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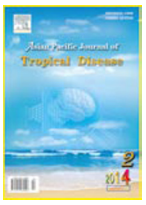

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Iron deficiency anaemia associated with helminths and asymptomatic malaria infections among rural school children in Southwestern Nigeria

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ABSTRACT

Objective: To estimate the relative contribution of causes of anaemia in the rural communities and evaluate the association between parasitic infections and anaemia.

Methods: A total of 292 blood and stool samples of aged 1-15 years school children were collected and analyzed using direct smear saline preparation and concentration methods for examination of ova of parasites in the stool samples with thick and thin blood films stained using Giemsa and Leishman stains as described by World Health Organization. Serum was estimated using ELISA test kit by Syntron Bioresearch, Inc., USA.

Results: The overall prevalence rate of parasitic infection was 66.4% with four species of intestinal helminth identified. *Ascaris lubricoides* (50.0%) was the most common followed by hookworm (8.9%), *Trichuris trichiura* (6.2%) and *Schistosoma mansoni* (1.4%). The mean haemoglobin level of plasmodium positive school children without intestinal helminth infection (10.8 g/dL) was slightly higher than those with intestinal helminth (10.0 g/dL). The mean serum ferritin of plasmodium positive without intestinal helminth (23.7 g/L) was also higher than those with helminth (22.5 g/L) and the differences were not statistically significant ($P>0.05$). Age and gender also made no significant differences in the distribution of the infections. However, there was a significant effect on weight and height by intestinal helminth infections ($P<0.05$).

Conclusions: It is recommended that the public be adequately health educated on the epidemiology of intestinal helminth infection. A periodic mass treatment of school children with iron supplementation is advocated.

1. Introduction

Anaemia continues to be a major public health problem worldwide and is estimated to affect half of the school age children in developing countries. Intestinal helminth infection, malaria and low iron intake are the main causes. Iron deficiency anaemia is the most prevalent nutritional deficiency worldwide and over 90% of affected individuals live in developing countries[1]. It is estimated to affect 1.3 to 2.2 billion persons[2]. Iron is an essential micronutrient that contributes to the production of haemoglobin, the transport of electrons in cells and the synthesis of a range of enzymes. When iron deficiency is sufficiently severe, red blood cell synthesis becomes impaired and anaemia results. Adverse consequences are most common and severe in women of reproduction age and young children[1].

Anaemia is a clinical condition characterized by a reduction in haemoglobin concentration of blood below a specified cut-off value for a particular age range and for the sex of the individual[3]. The World Health Organization (WHO)[4] defines anaemia in man as Hb<13 g/dL, woman with Hb<12 g/dL, children 6 month to 6 years with Hb<11 g/dL and those aged 6-14 years with Hb<12 g/dL[3].

Globally, the most common cause of anaemia is believed to be iron deficiency due to inadequate dietary iron intake, physiologic demands of pregnancy and rapid growth and iron losses due to parasitic infection. And parasitic infection, malaria, *Trichuris trichiura*, hookworm

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Schistosoma haematobium infection are known to contribute to iron status and iron deficiency anaemia[5,6]. However, iron deficiency is not the only cause of anaemia. Other prevalent causes of anaemia include chronic infections and nutritional deficiency of vitamin A, folate and vitamin B12[7].

In view of the insidious nature of these infections and paucity of report on the infection in these communities, our goal was to estimate the relative contribution of causes of anamiea in the rural communities in Osogbo and evaluate the association between parasite infection and anaemia in order to provide a basis for more effective prevention and control.

2. Materials and methods

2.1. Study area

The study was conducted in three communities, located in two local government areas of Osun State. The communities are Ara and Okinni located in Egbedore local government area, and Ilie located in Olorunda local government area. The communities have a tropical climate with temperature ranging from 25 °C to 32 °C. The two distinct seasons in the areas are the wet/raining and dry seasons. The three communities are developing rural communities whose inhabitants are predominantly Yoruba (Osogbo dialect), who engage mainly in subsistence farming. In the communities, sanitation is very poor. Health care services are not widely available and portable water supply is infrequent, therefore the inhabitants usually depend on streams, well and harvested rain water.

2.2. Study population

The study population consisted of both male and female children aged 1-15 years in school and available healthcare centres. Prior to the commencement of the study verbal permission was obtained from the local education authority of the two local government areas and from the community leader/traditional institutions.

2.3. Data collection

Personal hygiene and environmental sanitation information were obtained about the children, which was done directly through the teachers and health centre nurses who were familiar with the local condition. The questionnaire included information on age, sex and nutritional level was administered by a trained interviewer. Anthropometric measurements were obtained during each visit. Weight was measured to the nearest 0.1 kg with a standard standing scale. Height was measured to the nearest 0.1 cm with a paper stadiometer attached to a straight wall.

2.4. Sample collection

The subjects were given a stool receptacle on the eve of the day of examination with specific instruction to collect the fresh stool samples that was passed in the morning while blood samples were collected into ethylenediaminetetraacetic acid bottle.

2.5. Laboratory analysis and classification of parasites

Direct smear saline preparation of stool was examined for ova of parasites under the microscope within 24 h of collection using ×10 and ×40 objectives lenses as recommended by WHO[8]. Negative samples were subjected to concentration method as described by WHO[8]. Thick and thin films were made from collected blood samples and stained with Giemsa and Leishman respectively, employing the methods[9] in order to detect and identify the species of plasmodium parasites in the blood. The haemoglobin concentration was evaluated using cyanmethaemogbloin method[9]. Serum ferritin was estimated using ELISA test kit (Microwell Ferritin EIA) produced by Syntron Bioresearch, Inc. CA, USA. The procedure was according to the manufacturer's instruction.

2.6. Statistical analysis

Differences in mean haemoglobin values between plasmodium infected pupils with and without intestinal helmnith infections were tested for statistical significance using chi-square analysis. The mean serum ferritin differences values between plasmodium infected pupils with and without intestinal helminth infections were also tested for stastical significance.

3. Results

3.1. Prevalence of intestinal helminthes among the school children

Intestinal helminthiasis among the pupils in three communities is shown in Table 1. Of the 292 stool samples examined, 194 (66.4%) were infected with helminth consisting mainly of *Ascaris lumbricoides* (*A. lumbricoides*), hookworm, *Trichuris trichiura* (*T. trichiura*) and *Schistosoma mansoni* (*S. mansoni*) with prevalence rate of 50.0%, 8.9%, 6.2% and 1.4% respectively.

3.2. Haemoglobin distribution among plasmodium positive subjects with and without associated helminth infections

Table 2 shows the mean haemoglobin of plasmodium positive school children with and without helminth infections. This illustrated the effects of plasmodium with