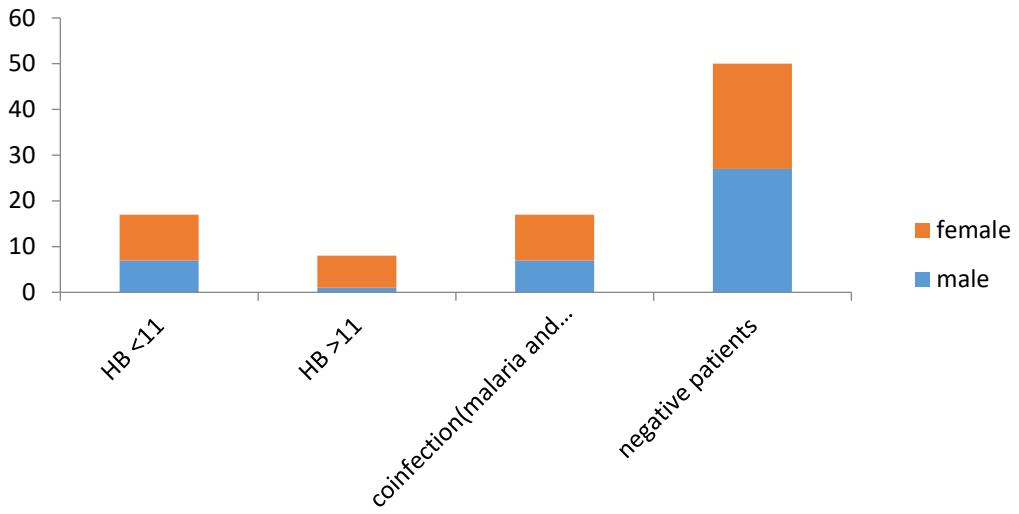

Figure 2. Relationship between malaria parasite and Hb concentration from the study Community

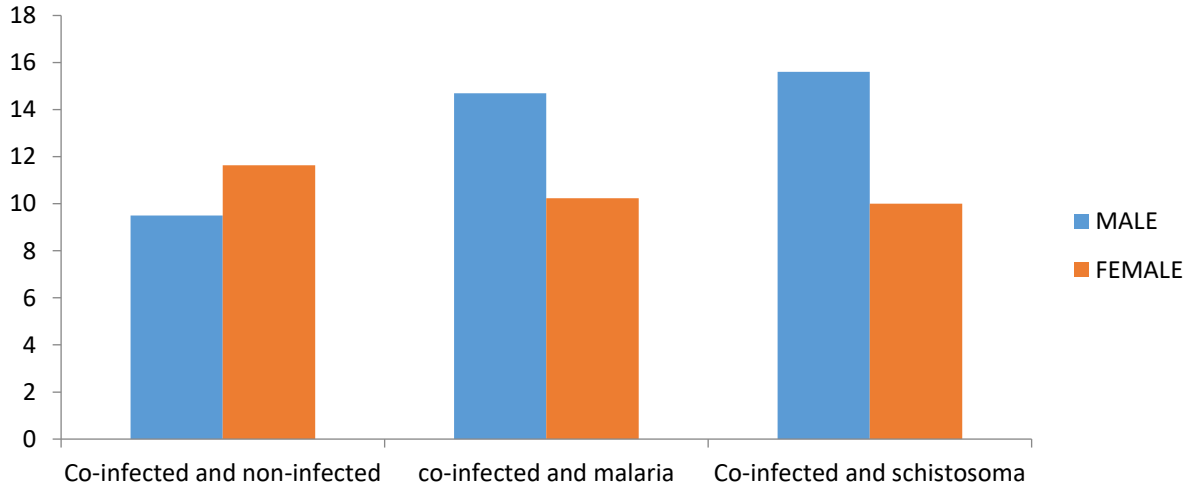

Figure 3. Mean Hb concentration in non-infected, co-infected, malaria infected and schistosomiasis infected children from the study Community

DISCUSSION

The findings from this study on urinary schistosomiasis, malaria, and associated anaemia among children aged 5–15 years in Dogo Community, Moro Local Government Area (LGA), Kwara State, Nigeria, are consistent with global and regional epidemiological data documented by the World Health Organization (WHO) and other scholarly investigations. This study observed a urinary schistosomiasis prevalence of 22%, with males disproportionately affected (15 males vs. 7 females), aligning with the study from the following authors and WHO's estimate that urinary schistosomiasis prevalence ranges between 10% and 50% in endemic rural African communities (Stothard *et al*., 2017; Ayabina *et al*., 2021; WHO, 2023a). In this study, malaria prevalence reached 25%, slightly higher among females (17 females vs. 8 males), and it align with the 20–60% range commonly reported in high-transmission zones across West and Central Africa (WHO, 2023b). Nigeria, recognized as one of the countries with the highest malaria burden globally, continues to experience significant challenges in malaria control, especially in rural settings like Dogo community of Kwara State.

The observed gender disparity in malaria infection in this study is attributed to sociocultural practices and exposure dynamics; females often partake in household activities during evening hours when mosquito biting peaks, heightening their vulnerability and is in agreement with the study of (Nzioki *et al*., 2021; WHO, 2023b).Co-infection with both urinary schistosomiasis

and malaria was found in 5% of participants in the study area, exclusively among males was in agreement with other West African studies where co-infection rates generally remain below 10% (Okoyo *et al*., 2019). Anaemia, defined here by haemoglobin levels below 11 g/dL, was prevalent in approximately 40–45% of children, particularly in those infected with one or both parasites. This prevalence aligns with WHO data indicating that roughly 40% of global children are anemic, with significantly higher rates in malaria and schistosomiasis-endemic regions (WHO, 2022). The greater malaria prevalence among females from this study supports evidence that mosquito exposure varies with gender-specific behaviors, such as the timing of outdoor activities and it is agreement with the study of (Ngutu *et al*., 2025). Conversely, higher urinary schistosomiasis rates among males reinforce our earlier findings that boys' engagement with infected water body's increases infection risk and is alignment with the study of the following authors (Stothard *et al*., 2017; Reitzug *et al*., 2023). Notably, only males endured co-infection, showing a further decline in haemoglobin concentration compared to single infections or uninfected peers. This observation from our study is supported by reports of Okafor and Elenwo (2007), who reported lower haemoglobin among children co-infected with malaria and urinary schistosomiasis, emphasizing the compounded impact on anaemia severity. Interestingly, from our study a negative correlation between parasitaemia and haemoglobin concentration was observed, though this did not reach statistical significance within this study cohort and is in contrasts with findings by Kabaghe *et al*. (2017), who documented a significant inverse relationship between malaria parasite density and anaemia prevalence.

CONCLUSION

In this study both *S. haematobium* and *Plasmodium* spp infections were prevalent among the children. Although a low co-infection was observed, a high prevalence of anaemia and malnutrition was found in the studied areas. Despite the fact that the parasite infections (*S. haematobium*, *Plasmodium* sp. and co-infection) were not significantly correlated with malnutrition (stunting, underweight or wasting), there was, however, a significant difference in *Plasmodium* spp. single infection as well as co-infection with anaemia. The study area was an independent significant predictor of anaemia, while being in the 12-15year age group. Swimming, irrigation and fishing were independent significant risk factors of urogenital schistosomiasis infection. In view of the findings of this study, there is need for large-scale interventions in the communities within and around the Dogo Dam area via mass drug administration. The co-occurrence of malaria and urinary schistosomiasis, particularly among males, is of significant concern, as co-infections not only increase the overall disease burden but also worsen anaemia and its associated complications. The data obtained from this study provide a clear picture of the current health burden in the area and serve as a vital reference point for public health authorities, researchers, and policymakers to design and implement effective disease control strategies tailored to the needs of the community.

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