HAEMOGLOBIN LEVELS OF WELL PRE-SCHOOL CHILDREN IN BIBIANI, GHANA

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SUMMARY
The significant contribution of anaemia to childhood morbidity and mortality in developing countries calls for a critical and regular assessment of the situation for appropriate control measures.

This study was carried out to determine the haemoglobin level in 200 pre-school children in Bibiani, and the effect of sickle cell disease, malnutrition and malaria, on it.

One millilitre of venous blood was drawn from each child for haematological investigations, sickle cell status and malaria parasite status. A structured questionnaire was used to collect information on their nutritional status and the socio-demographic characteristics of the household the children belonged.

The mean haemoglobin (Hb) level was 9.8 (1.6)g/dl. Seventy-one per cent of the children were found to be anaemic (Hb<11.0g/dl). Almost half (42.0%) of the anaemic children had microcytic anaemia, indicating iron deficiency anaemia. Prevalence of malaria parasites in the blood was 18.0%, while, sickle cell disease and malnutrition (stunting) prevalence were 2.0%, and 19.0%, respectively.

Anaemia and stunting ($\chi^2$=30.1), as well as anaemia and malaria parasitaemia ($\chi^2$=12.4), were significantly associated (p<0.05). The children were thus found to be mostly anaemic (iron deficiency anaemia) even before they got sick. Malnutrition (stunting) and malaria parasitaemia contribute significantly (p<0.05) to this situation. Iron supplementation, or improvement in childcare practices and subsequently in dietary iron intake, prevention of helminthic infestation through regular deworming, malaria chemoprophylaxis for children with sickle cell disease, and the use of insecticide treated nets are recommended.

Keywords: Anaemia, haemoglobin, malaria parasitaemia,

INTRODUCTION
Anaemia is a pathophysiological state in which an individual's blood haemoglobin is below the normal range for the person's age and sex. It is a serious public health problem in Sub-Saharan Africa, where it contributes significantly to morbidity and mortality among children under 5 years of age.

The World Health Organization estimates that about two billion people are anaemic globally; children and women are most at risk. According to the Ghana Demographic Health Survey Report (1998), about 83.5% of children under 5 years of age in Ghana are anaemic. At the Bibiani Government Hospital, about 49.0% of paediatric admissions received blood transfusion in 2001.

Malaria plays a major role in childhood anaemia and causes about 1 million deaths per year in African children. Due to the destruction of red blood cells by the malaria parasites, concurrent parasitaemia is significantly associated with low mean haemoglobin in children.

Severe malarial anaemia which often requires blood transfusion is associated with a high mortality. Bojang et al. have indicated that 65.0% of children admitted for blood transfusion died before the transfusion was given, and in those who received transfusion, 15.0% died after discharge within two months of transfusion. Blood transfusion itself poses the risk of transmission of transfusion-acquired infections such as HIV/AIDS. In order to minimize such risks, the rate of paediatric blood transfusion needs to be reduced. This can be done by assessing the haemoglobin levels of well children and instituting...
effective prevention methods if they are found to be low.

This study was therefore carried out to assess the prevalence of anaemia in pre-school children in Bibiani, and how this is influenced by sickle cell disease, malnutrition and malaria.

MATERIALS AND METHODS

The study type was cross-sectional and analytical. Two hundred (200) pre-school children were selected from the local schools, using multi-stage sampling methods, involving simple and systematic random sampling for the pupils from the schools.

Parental consent was given for the participation of the pupils in the study. After this, one millilitre of venous blood was drawn from each child for all the haematological investigations. Information related to the socio-demographic characteristics of the households to which the children belonged, were obtained using a pre-tested structured questionnaire administered to the mothers.

The blood samples were drawn into EDTA tubes for haematological analyses. Haemoglobin determination was by the cyanmethaemoglobin method. Thick blood films were prepared to determine the presence of malaria parasites by microscopy. Data on weight, height and age of the children were determined and transformed into nutritional status indexes (Weight-for-age, Weight-for-height, and Height-for-age), using Epi Info 2000 software. The children were classified into Normal (Z>2SD), moderately (-3SD<Z<2SD) and severely (Z<3SD) malnourished, using Z-score.

The data were analyzed using EPI Info 2000. Chi-square test of association at a significant level of 5% was also performed. The results are presented as mean(SD).

RESULTS

Socio-demographic characteristics of the children and their mothers

The male to female ratio of the study population was 52.0% to 48.0%. The mean age of the children was 30.9 (8.3) months, whilst that of their mothers was 28.4 (9.7) years, ranging from 16 to 43 years. Almost a third (32.0%) of the mothers were in the modal class of 25 to 29 years, whilst 3.5% were teenagers. Farming (27.0%) and trading (25.0%) were the predominant occupations of the mothers.

Seventeen percent (17.0%) of the mothers had educational level above secondary education, 42.0% had up to junior secondary and 51.0% had no formal education.

Health Status of the Children

Fourteen percent (14.0%) and 48.0% respectively, had had febrile illness 3 months and 1 month preceding the study. Mothers had given anti-malaria medication in all cases.

None of the children was severely wasted or underweight, but 9.0% were severely stunted. Moderate stunting (10.0%), wasting (8.5%), and underweight (2.0%) were observed among them.

Seventy-one percent (71.0%) of the children were anaemic (Hb < 11.0g/dl). The mean haemoglobin level of the children was 9.8 (3.6)g/dl.

Table 1: Distribution of haemoglobin level (g/dl) of well pre-school children in Bibiani, Ghana, 2001. (N=200)

<table>
<thead>
<tr>
<th>Haemoglobin (Hb) level (g/dl)</th>
<th>Number (N=200)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 - 6.9</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>7.0 - 8.9</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>9.0 - 10.9</td>
<td>70</td>
<td>35</td>
</tr>
<tr>
<td>11.0 - 12.9</td>
<td>52</td>
<td>26</td>
</tr>
<tr>
<td>13.0 - 14.9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Forty-two percent (42.0%) of the anaemic children had microcytic anaemia (Mean Corpuscular Volume (MCV) less than 78 femtolitres), whilst 10.0% had the macrocytic type (MCV > 85 femtolitres). Forty-eight percent (48.0%) had normocytic anaemia (MCV between 78 and 85 femtolitres). Twenty percent (20.0%) of the anaemic children had the hypochromic type (Mean Corpuscular Haemoglobin (MCH) less than 24 pico grams). All those who had hypochromic anaemia also had microcytic anaemia, implying that 20.0% had microcytic and hypochromic anaemia, 22.0% had only microcytic anaemia.

An assessment of the 'sickling' status of the children revealed the following: 77.0% had Haemoglobin AA, while 14.0% had AS, 7.0% AC and 2.0% were SC. There was no haemoglobin SS. Those with haemoglobin SC had mild anaemia (9.0 - 10.9)g/dl (Table 2).
Table 2 Distribution of mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) by the anaemia status of children (<5 years old) in Bibiani sub-district, Ghana (2001) (N=200).

<table>
<thead>
<tr>
<th>Haematological index</th>
<th>Number</th>
<th>Anaemic % of total</th>
<th>% of anaemic</th>
<th>Normal Number</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCV (fl):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;78</td>
<td>60</td>
<td>30</td>
<td>42</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>78-85</td>
<td>68</td>
<td>34</td>
<td>48</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>&gt;85</td>
<td>14</td>
<td>7</td>
<td>10</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>MCH (pg):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;24</td>
<td>28</td>
<td>14</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&gt;=24</td>
<td>114</td>
<td>57</td>
<td>80</td>
<td>58</td>
<td>29</td>
</tr>
</tbody>
</table>

Malaria parasitaemia was present in 18.0% of the children, and 89.0% of these were anaemic, while 11.0% had normal haemoglobin values.

Relationship between Anaemia, and nutritional status and malaria parasitaemia

The relationship between anaemia and nutritional status, as well as malaria parasitaemia is shown in Tables 3. A chi-square test of association indicated that there is a significant association (p=0.05) between anaemia and malnutrition, as well as between anaemia and malaria parasitaemia.

Health Status of the Children

In a malaria endemic zone, the observation that almost a half (48.0%) of the children experienced a febrile illness within a period of less than one month before the study, whilst 14.0% had suffered the same fate about three months ago is likely to be true.

Table 3 Distribution of Anaemia status by malarial parasitaemia and nutritional status of Pre-school children at Bibiani, Ghana. (N=200)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absent</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No.</td>
<td>No. (%)</td>
<td>No. (%)</td>
<td></td>
</tr>
<tr>
<td>Malaria parasite Present</td>
<td>4 (2.0)</td>
<td>10 (5.0)</td>
<td>18 (9.0)</td>
<td>4 (2.0)</td>
<td>36</td>
</tr>
<tr>
<td>Malaria parasite Absent</td>
<td>54 (27.0)</td>
<td>60 (30.0)</td>
<td>42 (21.0)</td>
<td>8 (4.0)</td>
<td>164</td>
</tr>
<tr>
<td>Normal Growth</td>
<td>57 (28.5)</td>
<td>59 (29.5)</td>
<td>41 (20.5)</td>
<td>5 (2.5)</td>
<td>162</td>
</tr>
<tr>
<td>Stunted Growth</td>
<td>1 (0.5)</td>
<td>11 (5.5)</td>
<td>19 (9.5)</td>
<td>7 (3.5)</td>
<td>38</td>
</tr>
</tbody>
</table>

DISCUSSION

Socio-demographic characteristics of the children and their mothers

With as much as 51.0% of the mothers without any formal education, and 42.0% with education not exceeding Junior Secondary School level, it is not surprising that the mothers were predominantly farmers (27.0%) and petty traders (25.0%). By the nature of their work these mothers are likely to spend little time to do “active feeding”, the strategy recommended to mothers and caregivers to ensure that the child’s desires and nutritional requirements are met 3, hence the children are at risk of nutrients deficiency. In a sub-urban community like Bibiani, the underlying poverty resulting from the socio-economic situation of the mothers is likely to exacerbate the nutritional deficiencies, with the accompanying health risks.

The study reveals a significant proportion (almost 30%) of children under 5 with some abnormality in their nutritional status; 9.0% severely stunted, and a few moderately stunted (10.0%), wasted (8.5%), and underweight (2.0%). Though the wasting prevalence was close to the national figure of 9.5%, the prevalence of stunting in the area was lower than the national rate of 25.9%. This is indeed encouraging, since though not really what one would call ‘good’ nutritional status in a community, it is much better than the country’s average.

Anaemia prevalence of 71.0% among the children was rather high. This suggests that conditions that are likely to further reduce the haemoglobin levels,
such as worm infestation, severe malaria and inadequate intake of nutrients should be prevented in the children. Regular physical examination is necessary in such a population to initiate treatment when needed. Nevertheless, this figure is lower than the national prevalence rate of 83.5%\(^2\), probably, because the study subjects were supposedly healthy, while the national survey might have involved the entire population, including those who were clinically sick. Since iron deficiency and malaria have been found among others, to be associated with anaemia\(^1\), the endemic nature of these conditions in the area may account for the high prevalence of anaemia.

Our results of 42.0% of the anaemic children with MCV value of less than 78 femtolitres, and 20.0% with both microcytic and hypochromic anaemia, suggests iron deficiency anaemia. This finding could be compared with that of Tanzania in which iron deficiency was found to account for 30.0% of all cases of severe anaemia among infants\(^4\). Though the possibility of thalassaemia contributing to the microcytic hypochromic anaemia cannot be ruled out, its contribution is established to be more significant in the Mediterranean and South-East Asian countries\(^5\) and probably insignificant in the study area where the prevalence of Sickle cell disease (2.0%) among the children is as low as in the Ashanti region of Ghana\(^6\). However, the fact that all the 2.0% who had Sickle cell disease were moderately anaemic suggests that the condition is a key factor influencing the anaemia status of an individual. The conspicuous absence of HB SS cannot be explained but the small number studied could be a factor.

**Influence of malnutrition and malaria on anaemia**

The study established a significant association (p<0.05) between anaemia and either malnutrition or malaria parasitaemia (Table 2), thus confirming the assertions by, WHO\(^3\), McElroy et al\(^8\), and Menendez et al\(^9\) linking anaemia to malnutrition and malaria. Wardlaw\(^15\), also affirms the ability of iron deficiency anaemia to interfere with longitudinal growth, weight gain, and behavioural development, resulting in reduced mental and motor development.

**CONCLUSION AND RECOMMENDATION**

Our results indicate that the majority (71.0%) of children in the study were anaemic even before they get sick, clinically.

Microcytic anaemia, suggestive of iron deficiency anaemia was high, representing 42% of the anaemic children. Microcytic hypochromic anaemia affected 20.0% of the children.

Malnutrition (stunting) and malaria parasitaemia were found to be significantly (p<0.05) associated with anaemia among the children.

Iron supplementation or improvement in childcare practices and subsequently in dietary iron intake, prevention of helminthic infestation through regular de-worming and the use of insecticide treated nets are recommended for children under five years in the Bibiani District.

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