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ORIGINAL ARTICLES

An investigation of symptomatic malaria parasitaemia and anaemia in nursery and primary school children in Buea District Cameroon

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Abstract

Objectives: To investigate the prevalence of asymptomatic malaria parasitaemia and anemia in nursery and primary school children and correlate parasite density with haemoglobin levels.
Design: Cross sectional study.
Setting: Samples were collected from children attending the Saint Theresa's bilingual school and the Government Primary school, Buea, South West Province, Cameroon.
Subjects: 297 nursery and primary school children two to 11 years old selected based on parental consent.
Main Outome Measures: Relationship between asymptomatic malaria and anaemia.
Results: The prevalence of asymptomatic malaria in children was 30.3%. Parasite prevalence and density was independent of age and sex ($p>0.05$). The mean haemoglobin level for parasitaemic children was 11.9g/dl (±SD1.1) compared with 12.1g/dl (±1.2) for non-parasitaemic children. The difference was not significant ($t=1.918$, $p>0.05$). Anaemia when present was mild. No correlation was found between malaria parasite density and haemoglobin levels ($r=-0.065$; $p>0.05$).
Conclusion: Asymptomatic malaria was accompanied by low grade parasitaemia, which did not seem to have a significant effect on haemoglobin levels.

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Introduction

Malaria remains one of the leading causes of morbidity and mortality in sub-Saharan Africa where the disease results in 1.5 to 2.7 million deaths annually.[1,2] *Falciparum* malaria particularly has been implicated as the primary cause of severe aneamia and probably accounts for 4.6% of anaemia cases. The contribution of malaria to the development of anaemia, however, is difficult to determine in malaria endemic areas, since other causes of anaemia, particularly iron deficiency and haemoglobinopathies co-exist.[3] In chronic malaria the patient presents with malaise, pain and headache due to a rise in body temperature; weakness and fatigue due to a drop in haemoglobin levels and in some cases there is joint pain, diarrhoea, vomiting and other abdominal disturbances. In asymptomatic malaria the signs and symptoms of malaria are not obvious but haemoglobin levels, however, could be affected and remain undetected if the patient is not ill enough to report to the hospital.

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The aim of this study was to determine the prevalence of asymptomatic malaria parasitaemia and anaemia in nursery and primary school children and correlate parasite density with haemoglobin levels.

Materials and Methods

Study Area.

The study was carried out in the Buea district of Fako Division, South West Province. The children recruited into the study resided in various sections of the district which ranged from 400 to 800 metres above sea level. The climate in Buea is that of the tropical rain forest zone. There are two distinct seasons each year; a warm dry season from November to March and a cooler rainy season from mid-March to October. This study was conducted from March to June 1999 coinciding with the season of high malaria transmission.

Study Population.

The study population comprised 297 children two to 11 years old, attending nursery and primary schools in the Buea district. Parental consent was obtained prior to the recruitment of these children into the study. There were 195 pupils from Saint Theresa International Bilingual Nursery and Primary School and 102 pupils from the Government Nursery and Primary School. A questionnaire was administered to each child assisted by their parents or guardians to obtain information on age, sex, occupation of parents, number of previous malaria attacks, number of fever episodes in the last year and control measures used against malaria. Nutritional status was assessed using several parameters namely measurement of the mid upper arm circumference, measurement of weight compared to height (muscle mass), weight compared to age; observation for 'pot belly', swollen feet, swollen face, scanty hair; weakness and the presence of rashes or blisters on the body. A standard chart served as a guide for interpretation of findings. Only children who appeared healthy with no obvious symptoms of malaria and whose parents completed the questionnaire and gave their consent were recruited into the study. Ethical clearance was obtained from the Ethical Review Committee of the Provincial Delegate of Health in Buea.

Detection of Malaria Parasites.

Blood was collected from children in their respective schools by finger pricking using lancets. Thin and thick blood films were prepared, transported to the University of Buea research laboratory and the slides were stained with giemsa. Absolute parasite counts were obtained from thick smears by counting the number of parasites among 200 leucocytes and multiplying the count by 8 000.[4] Thick smears were recorded as negative only after 100 high power microscope fields had been scanned.

Estimation of Haemoglobin Levels.

Blood samples were collected in the field into heparinized microcapillary tubes. Haemoglobin levels were determined using the photometric colometric test[5] (Linear Chemicals, Badalona, Spain). Essentially, 20 microlitres of blood was mixed with 5ml of Drabkin reagent, allowed to stand for three minutes at room temperature and the absorbance read at 540nm. The absorbance of the complex is directly proportional to the haemoglobin concentration.

Statistical Analysis.

Comparisons of malaria parasite rates were performed with the Chi square test while mean values were compared with the Student's t-test or Analysis of Variance (ANOVA). The Pearson's regression analysis was used to correlate values. A value of $p<0.05$ was considered statistically significant. All tests were performed using the Software, Statview and Graphics.

Results

Study Population.

The mean age of the children was 6.7 years (SD±2.3). The proportion of female and male pupils was 51.5% and 48.5% respectively. Of the 237 children who responded to the questionnaire 62.9% (149) reported a history of malaria attack in the previous one year. Only 47.3% of the children were exposed to any kind of preventive measure against malaria, the most common being prophylaxis (16.9%) followed by insecticide sprays (14.8%). At least one of the parents of each child had a job. The family income of participants ranged from $131 to $655 per month. The overall nutritional status of the children was assessed to be generally good.

Parasite Rates and Density.

Parasite levels were generally low, ranging from 40 to 9 400 parasites/microlitre of blood. The geometric mean parasite density was 338. The prevalence of asymptomatic malaria was 30.3%. As far as age was concerned it was observed that children in the two to three year age group had the highest frequency of asymptomatic malaria (Table I). The parasite rate in this group was 40%. However, there was no significant difference in the occurrence of asymptomatic malaria in the various age groups. *Plasmodium falciparum* was the prevalent parasite species identified (92.2%) followed by *P. malariae* (7.8%), which occurred only in mixed infections with *P. falciparum.*

Table I: Malaria parasite rates and mean (± SD) parasite densities in the different age groups.

Age Group (years)	Parasite Rate [1]	Mean Parasite Density [2]
2 – 3	40% (10/25)	2.6 (±0.6)
4 – 5	23% (14/61)	2.4 (±0.7)
6 – 7	35% (32/91)	2.4 (±0.5)
8 – 9	25% (19/77)	2.8 (±0.4)
10 – 11	31% (12/39)	2.6 (±0.6)

[1] Chi square = 4.856; p> 0.05 (parasite rate = percentage of subjects with any asexual malaria parasites detected in thick blood films).
[2] F = 1.955; p>0.05 (parasite density = Log_{10} of number of malaria per microlitre of blood).

Haemoglobin Levels.

Level of haemoglobin ranged from 8.6 to 15g/dl with a mean value of12g/dl (SD±1.1). The overall prevalence of anaemia was 11.8%. All children classified as anaemic had values between 8.6 to 10g/dl, which corresponded to mild anaemia. Based on WHO standards [6] there was no case of severe anaemia (haemoglobin levels < 5g/dl) detected. With reference to age the difference in mean haemoglobin levels was not significant between the different age groups ($F = 1.939$; $p>0.05$). However, children in the two to three year age group had a slightly lower mean haemoglobin level compared to that observed for children of other age groups. The mean haemoglobin level of male children (12.0±1.1g/dl) was similar($t=-0.05$; $p=0.9598$) to that of females.

Malaria Parasite Density and Anaemia.

The mean haemoglobin level of malaria asymptomatic children was 11.9g/dl (SD±1.1) compared with 12.1g/dl (SD±1.2) obtained for children without malaria parasitaemia and this difference was not significant ($t=1.918$; $p=0.0561$). No correlation was found between haemoglobin levels and parasite density ($r=-0.065$); $p=0.5397$). Comparison of malaria parasite density and haemoglobin levels (Table II) showed mean parasite counts in anaemic and non-anaemic children to be identical ($p=0.9063$). Haemoglobin values in anaemic children with malaria parasitaemia ranged from 9.0 to 10.6g/dl while absolute parasite counts ranged from 40 to 3 560 parasites/ microlitre of blood.

Table II: Mean (±SD) haemoglobin level and mean (±SD) parasite densities in anaemic and non-anemic children.

Group	Mean Haemoglobin Level	Mean Parasite Density
Anaemic children	10.1 (±0.5)	2.5 (±0.6)
Non-anaemic children	12.1 (±0.8)	2.5 (±0.6)

Difference in mean haemoglobin level significant: t=-9.686; p=0.0001. Difference in mean parasite density not significant: t=0.118; p=0.9063.

Discussion

This study was aimed at determining the prevalence of asymptomatic malaria and haemoglobin levels in nursery and primary school children in Buea. The generally low parasite counts (40 to 9 400 parasites/microlitre of blood) observed in the study is a similar finding to that reported from Gambia and Vanuatu on asymptomatic malaria carriage in children less than 10 years of age.[7,8] The highest parasite rate (40%) was observed in children two to three years old although we found no significant variation in parasite rates and density in the various age groups. It has been established that because of lowered immunity, children zero to five years in endemic areas are most susceptible to malaria attacks. A recent study on the investigation of active malaria infection in Buea reported a prevalence of 53.3% in children zero to five years old and this prevalence was significantly higher than that obtained for individuals above five years old (unpublished data). In the present study, the prevalence of asymptomatic malaria in children five years old and below was 27.9% compared with 30.4% for those six to 11 years old. Our findings agree with those of Newton and collaborators who reported mean parasite densities to be similar in all age groups in apparently healthy children in Kenya.[3]

Based on the haemoglobin levels recorded in malaria asymptomatic children, the prevalence of anaemia was 11.8% and anaemia was mild in all cases. A previous study carried out in the Buea district reported a prevalence of 78.6% for anaemia in hospitalised children with acute malaria, (unpublished data). In these children the mean haemoglobin level was 7.8g/dl. Anaemia in acute *falciparum* malaria is reported to be caused by increased destruction of both infected and non-infected erythrocytes and decreased erythropoiesis.[9]

There was a significant difference observed in the mean haemoglobin levels of anaemic and nonanaemic parasitaemic children ($p < 0.05$). Furthermore, of the 35 anaemic children, 60% had no malaria parasites. These observations suggest that the low haemoglobin levels may not have been solely due to malaria. Other causes particularly the presence of other parasitic infections such as hookworm infestation were not investigated. The general nutritional status of the children was estimated to be good.

Based on analysis of questionnaires, it was evident that the majority (70.5%) of parents of the children in this study earned above average income based on the Country's salary scale. This may likely have accounted for the general well being of the children. Furthermore, many parents were familiar with the signs and symptoms of malaria, its treatment and preventive measures against the disease. This could explain why children at these schools who were parasitaemic generally had low parasite counts. Our findings confirm that a fair amount of knowledge about malaria by parents would contribute significantly in lowering childhood mortality due to the disease as a consequence of recognizing signs and symptoms and seeking prompt medical intervention.

It is expected that children living in malaria endemic areas build up immunity gradually with increasing age and the degree of constant exposure to the parasite.[10] It is likely that between intervals of clinical attack the level of immunity is sufficient to keep malaria parasitaemia at levels low enough to prevent signs and symptoms. The presence of such low parasitaemia would most likely have a 'booster effect' on the immune system and during clinical attacks in children with normal haemoglobin levels prevent the occurrence of severe malaria. In children who already have mild anaemia there is the fear that when opportunities arise for a clinical attack, a more severe anaemia could develop. Some medical personnel argue that this latter group of asymptomatic children with mild anaemia should be treated whenever parasites are detected.

In conclusion, we found that asymptomatic malaria in nursery and primary school children in the Buea district

was accompanied by low grade parasitaemia, which did not seem to have a significant effect on haemoglobin levels.

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References

1. World Health Organization. *Trop Dis Res* Geneva 1995:57-76.
2. Butler D. Time to put malaria control on the global agenda. *Nature* 1997;386:525-630.
3. Newton CRJC, Warn PA, Peshu N, Snow RW, Pasvol G, Marsh K. Severe anaemia in children living in a malaria endemic area of Kenya. *Trop Med Int Health* 1997;2:165-78.
4. Earle WC, Perez M. Enumeration of parasites in the blood of malaria patients. *J Lab Clin Med* 1983;17:1123-30.
5. International Committee for Standardization in Haematology (ICSH). *Brit J Haematol* 1967; 13:71-5.
6. *Bulletin of the World Health Organization* 1997; 75:97-102.
7. Greenwood BM, Bradley AK, Greenwood AM. Mortality and morbidity from malaria among children in rural area of the Gambia, West Africa. *Trans R Soc Trop Med Hyg* 1987;81:478-86.
8. Maitland K, Williams TN, Bennett S, Newbold CI, Peto TEA, Viji J, *et al.* The interaction between *Plasmodium falciparum* and *Plasmodium vivax* in children on Espirutu Santo Island, Vanuatu. *Trans R Soc Trop Med Hyg* 1996;90:614-20.
9. Dondorp AM, Angus BJ Chotivanich K,Silamut K, Ruangveeraynth R, Hardeman MR, *et al.* Red blood cell deformability as a predictor of anaemia in severe falciparum malaria. *Am J Trop Med Hyg* 1999;60;733.
10. Nkuo Akenji T, Deas JE, Leke R, Ngu J. Patterns of antibody levels to the 96tr recombinant protein of *Plasmodium falciparum* in children over a six month period. *J Parasitol* 1995;8:195