CHILDHOOD ASYMPTOMATIC MALARIA AND NUTRITIONAL STATUS AMONG PORT HARCOURT CHILDREN.

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Abstract:

Objective: **Our study in Port Harcourt children with asymptomatic malaria aimed at assessing the baseline anthropometric indices of nutritional status, and whether their nutritional status (especially under nutrition) offers any advantage for living in malaria endemic areas.**
Design: **Cross-sectional study was used.**
Setting: **Rumueme Community in Port Harcourt, Nigeria.**
Subjects: **Apparently healthy children aged 1 – 8 years of both sexes (Boys = 117, Girls = 123; Ratio 1: 1.05), 240 children from randomly selected households within the study community participated in the study.**
Results: **Of the 240 children, 66 (27.5%) were infected with malaria (*P falciparum*). Children below 5 years had a higher parasitaemic rate (36.36%) than those in 5-8 years group (21.27%). Our baseline data showed that 17.5% were underweight (WFA Z < -2), 3.75% were stunted (HFA Z < -2) and 22.5% were wasting (WFH Z < - 2). Children who are underweight were found to be at higher risk of acquiring malaria infection than the well nourished children (RR = 1.02, $\chi^2 = 0.320$, p < 0.02, 95% CI 0.34-2.37). Under nutrition was more prominent in the children below 5 years than the older children (RR = 3.625, $\chi^2 = 10.36$, p < 0.006, 95% CI I.81-5.43). The haemoglobin value of parasitized children (10.8 ± 1.9 g/dl) was significantly lower than the non-parasitized group (11.3 ± 1.7 g/dl,) (p < 0.01).**
Conclusion: **We concluded that the presence of under nutrition places children (especially below 5 years of age) at higher risk of malaria related morbidity. Children in malaria endemic areas need adequate nutrition to withstand the negative impact of malaria.**

Key words: Anthropometric indexes, Wasting, Stunting, malaria parasite, Nigeria

Introduction

Malnutrition is a serious global issue and each year, some 24 million babies are born too small to lead healthy lives because their mothers were either ill or malnourished (1,2). Recent reports show that among children under five years of age in developing countries, 206 million are stunted (low height for age) 50 million are wasted (low weight for height) and 167 million are underweight (low weight for age) due to lack of food and the presence of disease, mostly malaria (3).

The World Health Organisation (WHO) estimates that malaria caused 300-500 million infections, 100 million clinical cases (*Plasmodium falciparum),* and 1.5 – 2.7 million deaths in 1994 (3). Majority of cases and deaths are estimated to occur in sub-Saharan Africa, especially children <5 yeas of age (4-9). The relationship between malaria and malnutrition remains unclear and controversial. Malnutrition appears to influence susceptibility to malaria and affects the course of the infection. On the other hand, malnutrition is said to protect against malaria infection (10).

The prevalence of wasting and stunting has been widely used to characterize the nutritional status of populations (11,12). Reasons being that, wasting reflects a deficit in weight relative to height due to a deficit in tissue and fat mass, whereas stunting reflects a deficit in height relative to age due to linear growth retardation. Epidemiological evidence suggests that the first response to a nutritional and/or infection insults is weight loss (wasting), followed by retardation in linear growth (i.e. stunting) (13). If the infection persists, children will cease to grow in height and will lose weight, thus augmenting the process of wasting (14). The end result is that the child becomes chronically wasted after surviving the infection and the prevalence of wasting in populations will be high.

Among the three methods of assessing nutritional status (i.e. clinical signs of malnutrition, biochemical indicators and anthropometry); anthropometry has an important advantage over other nutritional indicators; whereas biochemical and clinical indicators are useful only at the extremes of malnutrition, body measurements are sensitive over the full spectrum. In addition, anthropometric measurements are non-invasive, inexpensive and relatively easy to obtain. The main disadvantage of anthropometry is its lack of specificity as changes in body measurement are also sensitive to several other factors including intake of essential nutrient, infection, altitude, stress and genetic background. However, it is the recommended method of choice for nutritional surveys (15).

In Rivers State, Nigeria where this study was conducted, there is paucity of information on child health surveys. The recent national nutrition survey (Maziya-Dixon et al, 2006), which provided national data on the nutritional states of children, did not include Rivers State; hence no literature was encountered on this subject in this part of the world. This study was therefore designed to assess the nutritional status of children aged 1-8 years by use of anthropometric indices of nutrition and also relate such data obtained to the prevalence of malaria. It is hoped that the results obtained in this study will provide baseline information on the children nutritional status and provide a base for future research.

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Materials and Methods

Study area and population

This was conducted in Rumueme Community in Port Harcourt; the capital of Rivers State, Nigeria. The geographical location is latitude 4°31'–5°31' and longitude 6°3°'-7°21'. The typical deltaic wetlands and mangrove forests that characterize the area provide enough breeding grounds for mosquito and malaria transmission occurring throughout the year. The study population consisted children aged 1 – 8 years of both sexes recruited from households within a period of 12 months. 240 children participated in the study (Boys = 117, Girls = 123; Ratio = 1:1.05).

Study design

A cross-sectional study was used in this study. The Rivers State University of Science and Technology, Port Harcourt ethical committee approved the study, thereafter samples were collected randomly after obtaining a written or oral informed consent from the parents. The parents brought their children to the research base located in Rumueme, Port Harcourt. Children residing in randomly selected households were recruited. Selection of households for inclusion in this study was based on a random-cluster sample of all the households identified within the prescribed study area (Rumueme, Port Harcourt). All children were weighed using the YAMATO digital scale (CHINA) while heights were measured in children ≥ 1 year with a Leicester height measure (CMS instruments). Two milliliters of venous blood was collected into EDTA anticoagulant bottle for hemoglobin and malaria parasite estimations.

Laboratory procedures

Malaria: Microscopic examination of blood film

Thin and thick blood films were stained with Giemsa and examined for malaria parasites by standard methods. Parasite densities were recorded as a ratio of parasites to white blood cells (WBCs) from thick smears. Densities (parasites per microlitre of while blood) were then calculated on the basis of a WBC count of the individual children. Average of 500 WBCs were counted for each child before parasite densities were estimated.

Haemoglobin estimation

The haemoglobin estimation of the children were estimated using the cyanmethaemoglobin method. The reagents were bought from Pointe Scientific Inc, USA (Catalog #H7504 – 500). Two (2.0) millilitre of total haemoglobin reagent was pipetted into 3 test tubes labeled blank, control and test. 0.01 millilitre (10μl) of the standard, control ad sample was pipetted into their respective tubes. The contents were mixed and allowed to stand for 3 minutes at room temperature. Absorbance was read with spectrophotometer at 540nm wavelength. The haemoglobin values were calculated as follows:

$$\text{Haemoglobin (g/dl)} = \frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times \text{Concentration of standard}$$

Determination of nutritional status using anthropometric indexes

Z score values were determined using the CDC EpiInfo V6.04 to classifiy children as underweight (WFA Z < -2), stunting (HFA Z < - 2) and wasting (WFH Z < - 2).

Statistics

Descriptive statistics of continuous variables were expressed as mean ± standard deviation. The students' t-test was used for the comparison of means. Relative risk ratio (RRR) and Chi-square value were calculated using standard statistical formulae. Significant level was set at P<0.05.

Results

Of the 240 children that participated in this cross-sectional survey, 66 (27.5%) were infected with malaria parasites. The mean values of the anthropometric indices and haemoglobin in this study is shown in Table 1. There is statistically significant difference in the haemoglobin values between the parasitized and non-parasitized children (p < 0.01). No significant difference in height, weight and body mass index was observed (P > 0.05). The baseline nutritional status is shown in Table 2. 17.5% were underweight (WFH Z < - 2), 3.75% were stunted (HFA Z < - 2) and 22.5% were wasting (WFH Z < - 2). Table 3 shows the risk analysis of malaria parasite infection in relation to nutritional status. Children who are underweight were found to be at a higher risk of acquiring malaria infection than the well nourished children (RRR = 1.02, χ^2 = 0.320, P < 0.02).

Table 1: Mean values of the anthropometrical indices, temperature and haemoglobin in the study population

	Parasitized	**Non-parasitized**	**p-value**
	Mean ± SD	**Mean ± SD**	
Temp ^{0}C	37.3 ± 4.3	36.8 ± 0.8	< 0.02 *
Height (cm)	111.5± 17.2	111.6 ± 18.0	> 0.05^{ns}
Weight (kg)	15.1 ± 1.9	15.2 ± 1.7	> 0.05 ^{ns}
BMI (kg/m^2)	15.2 ± 2.2	15.5 ± 3.1	0.77 ^{ns}
Haemoglobin (g/dl)	10.8 ± 1.9	11.3 ± 1.7	< 0.01

* = Significant ns = not significant

Table 2: Nutritional status of the children by Z score analysis

	Z scores		
	< - 2	< - 1 to 2	> 2
WFA			
<5 years n (%)	24(10.0)	57(23.75)	18(7.5)
5 years and above n (%)	18(7.5)	114(47.5)	9(3.75)
Total	42(17.5)	171(71.25)	27(11.25)
RRR = 3.625 , χ^2 = 10.36, p < 0.006, 95% CI 1.81-5.43			
Boys n (%)	24(10.0)	72(30.0)	21(8.75)
Girls n (%)	18(7.5)	94(41.25)	6(2.5)
Total	42(17.5)	171(71.25)	27(11.25)
HFA			
<5 years n (%)	9(3.75)	63(26.25)	24(10.0)
5 years and above n (%)	0(0)	114(47.5)	30(12.5)
Total	9(3.75)	117(73.75)	54(22.5)
Boys n (%)	6(2.5)	87(36.25)	27(11.25)
Girls n (%)	3(1.25)	90(37.5)	27(11.25)
Total	9(3.75)	117(73.75)	54(22.5)
WFH			
<5 years n (%)	27(11.25)	54(22.5)	18(7.5)
5 years and above n (%)	27(11.25)	78(32.5)	36(15.0)
Total	54(22.5)	132(55.0)	54(22.5)
Boys n (%)	30(12.5)	60(25.0)	21(8.75)
Girls n (%)	25(10.0)	72(30.0)	33(13.75)
Total	54(22.5)	132(55.0)	54(22.5)

WFA = Weight for age HFA = Height for age
WFH = Weight for height

Table 3: Risk analysis of malaria parasite infection in relation to nutritional status.

	Parasitized	Non-parasitized	Total
	N (%)	n (%)	
Underweight (BMI Z < -2)	12 (5)	24 (10)	36 (15.0)
Well nourished (BMI Z + 1 to 2)	27 (11.25)	57 (23.75)	84 (35.0)

RRR = 1. 03, χ^2 = 0.320, p < 0.02, 95% CI 0.34-2.37

Discussion

One of the reasons for assessing the anthropometric indices of nutrition is to characterize the nutritional status of a given population. The data generated is often used to make decisions about the need for intervention, what type of intervention is needed and to whom it should be delivered (11). In Nigeria, the national food consumption and nutrition survey covering 2001-2003 published recently by the International Institute of Tropical Agriculture (IITA) covered only 12 states of the federation and Rivers State was not included as a focal state.

This has contributed to the scarcity of information on child health in this region of the world (16). However, the National data produced showed that 42% of children below 5 years were stunted, 25% were underweight and 10% were wasted.

In this present cross-sectional survey, the prevalence of underweight, in children below 5 years was found to be 17.5% The prevalence of stunting and wasting were 3.75% and 22.5%. The majority of the children in the study population were wasted as against 10% recorded in the National survey (16). Epidemiological survey suggests that the first response to a nutritional and/or infection insult is weight loss (wasting) followed by retardation in linear growth (13). The relatively high prevalence of wasting recorded in this study is an indication of acute and short-term exposure to a negative environment. The population determinants of wasting were analysed with a framework adapted from the United Nations Children's Fund (UNICEF) (11). According to this framework, the prevalence of wasting in a population is determined by immediate, underlying and basic causes. Immediate causes are inadequate dietary intake and disease, while underlying causes lead to inadequate dietary intake and disease. There are three main groups of underlying causes; inadequate health services and an unhealthy environment; inadequate household food security and inadequate mother- and children-caring practices (17).

In Africa, wasting prevalence approximately followed a U-shape over the time span of 1969-95 as reported by Fernandez *et al* (2), initially decreasing in earlier years before increasing again in more recent years. This was attributed to high rates of low birth weight (LBW) infants and low rates of adult literacy. Another contributory factor is the prevalence of malaria in sub-Saharan Africa and this may appear to be one of the strongest indicators of wasting in our typical tropical environment. Our study confirmed that undernutrition was most pronounced in children below 5 years of age. This corroborate findings in most studies that the prevalence of underweight in children <5 years in developing countries is high (2, 10, 15, 18). Apart from wasting (weight for height) being a measure of acute or short-term exposure to a negative environment, it is also sensitive to changes in calorie intake or the effects of disease. It is also a measure of current body mass and the best index to use to reflect wasting malnutrition especially when it is difficult to determine the exact ages of the children being measured. On the other hand, stunting (Height for age) is a measure of linear growth. Stunting refers to shortness and reflects linear growth achieved pre and post natal.

It is often used to indicate long-term, cumulative effects of inadequate nutrition and poor health status. Height for age (HFA) is considered a measure of past nutrition, because a child who is short today, may be did not have adequate nutritional intake at some point in the past. In this study, a low prevalence of stunting (3.75%) among children under 5 years was observed and 0% in children 5 years and above. Majority of the children in this study achieved their full growth potential (73.75%). This finding is quite contrary to some observations in some parts of Africa (Kenya) where the prevalence of stunting was 39% and wasting 5% (19).

Analysis of the malaria prevalence in this study population revealed that children under five years are more affected (36.36%) than those of 5 years and above (21.27%). An overall prevalence of 27.5% was observed in this study of which *P. falciparum* accounted for all. 21.25% of the children were anaemic (Haemoglobin values < 10g/dl). The haemoglobin values of the children infected with malaria parasites (10.8 ± 1.9g/dl) was significantly lower than 11.3 ± 1.7 g/dl in the uninfected children. Our findings indicate that malaria is associated with anaemia even in the asymptomatic state.

It could be deduced from this study that the presence of undernutrition places children (especially below 5 years of age) at higher risk of malaria related morbidity. This finding is in support of Shankar's view that malnutrition is associated with increased occurrence of infection and symptomatic malaria (20). This view does not apply only in symptomatic malaria infection but is also a feature of asymptomatic malaria infection as observed in this study. The negative effect of the malaria infection together with other environmental factors could be a contributory factor for the relatively high wasting rate among children. A longitudinal cohort study may be needed to establish causality before appropriate intervention measures are put together.

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