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RESEARCH ARTICLE

IMPACT OF SCHISTOSOMIASIS ON HAEMATOLOGICAL PARAMETERS IN THE AHOMEY PEOPLE OF THE SO-AVA LAKE DISTRICT, BENIN

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ABSTRACT

Background: Schistosomiasis is the second most common parasitic disease after malaria. It is caused by trematodes of the genus Schistosoma. **Objective**: The aim of this study was to assess the impact of *Schistosoma haematobium* infestation on haematological parameters in So-ava, Benin, West Africa. **Methods**: This is a cross-sectional, prospective, descriptive study. Each participant underwent a urine parasitological test for schistosomiasis eggs and a blood count on a venous sample. **Results**: Of the 120 participants in this study, 93% were male and 38% were aged between 25 and 35 years. 1 in 2 participants carried *Schistosoma haematobium*, a prevalence of 50%. Almost all parasites were male and 63.63% of participants aged 25-35 years were parasitised. There was no statistically significant difference between the blood parameters of parasitised and non-parasitised participants. Similarly, there was no statistically significant difference between the mean lymphocyte, basophil, neutrophil and neutrophil counts of parasitised and non-parasitised participants. On the other hand, there was a significant increase in the mean eosinophil polymorphonuclear count in parasitised subjects compared with non-parasitised subjects. **Conclusions**: *Schistosoma haematobium* bilharziasis in the study population did not have a significant effect on blood parameters, except for the eosinophil count, which we observed to be elevated in response to tissue migration of parasite larvae. Rethinking the control of schistosomiasis will help to significantly reduce its prevalence.

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INTRODUCTION

Schistosomiasis is a neglected tropical parasitic disease caused by worms (trematodes) of the genus Schistosoma. It is estimated that by 2021, at least 251.4 million people will be in need of preventive treatment. Schistosomiasis is known to be transmitted in 78 countries. It is estimated that at least 90% of people requiring treatment for schistosomiasis live in Africa. Schistosomiasis mainly affects poor and rural communities, especially farmers and fishermen, as well as women who perform their household chores in contaminated water. Poor hygiene and contact with contaminated water make children particularly vulnerable to infection (WHO, 2022; Wang *et al*., 2024; Hussen *et al*., 2021). In Benin, the results of a number of epidemiological studies indicate the presence of two species of schistosomes: *Schistosoma haematobium*, which is widely distributed with infestation frequencies ranging from 4% to 100%, and *Schistosoma mansoni* (intestinal form), which is concentrated with prevalence rates up to 74% (Ibikounlé *et al*., 2009; Ibikounlé *et al*., 2012; Ibikounlé *et al*., 2013). Urogenital manifestations are the usual manifestation of *Schistosoma haematobium* bilharziasis, and gastrointestinal tract involvement is less common than in *Schistosoma mansoni*. It may be the cause of the associated malnutrition. It can be the cause of malnutrition associated with iron deficiency anaemia and stunted growth. In several sub-Saharan African countries, the prevalence of anaemia among school-aged children ranges from 30 to 50 per cent (Turlow *et al*., 2006). Iron deficiency and the resulting iron deficiency anaemia are very common in developing countries and are the most common nutritional deficiency in the world (WHO, 2004). Anemia is known to weaken the immune system, making children more susceptible to infectious diseases; conversely, certain infections such as malaria and intestinal and urinary parasitosis can have a profound effect on human nutritional status (Daboné, 2011).

It is also known that the high prevalence of intestinal parasites is most often associated with iron deficiency anaemia and protein-energy malnutrition (WHO, 2004, 2010; Kabatereine *et al*., 2006, 2007). The lake commune of So-ava, surrounded by Lake Nokoué, is crossed by the So River. This situation, combined with the problem of access to drinking water, which forces the population to come into contact with contaminated water sources, exposes the population to waterborne diseases such as schistosomiasis. In 2013, an epidemiological study conducted by Ibikounle and colleagues on the epidemiological status of urogenital schistosomiasis and geohelminthiasis among school-aged children in Sô-Ava community revealed respective prevalences of *Schistosoma haematobium* of 22%, 21. 43%, and 46.47% in three villages, respectively, for an overall prevalence of 32.78%, with as many boys as girls being affected, and children aged 7-8 years being the most affected age group (Ibikounle *et al*., 2013). However, none of these studies have investigated the haematological parameters of subjects exposed to this parasite. The present study is essential and aims to determine the effect of *Schistosoma haematobium* infestation in So-ava on haematological parameters.

MATERIALS

The biological material consisted of venous blood taken from an EDTA tube and urine (micturition) collected in a sterile pot. As laboratory equipment, we used:a Sysmex hematology machine for blood count and a centrifuge to obtain the urine pellet for microscopic examination (to look for bilharzia eggs).

METHODOLOGY

This was a descriptive study. The study population consisted of 120 residents of Ahomey (So-ava, Benin) aged 5 years and above who agreed to participate in the study. Pregnant women, residents of Ahomey suffering from malaria or under antiparasitic treatment were excluded from this study. Participants were included on the basis of convenience. A questionnaire was used to collect information on socio-demographic and anthropological data. The variables studied were: age, sex, prevalence of schistosomiasis, haematological parameters (red blood cell (RBC) count, white blood cell (WBC) count, haemoglobin (HB), haematocrit (HCT), lymphocytes (L), monocytes (M), neutrophilic polymorphonuclear (NP), eosinophilic polymorphonuclear (EP), basophilic polymorphonuclear (BP). Each participant provided venous blood, which was collected on EDTA, and urine, which was collected in a sterile glass after physical exertion. Samples were collected between 11 am and 2 pm. After collection, the samples were transported to the laboratory according to the required transport conditions. Macroscopic and microscopic examinations were performed on each urine sample. The macroscopic examination assessed the appearance, colour, odour and consistency of the urine.The pellet obtained after centrifugation of the urine was placed between a microscope slide and a coverslip, and examined for *Schistosoma haematobium* eggs under a microscope with objectives 10 and 40. Blood cell counts were performed on each blood sample using the Sysmex XT-1800i automated system. Data were entered and analysed using Excel and Stata v11.0 software. The statistical tests used were ANOVA test for comparison of means and Fisher's EXACT test for comparison of proportions. A statistically significant difference was defined as P less than 0.05.

RESULTS

Characteristics of the study population: At the end of this study, in which 120 participants were enrolled, the following figures show their distribution according to sex and age.

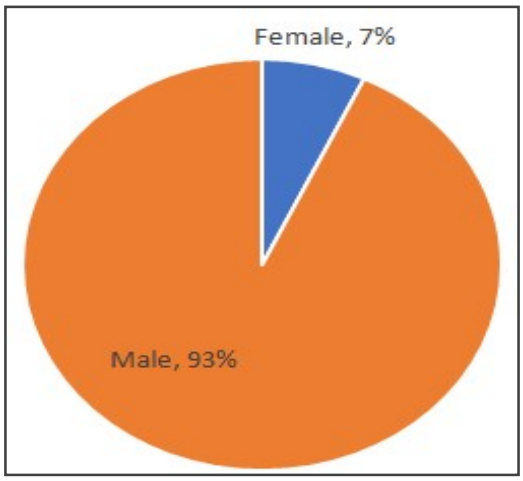

Figure 1. Distribution of participants by gender

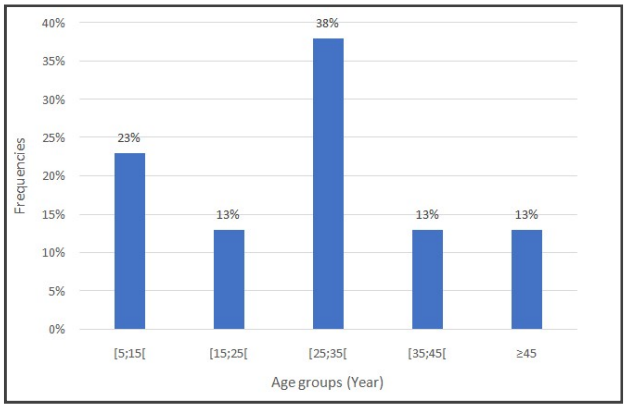

Figure 2. Participants according to age

Figure 1 shows that the majority of participants were male (93%). Figure 2 presents the breakdown of participants by age group. The figure shows that 38% of the participants were between 25 and 35 years old. The average age was 26.4 years, with extremes ranging from 6 to 50 years.

Prevalence of schistosomiasis caused by *Schistosoma haematobium:* Figure 3 shows the results of the parasitological examination of urine.

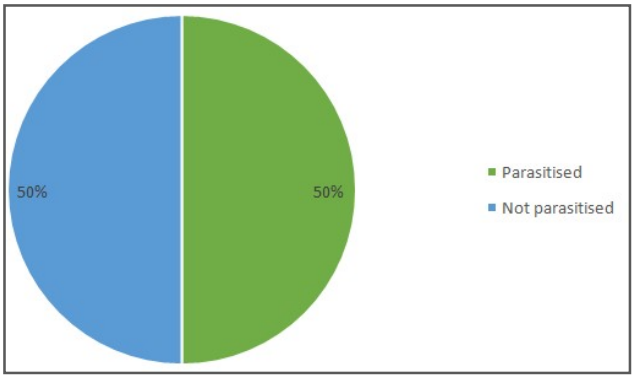

Figure 3. Prevalence of schistosomiasis caused by *Schistosoma haematobium*

One in two participants was a carrier of *Schistosoma haematobium*. The tables below show the distribution of positive cases according to sex and age.

Table I. Distribution of urine parasitology results by sex

SEX	Participants		Total
	Not parasitised	Parasitised	
Female	8 (100 %)	0(0%)	8 (100%)
Male	52 (46.43%)	60 (53.57%)	112 (100%)
Total	60 (50%)	60 (50%)	120 (100%)

Almost all of the parasitised participants are male, according to an analysis of this table.

Table II. Breakdown of urine parasitology results by age group

Age groups	Participants		Total
	Positive cases	Negative cases	
(5-15)	8 (28.57%)	20 (71.43%)	28 (100%)
(15-25)	8 (50%)	8 (50%)	16 (100%)
(25-35)	28 (63.63%)	16 (36.36%)	44 (100%)
(35-45)	8 (50%)	8 (50%)	16 (100%)
≥45	8 (50%)	8 (50%)	16 (100%)
Total	60 (50%)	60 (50%)	120 (100%)

Analysis of this table shows that the 25-35 age group had the highest rate of parasitism (63.63%).

Haematological parameters in positive and negative cases: The mean values of haematological parameters such as red blood cell (NR) count (Figure D), Haemoglobin concentration (Hb) (Figure B), haematocrit (Hte) (Figure C) and white blood cell (NB) count (Figure A) were determined in parasitised (P) and non-parasitised (NP) participants and compared using Student's t-test. The results are presented in Figure 4 below.

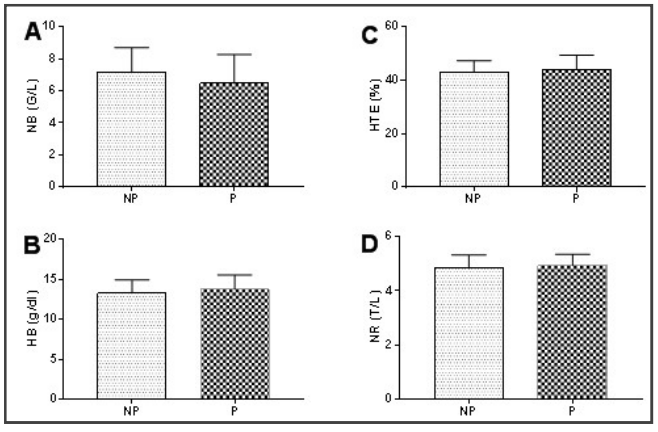

Figure 4. Variation in mean NR, HB, HTE and NB levels between non-parasitised (NP) and parasitised (P) participants

Analysis of Figure 4 shows that there was no statistically significant difference between the mean values of NB (Fig. 4A), NR (Fig. 4D), HB (Fig. 4B), HTE (Fig. 4C) of parasitised and non-parasitised subjects. The mean value of the different white cell types in the WBC formula was determined for non-parasitised and parasitised subjects and compared using Student's t-test. The results are presented in Figure 5. Analysis of Figure 6 shows that there is no statistically significant difference between the mean levels of lymphocytes (Fig. 5A), basophils (Fig. 5D), neutrophils (Fig. 5B) and monocytes (Fig. 5E) in parasitised and non-parasitised subjects. However, there was a significant increase in the mean eosinophil count (Fig. 5C) in parasitised subjects compared to non-parasitised subjects (p-value=0.01).

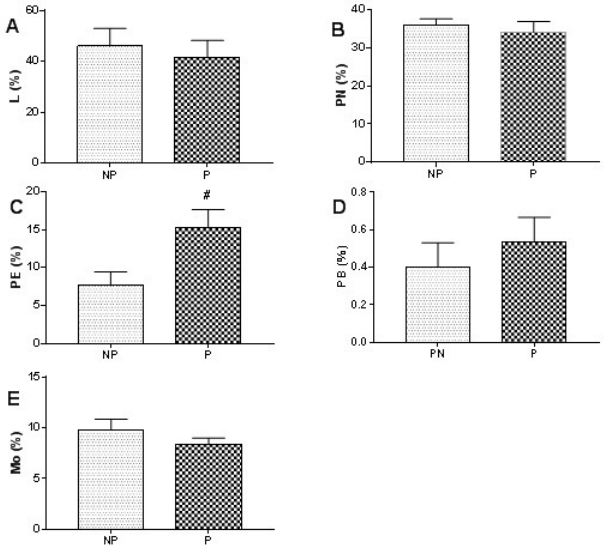

Figure 5. Variation in leukocytes between non-parasitised and parasitised subjects

Table III: Distribution of the values of the white blood cell count according to the presence or absence of the eggs of *Schistosoma haematobium* in the participants

		Presence of *Schistosoma haematobium* eggs	Absence of *Schistosoma haematobium* eggs	p-value
Neutrophilic Polynuclear (NP)	Neutropenia	3 (20%)	1 (6.67%)	0,28
	Normal values	12 (80%)	14 (93.33%)	
	Neutrophilia	0 (0%)	0 (0%)	
Eosinophilic Polynuclear (EP)	Eosinopenia	01(6.67%)	2 (13.33%)	0,53
	Normal values	04 (26.67%)	6 (40%)	
	Hypereosinophilia	10 (66.67%)	7 (46.67%)	
Basophilic Polynuclear (BP)	Low values	0 (0%)	0 (0%)	0,98
	Normal values	15 (100%)	15 (100%)	
	Basophilia	0 (0%)	0 (0%)	
Lymphocyte (L)	Lymphopenia	1 (6.67%)	0 (0%)	0,30
	Normal values	14 (93.33%)	15 (100%)	
	Lymphocytosis	0 (0%)	0 (0%)	
Monocyte (Mo)	Monocytopenia	0 (0%)	0 (0%)	0,54
	Normal values	14 (93.33%)	13 (86.67%)	
	Monocytosis	01 (6.67%)	2 (13.31%)	

Analysis of this table shows that the levels of Neutrophilic Polynuclear, Basophilic Polynuclear (BP), Monocyte and Lymphocyte are within the reference limits in most subjects, both parasitised and non-parasitised. However, there was a significant incidence of hypereosinophilia (66.67%) in parasitised subjects compared with 46.47% in non-parasitised subjects. However, no statistically significant difference was found when comparing these two proportions.

DISCUSSION

The overall aim of this study was to assess the impact of *Schistosoma haematobium* infestation on haematological parameters. Of the 120 participants in this study, 93% were male. This sample is not representative of the current socio-demographic situation of the country in terms of gender distribution, which shows a predominance of females. The predominance of men in our study is explained by the unavailability of women during the sampling period, who were busy with domestic chores.

At the end of the study, 60 of the 120 participants were carriers of *Schistosoma haematobium*, i.e. a prevalence of 50%. This prevalence is higher than that found among schoolchildren in the same community in 2013, which was 32.78% (Ibikounle *et al*., 2013). The frequency of *Schistosoma haematobium* egg carriage found in our study is also higher than the prevalence obtained in certain localities in northern Benin. These results once again demonstrate the endemic nature of this disease in this locality, partly due to its geographical location. Our study focused mainly on adults, and the high prevalence of carriage compared with that found in schools may be explained by the occupation of adults, especially men, most of whom are fishermen and farmers and therefore in constant contact with contaminated water. Mediavilla's team detected a total of 64.95% of samples positive by real-time PCR in Angola (Mediavilla *et al*., 2024) whereas in Kankossa and Oued Rawdha villages (southern Mauritania) Nakatt *et al*., obtain as prevalence of urogenital schistosomiasis 35.6% and 15.8%. Schistosomes are associated with an increased risk of anaemia, but the mechanisms underlying the relationship between schistosomiasis and anaemia remain unclear. We compared haematological parameters between parasitised and non-parasitised subjects. Our results showed that erythrocyte count, haemoglobin level and haematocrit were not significantly different between the two groups. Olajumoke's team found no link between *S. haematobium* infestation and abnormal haematological parameters. *Schistosoma haematobium* is a haematophagous parasite and its infection is associated with haematuria, which can lead to a decrease in haemoglobin levels (Dejon-Agobé*et al*., 2021). In a cross-sectional study of Somalis living in Kenya, Greenham found that the prevalence of anaemia was significantly increased in boys aged 10-15 years infected with *Schistosoma haematobium*, but not in girls (Greenham, 1998).

Furthermore, in a school setting, the presence of *S. haematobium* infection was associated with an increased risk of anaemia in children (aged 5 to 14 years), adolescents and adults (aged over 15 years). The team of Afrifa found low Haemoglobin, haematocrit, mean cell volume, mean cell haemoglobin, and mean cell haemoglobin concentration levels associated with *S. haematobium* infection among children in the Yeji district (Ghana) (Afrifa *et al*., 2017).The absence of a decrease in haemoglobin levels in the infected participants in the present study compared with the uninfected subjects observed in our study may be due to the fact that the study population consisted mainly of adults, since the authors who established an association between anaemia and schistosomiasis caused by *Schistosoma haematobium* worked mainly on children and adolescents. In fact, nutritional deficiencies coexist with infectious diseases in children, which would strengthen the association if this age group were included in the search for a link. In addition, our results showed that the mean blood eosinophil count of parasitised subjects was significantly higher than that of non-parasitised subjects. Our results confirm those reported in the literature suggesting the presence of hypereosinophilia during helminthiasis due to tissue migration of parasite larvae. More than half of the parasitised participants (66.67%) had hypereosinophilia. This frequency is higher than the hypereosinophilia observed in 46.47% of non-parasitised participants, but the difference is not statistically significant. Hypereosinophilia is not automatically synonymous with parasitosis. Blood eosinophilia also varies according to the developmental stage of the parasite.

Antigenic stimulation is caused by the presence of the parasite, which completes its cycle by developing from the larval to the adult stage. This causes a sharp increase in the number of eosinophils, which peaks between 20 and 90 days, depending on the parasite. The eosinophilia then subsides slowly over a period of weeks or months. Eosinophilia rises during the first 3 weeks, reaching relatively high levels of up to 1.10^9 to 5.10^9 eosinophils/L, and then falls slowly over several weeks to stabilise at sub-normal levels (e.g. $0.5.10^9$ to $0.7.10^9$ eosinophils/L) or even normal levels (< $0.45.10^9$ eosinophils/L). This is the case in schistosomiasis, where the worms 'camouflage' themselves by covering themselves with the host's proteins and are therefore no longer recognised as 'foreign' by the immune system. This delays the immune response and explains the absence of hypereosinophilia in some infected individuals.

CONCLUSION

At the end of this study, the prevalence of *Schistosoma haematobium* carriage among the inhabitants of Ahomey was 50%. *Schistosoma haematobium* bilharziasis does not have a significant effect on the number of blood cells, haemoglobin and haematocrit in adult parasites; however, it leads to an increase in the number of eosinophilic polymorphonuclear cells in response to tissue migration of parasite larvae. This study should be extended to schools in order to better assess the impact of this condition on haematological parameters in association with other factors causing nutritional deficiencies.

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