

## Malaria Parasitaemia in Children With Protein Energy Malnutrition In North Central Nigeria: A Case Control Study.

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**Abstract: Background-**Malaria and Protein- Energy-Malnutrition (PEM) are two major causes of childhood mortality in sub-Saharan Africa. Malaria can predispose a child to PEM and the reverse may also be true. Recent studies have presented inconsistent findings about nutritional status and the occurrence of malaria. The goal of this study was to evaluate the association between PEM and malaria parasitaemia if any.

**Methods-**A case control study in which 90 children diagnosed for PEM (aged 6 -59 months), and another well nourished 90 children age and sex- matched controls were evaluated for malaria parasitaemia. A semi-structured proforma was used to obtain relevant information on the children's socio-demographic characteristics, nutritional indices amongst others. Venous blood sample blood was collected and thick and thin blood film were prepared and viewed under the microscope.

**Results-**Malaria parasitaemia was present in 82 (91.1%) of malnourished group and 12 (13.3%) of the well nourished group ( $p < 0.05$  OR=66.62). Malaria parasitemia was highest in those with kwashiorkor and marasmic kwashiorkor compared with underweight. These differences were statistically significant ( $p < 0.05$ ).

**Conclusion and Recommendation-**The study demonstrates that malnourished children have higher degree of malaria parasitaemia and are at risk of malaria. It also shows that severe forms of malnutrition are associated with heavier malaria parasitaemia.

It is therefore recommended that all malnourished children should have access to use of Insecticide Treated Nets (ITN), malaria chemoprophylaxis as well as empiric treatment of malaria in endemic areas where access to malaria parasite diagnosis is difficult.

**Keywords:** Severe Protein energy malnutrition(PEM), Malaria Parasitaemia, Insecticide Treated Nets (ITN).

### I. Introduction

Protein energy malnutrition (PEM) is a leading cause of morbidity and mortality among children under five worldwide, especially in the developing countries<sup>1</sup>. Causes of severe morbidities as well as mortality usually results from complications associated with the condition as well as the existence of other co-morbidities. The presence of Infection is a common cause of death among children with protein energy malnutrition. Common causes of infection in them include bacteria, viral and parasitic infections. A common parasitic infection which can occur as co-morbidity is Malaria.<sup>1</sup>

Malaria and under-nutrition are the two major causes of childhood mortality in sub-Saharan Africa<sup>2</sup>. Complex relationships exist between malaria and malnutrition. Complicated malaria can predispose a child to malnutrition when while a malnourished child can be predisposed to be infected with malaria<sup>2,3</sup>. Malaria like PEM is commonly associated with poverty; both can also be a cause of poverty and are major hindrance to economic development<sup>1</sup>. Both have common effects such as chronic anemia, impaired growth, and delayed cognitive development on children<sup>1,2</sup>.

The impact of malnutrition on malaria outcome as well as that of malaria on nutritional outcome has been studied by previous authors<sup>2-9</sup>. A number of observations have indicated a deleterious effect of malaria on nutritional status,<sup>2,3</sup> while earlier observational studies provide some evidence of protective effect of under-nutrition against malaria<sup>4-6</sup>. However, more recent studies have presented inconsistent findings that nutritional status was not associated with the occurrence of malaria<sup>7-9</sup>. The outcome of malaria on the nutritional status of

affected children has also been clearly defined<sup>3</sup>. However the effect of nutritional status on host resistance to acquisition and progression of malaria is still not clearly defined. A clear relationship has to be defined between these very important causes of childhood morbidity and mortality in this part of the world. Thus, the goal of this study was to evaluate whether malnutrition is associated with increased or decreased malaria parasitaemia.

## II. METHODS

This was a case control study in which subjects were children diagnosed with PEM with ages between 6 to 59 months old and controls were children with normal nutritional status admitted to paediatric ward of the University of Ilorin Teaching hospital which is located in the North Central zone of Nigeria. PEM patient were classified based upon the Wellcome classification<sup>10</sup>.

Clinical examination and anthropometric measurements such as weight and height were carried out among the subjects by the investigator. The weight was measured to the nearest 0.1 kilogram using standardized scales while the length was measured to an accuracy of 0.1 meter using an infantometer for children less than 2 years and a stadiometer for height among children older than 2 years children.

A semi-structured questionnaire was used to obtain information from the subjects using an interview method. Relevant information on the children's socio-demographic characteristics, nutritional indices and laboratory findings were documented.

Socio-economic index scores were awarded to the occupations and educational attainments of their parents or caregivers using the Oyediji socio-economic classification scheme<sup>11</sup>. Socio economic class I and II are the upper socio-economic class, class III is the middle class while socio economic class IV and V are the lower socio-economic class<sup>11</sup>.

The study was approved by the Ethics and Research Committee of the University of Ilorin Teaching Hospital.<sup>21</sup>

### Sample collection and analysis

Under strict aseptic conditions, after cleaning the blood collection site thoroughly with 70% alcohol, 1ml of venous blood was collected by venepuncture using a fixed hypodermic needle. Blood films were prepared both thin and thick films in the standard manner. The slide was then air dried and the films were then fixed with methanol or ethanol on a standing rack. After about three minutes, staining was done with 10% Giemsa stain diluted to pH of 7.2 with phosphate buffer for 10 minutes after which clean water was used to wash the stains.

### Reporting the thick film

The report of the thick film was done using the protocol described by Cheesbrough M<sup>12</sup>. Briefly, a drop of immersion oil was applied to the film and viewed under microscope using the 100x objective to examine at least 100 high power fields (HPF). The finding was reported as:

1-10 parasites per 100HPF was recorded as +

11-100 parasites per 100HPF as ++

1-10 parasites in one HPF as +++

More than 10 parasites in one HPF as ++++

Data entry and analysis were carried out with a micro-computer using the Epi info version 3.5 (2008) software packages. P value was set at <0.05 for significant relationships. Odd ratio interpretation was 1=risk in the two groups, <1=lesser risk in the first group and >1=higher risk in the first group. The malnourished children form the first group while the controls formed the second group.

## III. RESULTS

A total of 90 children with PEM and 90 well nourished children were studied. Of the 90 children with PEM, 59 (65.6%) were males and 31 (34.4%) were females, (M: F ratio 1.9:1). While of the 90 well nourished ones, 53 (58.9%) were males and 37 (41.1%) were females (M: F ratio 1.4:1.) ( $p=0.36$ )

The mean age of the children with PEM was  $22.7 \pm 14.4$  months while the mean age of the control was  $29.3 \pm 16.9$  months. ( $p=0.08$ ).

Children with PEM were mainly from low socio economic class and there was a statistical significant difference in the social economic status of the malnourished group and the well nourished group ( $p=0.00001$ ) as shown in Table 1.

Fifty (55.6%) children with PEM were underweight, 21 (23.3%) had marasmus, 11 (12.2%) had marasmic-kwashiorkor and 8 (8.8%) had kwashiorkor. (See-Table II).

Of the malnourished 82 (91.1%) had malaria parasitaemia compared with 12 (13.3%) of the well nourished ones. There was a statistical significant difference. ( $p=0.0000$ ). (See Table III)

All the 11 (100%) children with kwashiorkor as well as all the 8 (100%) with marasmic-kwashiorkor were positive for malaria parasitaemia. Nineteen (90.5%) of the 21 children with Marasmus and 44 (88.0%) of underweight children also had malaria parasitaemia. Each of these compared with the well nourished children

showed statistically significant differences. ( $p < 0.05$ ) The degree of parasitemia in each of the types of PEM is as shown in the Table IV below.

#### IV. DISCUSSION

Malaria and PEM are common in sub-Saharan Africa, it is therefore important to understand the relationship which exists between them because of its enormous public health importance.

This present study shows that over ninety percent of the malnourished children studied had malaria parasitaemia. There was also a significant difference when the density of parasitemia of the malnourished was compared with that of well nourished children. The odds ratio further strengthens this fact as the findings derived demonstrate a higher risk of malaria among the malnourished children. Our findings show that undernourished children experienced more, not less, malaria parasitaemia when compared to well nourished children. This finding is similar to previous studies. A more recent study in Ibadan Nigeria by Olumese *et al*<sup>13</sup> also reported that malnutrition was associated with severe forms of malaria.

In Sudanese children, el Samani *et al* recorded that malaria was more often in malnourished than in adequately nourished children.<sup>14</sup> Other studies from Tanzania, Chad, Zaire and Kenya<sup>15-18</sup> also confirm the greater risk of malaria among children with poor nutritional status. Another longitudinal study from Vanuatu<sup>19</sup> supports the claim that malnutrition predisposes the host to malaria infection. However none of these studies demonstrated if malaria preceded malnutrition or vice versa.

The study also shows that the degree of parasitaemia also varied among the various classes of malnourished children. Kwashiorkor and marasmic-Kwashiorkor which were the most severe forms of malnutrition had higher density of malaria parasitaemia. These findings show that the host resistance to malaria is poor as the more severe forms which are associated with diminished immunity experience higher intensity of the malaria parasite. It also shows that more severe forms of malnutrition might likely experience severe forms of malaria as they are associated with higher degree of parasitaemia. This finding is also in consonance with previous findings such as the one by Ahmad *et al* which showed a positive correlation between the level of parasitemia and weight-for-age in children infected with either *P. falciparum* or *P. vivax*.<sup>20</sup>

#### V. CONCLUSION

The study clearly demonstrates that malnourished children have a higher degree of malaria parasitaemia and are at a higher risk of malaria. It also shows that more severe forms of malnutrition are associated with a higher degree of malaria parasitaemia.

#### VI. RECOMMENDATION

The finding of this study thus recommends that all malnourished children should have access to the use of Insecticide Treated Nets (ITN), malaria chemoprophylaxis as well as recommends empiric treatment of malaria in children with malnutrition in areas where the access to malaria parasite diagnosis is complicated. This we opine will go a long way in reducing mortality as well as increase the survival of children with PEM who often have malaria as a co-morbidity. It also recommends that further studies on the relationship between malaria and protein energy malnutrition should be carried out by other research work

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#### Abbreviation

PEM Protein energy malnutrition.

MP Malaria parasite

HPF High power fields.

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Table 1: The Socio-Demographic Characteristics Of The Malnourished And Controls.

Variable	PEM (n=90)	Controls (n=90)	$\chi^2$	P
<b>Age (month)</b>	9.0-59.0	6.0-59.0	t=7.95	0.08
Range	22.7±14.4	29.3±16.9		
Mean± S.D				
<b>Gender</b>	59(65.6%)	53(58.9%)	0.85	0.356
Male	31(34.4%)	37(41.1%)		
Female				
<b>Social Economic Class</b>				
I	2(2.2)	4(4.4)		
II	6(6.8)	27(30.0)		
III	26(28.8)	35(38.9)	28.17	0.000012
IV	38(42.2)	16(17.8)		
V	18(20.0)	8(8.9)		

Table 2: Distribution Of Types Of Protein Energy Malnutrition

Type of PEM	Frequency	Percentage
Kwashiokor	8	8.9
Marasmus	21	32.2
Marasmic- Kwashiokor	11	12.2
Underweight	50	55.6
Total	90	100

Table 3: Malaria Parasitaemia among PEM and Non PEM

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Malaria parasitaemia	PEM n (%)	Non PEM n (%)
None	8 (8.9)	78(86.7)
+ (1-10 Parasite /100HPF)	63(70)	7(7.8)
++ (11-100 Parasite /100HPF)	18(20)	5(5.0)
+++ (1-10 parasites/ HPF)	1(1.1)	None
<b>Total</b>	<b>90(100)</b>	<b>90(100)</b>

$\chi^2=109.24$      $p= 0.0000$     **OR 66.625**

*HPF = High power field*

Table 4: Malaria Parasitaemia among various forms of PEM

Malaria Parasite	Kwashiokor	MarasmicKwashiokor	Marasmus	Underweight	Total (%)
None	0	0	2	6	8(8.9)
+(1-10 Parasite /100HPF)	3	7	14	39	63(70)
++(11-100Parasite /100HPF)	8	0	5	5	18(20)
+++ (1-10 parasites/ HPF)	0	1	0	0	1(1.1)
<b>Total</b>	<b>11</b>	<b>8</b>	<b>21</b>	<b>50</b>	<b>90(100)</b>

$\chi^2= 35.75$      $p= 0.0000$

*HPF = High power field*