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Relationship between Intestinal Helminthiasis and Hemoglobin Level among Primary School Children in Sokoto Metropolis

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Authors' contributions

This work was carried out in collaboration between all authors. Author OFA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MB and AEA managed the analyses of the study. Authors NMB and AAA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Intestinal helminthes are associated with the reduction in the level of haemoglobin. This abnormal reduction in haemoglobin results in anemia. The study determined the prevalence of parasitic infection and its relationship with haemoglobin level among primary school children in Sokoto metropolis. Stool and blood samples were collected from 224 children from some selected primary schools in Sokoto Metropolis. The stool specimens were examined for parasites by both macroscopic and microscopic methods (saline and wet iodine mount, and formol-ether concentration) while haemoglobin concentration in the blood sample was estimated using hemocue hemoglobin method. A prevalence rate of 8.5% was seen among the children sampled. Hookworm had the highest prevalence of 3.1%, followed by *Hymenolepis nana* (1.8%). *Ascaris lumbricoides* had a prevalence of 1.3%, *Schistosoma mansoni* (0.9%) and *Strongyloides stercoralis* (0.4%). 0.9% showed mixed infection with *H. nana* and Hookworm. Children within the

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age group of 4-6years had the highest prevalence rate (60%). Male children had a higher prevalence (4.5%) than female (4.0%). The mean haemoglobin concentration in the healthy subject was 11.82 g/dl, while in infected subjects it was 11.03 g/dl, the difference was statistically significant ($p<0.05$). The study demonstrated that there was a low prevalence of intestinal helminthiasis among children in Sokoto metropolis. However, the haemoglobin concentrations of infected children were significantly affected by parasitic infection. Low haemoglobin concentration in children can lead to behavioural disturbances as a result of impaired neurological development and reduced scholastic performance. Based on these findings, efforts must be made to create better sanitary and toilet facilities in schools at all times to avoid indiscriminate defecation that could lead to the transmission of helminthic infections.

Keywords: Intestinal helminthes; anaemia; children; haemoglobin concentration.

1. INTRODUCTION

Helminthiasis is an infection with one or more intestinal parasitic worms i.e. roundworm (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) or hookworms (*Necator americanus* and *Ancylostoma duodenale*). Intestinal helminthes are associated with the reduction in the level of haemoglobin. The susceptibility of children to parasitic infection is due to their lower immune response compared to adults, poor hygiene, poor sanitary and environmental condition which favour the development of parasites and eventual infection of host [1]. This abnormal reduction in haemoglobin results in anaemia. Anaemia in children is defined by the World Health Organization as a hemoglobin concentration less than 11.5 g/dl for children (5 - 12 yrs) and 12 g/dl for teenagers (12 - 15 yrs) [2]. Iron deficiency anaemia accounts for most of the anaemia that occur due to parasitic infection. Over 30% of the world's population is anaemic due to iron deficiency and parasitic infection. Anaemia in children has been related to reduced work performance, reduced cognitive functions, growth retardation, and impaired immune system. It is well-established that helminthiasis infection results in intestinal blood loss which, in turn, can contribute to low haemoglobin levels in children [3]. The extent to which intestinal helminths contribute to low haemoglobin levels in children is not adequately documented thus hindering public health policy and planning for helminthic disease control and management [4]. The worms contribute to anaemia by causing blood loss directly through ingestion and mechanical damage of the mucosa, and indirectly, by affecting the supply of nutrients necessary for erythropoiesis [5]. The correlation between intestinal helminthiasis and haemoglobin levels in primary school children was evaluated in this research.

2. MATERIALS AND METHODS

2.1 Study Population and Area

Two hundred and twenty-four (224) stool and blood samples were obtained from randomly selected primary school children within the age range of 4-12 years with no history of any major illness and who have not taken anti-helminthic drugs in recent past 2 or 3 weeks. These selected schools include; Dambuwa Model Primary School, Sokoto, Army Children Primary School, Sokoto, and Precious Bright Future Foundation, Sokoto. Approval for the study was obtained from Ministry of health and school authorities including their headmasters to have access to the pupils and their samples (stool and blood). Confidentiality was maintained by standard medical practice.

2.2 Sample Collection

A structured interviewer-administered questionnaire was used to elicit data on pupil's socioeconomic and demographic characteristics, including age, sex, parent's occupation, tribe, local government. Information on subjects such as type of toilet, washing of hands, walking barefoot was also obtained. Stool samples were collected in a clean, dry, wide-mouthed, sterile grease free sample containers. Blood samples were collected using a sterile, dry, 5ml plastic syringe attached to a needle. The samples and their respective questionnaires were collected and they were immediately transported to the Medical Microbiology Laboratory of the Faculty of Medical Laboratory Sciences, Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, where they were analyzed.

2.3 Sample Processing

The stool specimen was examined macroscopically and microscopically using direct saline

and wet iodine mount, and also formal-ether concentration method. The blood specimen was examined using the hemocue haemoglobin concentration method.

2.4 Direct Wet Mount Microscopy

For each sample, normal saline mount and iodine mount was prepared on a slide and examined microscopically at 10X and 40X for the presence of *Intestinal helminths*. The iodine preparation was used to assist in the identification of cysts [6].

2.5 Formalin-Ether Sedimentation

Formalin-ether sedimentation method was carried out as described by [7]. The prepared mount was observed at x10 and x40 magnification on a light microscope and the entire preparation was examined systematically for larvae, ciliates, helminth eggs and cysts.

2.6 Hemoglobin Estimation (Hemocue Hemoglobin Technique)

The microcuvette holder was pulled out to its loading position.The left button of the meter was pulled out until the display was activated. The meter automatically carries out a performance check. After 10 seconds the meter showed three flashing dashes, indicating it was ready for use. A microcuvette was filled in one continuous process with a well-mixed EDTA anticoagulated blood. Within 10 minutes of filling the microcuvette, the haemoglobin level was measured. This was done by placing the microcuvette in the microcuvette holder and pushed in the holder to its measuring position. After 15–60 seconds, the haemoglobin value was displayed in g/dl [6].

2.7 Data Management

The result of this study was expressed in tables and figures as appropriate. The statistical package for social science (SPSS) was used to analyse the data. Mean and the standard deviation was computed for normal distribution. The relationship between variables was assessed using Chi-Squared test for independence and the degree of confidence was set at 95% (P-value of 0.05).

3. RESULTS

The prevalence of intestinal helminthes among the overall population studied was 8.5%. The highest prevalence of 3.1% (7) was noted for hookworm forming the bulk of the infestations while the lowest prevalence was seen with *Strongyloides stercoralis* with 0.5% (1) as shown in Table 1. There were also mixed infections involving Hookworm and *Hymenolepis nana* 2 (0.9%).

Table 1. Prevalence of intestinal helminth infestation in primary school children examined

Parasites	Frequency (n=224)	Prevalence (%)
A. lumbricoides	3	1.3
Hookworm	7	3.1
H. nana	4	1.8
S. stercoralis	1	0.5
S. mansoni	2	0.9
Mixed infection	2	0.9
Total	19	8.5

A total of 120 (53.6%) male pupils and 104 (46.4%) females were involved in this study. Table 2 reveals a higher prevalence in males 4.5% (10). There was no statistically significant association between gender of school children examined and infection with intestinal helminths (P-value = 0.616, $\chi 2=4.454$, df = 6).

Table 3 shows the prevalence of intestinal parasite within the age groups with a higher prevalence in ages 4-6 years. Statistical analysis showed significant association (P-value = 0.000) between age group of school children examined and parasitic infestation.

Fig. 1 shows the Mean ± Standard Deviation of Hemoglobin concentration among infected and healthy subjects. The mean hemoglobin concentration of infected subjects is 11.03 g/dl (S.D=0.36242) while that of healthy subjects is 11.82 g/dl (S.D=0.35547), showing a statistically significant decrease (P. value = 0.000).

4. DISCUSSION

The results generally showed a low prevalence of 8.5% of infection with intestinal helminth. This prevalence is low when compared to 54.8% obtained in Jigawa [8] and 73.36% in India [9]. Similarly, [10] recorded a prevalence rate of 89.5% in Lagos state, Nigeria while Awogun [11] observed a prevalence rate of 70.8% in Ilorin, Nigeria. The low prevalence rate recorded in this

Table 2. Gender prevalence of intestinal helminth among the study population

Gender	No. examined	Intestinal helminth infection		p-value
		No. positive (n=224)	Percentage (%)	
Male	120	10	4.5	0.616
Female	104	9	4.0	

df = 6, X^2= 4.454

Table 3. Prevalence of Intestinal helminths according to the age group of children

Age group	Intestinal helminth infection		p-value
	No. examined (%)	No. positive (n=224)	
4-6 years	5 (2.2)	3 (6.0)	0.000
7-9 years	52 (23.2)	4 (7.7)	
10-12 years	167 (74.6)	12 (7.6)	
Total	224 (100.0)	19(8.5)	

df= 12, X^2 = 39.572

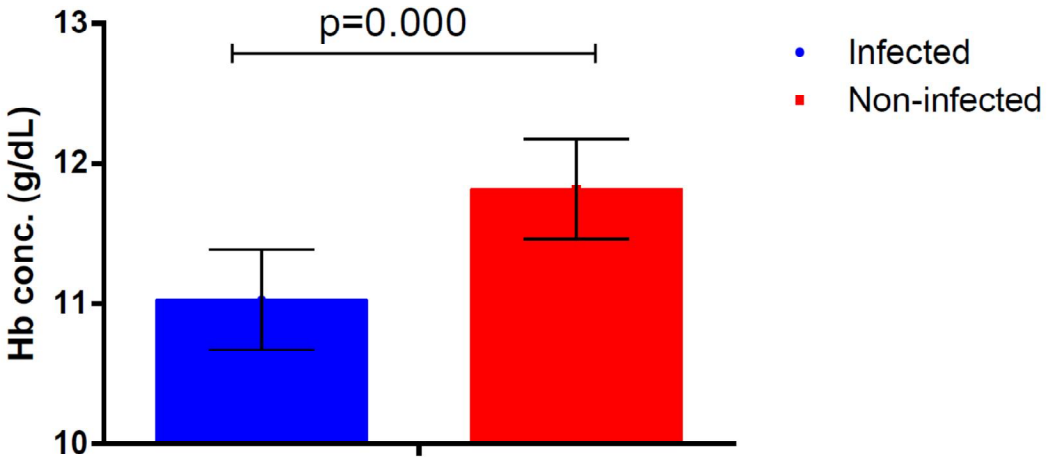

Fig. 1. Mean hemoglobin level among infected and healthy school children

study is in tandem with the prevalence rate of 16.9% observed by Chigozie et al. [12] in South Eastern Nigeria and 15.75% observed by Garba et al. [13] in Kaduna, Nigeria. The decrease in prevalence of intestinal helminths infection observed in this study might be due to desiccation of ova as a result of high temperature and low humidity in dry season as samples were collected and analyzed during this period. Higher prevalence of helminthiasis in the wet season is not surprising because it is well established that damp soil favours the embrayonation of helminths thereby making them to thrive well in rainy season [12]. The variability in prevalence could also be as a result of improved sanitary standard and personal hygiene in the study area. Even though, gender is not a significant risk factor for prevalence of intestinal helminth infection [14].This study revealed that male children (4.5%) had a higher prevalence than Females (4.0%) but the difference was not statistically significant (P=0.616). Nevertheless, the results are in agreement with the reports of Ijagbone and Olagunju [15]

In this study, the age group 4 to 6 years was the most affected while the age group 10 to 12 years was the least affected. The differences in infestation rates between the age group was statistically significant (P=0.000). This is in agreement with earlier reports [16,17]. This study revealed a decrease in prevalence as the age of the pupil increased. This could be attributed to the increased public health awareness of the danger of intestinal helminthiasis as the children grow older.

A decrease in the hemoglobin concentration of children infected with intestinal helminth from single to mixed infections as compared with the

non-infected children was observed in this study ($P < 0.05$). This observation is in line with earlier findings by Ehiaghe et al. [18]. World Health Organization defined anemia in children as hemoglobin concentration below 11.5 g/dl. The mean hemoglobin level among infected subjects obtained in this study was 11.0 g /dl which is below the normal range. Result obtained in this study is similar to the findings of Shah et al. [19] who reported a mean hemoglobin concentration of 11.4g/dl in infected subjects. The association between low hemoglobin and parasite positivity seems possible because intestinal parasites are lodged in the duodenum and jejunum, the site of iron absorption [20].The relationship between parasite infestation and anemia is a pathogenic-physiologic type [20]. It is recognized that certain factors play an important role,which include the strain and number of the parasite, the size and site, metabolic process of the parasite, particularly the nature of waste products, age and level of immunity at the time of infestation or presence of co-existing condition which reduce immune responses, malnutrition and the life style of the person infested [20]. Anemia caused by parasitic infestation with nutritional undertone is due to a deficiency of iron, folic acid, B-complex and protein [21]. Mucosal changes have been reported in subjects infested with intestinal parasites infestation [22]. Shortened gut transit time and steatorrhea which accompanies intestinal infestation can potentially reduce iron absorption from the gut [20]. Large family size and mal-absorption are also other factors affecting hemoglobin level indirectly.

5. CONCLUSION

This study demonstrated a low prevalence of intestinal helminthiasis among primary school Children in Sokoto Metropolis. However, the hemoglobin concentration levels of infected pupils were significantly affected by the parasitic infection. Low hemoglobin concentration in children can lead to behavioral disturbances as a result of impaired neurological development and reduced scholastic performance. Based on these findings, efforts should be made to create better sanitary and toilet facilities in schools at all times to avoid indiscriminate defecation that could lead to the transmission of helminthic infections. Children should also be educated on the need to always observe good hygienic practices and behavioral activities both at school and homes. These measures will not only increase the effectiveness of parasite control but also protect children from having other conditions associated with the infection.

CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical permission has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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