Haematological and Anthropometric Status of Children attending a Tertiary Health Facility, Abeokuta, Ogun State

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ABSTRACT

Background: *Nutritional and haematological status is a necessary and important tool in the determination of growth and development in children.*

Objectives: *This study aimed to investigate the haematological and anthropometric status of children attending Federal Medical Centre Abeokuta.*

Methods: *A total of 146 respondents were random selected using simple random sampling method. All children that attended paediatrics out-patient department whose parent gave informed consent for participation in the study were allotted numbers and random selection was done for recruitment of the respondents. Also, assent of the children was obtained. Ethical approval was obtained from the research ethics committee of the health facility. The study was conducted between January to June 2022. Children aged 0-24 months participated in the study.*

Sociodemographic data (age, sex) was collected through the use of a semi-structured questionnaire, anthropometric measurements, blood samples for haematological and biochemical test were also taken following standard procedures. Data were analysed using ENA software for SMART for under five and Statistical Package for Social Sciences (SPSS). Blood samples were analysed using appropriate test kits and result was compared to reference standard. Descriptive and inferential statistical techniques were used for data analysis and the significance level was set at $p = < 0.05$.

Results: *About one-fifth of the respondents (19.9%) had severe acute malnutrition according to the MUAC assessment. About one-fifth (21.2%) were also severely stunted, (21.3%) were severely malnourished considering their weight for age, about one-third (27.4%) were severely wasted in the study area. The study revealed positive falciparum malaria in 35% of the children. Furthermore, the study revealed that 57.5% of the children positive with malaria parasitaemia had a packed cell volume < 33% and 67.5% had haemoglobin concentration < 11g/dL and 28.6% had a plasma transferrin concentration > 347 mg/dL.*

Conclusion: *The study concludes that the children under study have poor nutritional status and malaria parasite was seen in more than half of the population. This can predispose them to iron deficiency and anaemia.*

Keywords: anthropometric status, haemological status, malnutrition, malaria, iron deficiency
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INTRODUCTION

The Sustainable Development Goal (SDG), which calls for "healthy lives for all," cannot be met if children's nutritional status is not improved (1). Poor nutrition during the early years of development can have serious health effects, such as considerable morbidity and death, as well as delayed mental and motor growth. Furthermore, child malnutrition may have an adverse effect on society as a whole as well as on present and future generations (2). These deficits are sometimes known as hidden hunger since they frequently go unnoticed (3).

Anthropometry is used to assess a person's weight, body proportions, and composition as well as to determine their nutritional and health status and assess the risk to their health and life (4). However, anthropometry is only useful for sub-clinical signs, necessitating biological assessment. Numerous biochemical factors are changed when someone is undernourished (5). The benefit of biological nutrition evaluation is its capacity to spot alterations far in advance of the onset of a biological or clinical disorder (6). The concentration of the body's cells can be accurately determined by the examination of haematological and biochemical characteristics. A vital tool for identifying any metabolic abnormalities and alterations in an organism is blood analysis of the symbolic and nutritional components (6). The most prevalent dietary deficit, iron deficiency anaemia, has significant negative health, social, and economic effects in many developing nations and it also stands as a prominent contributor to pediatric morbidity, hospitalization, and mortality. Furthermore, it adversely impacts children's cognitive performance and physical growth (7, 8).

Malaria, on the other hand, is still entirely preventable with accessible, inexpensive, and effective treatment (9) and almost one million people die from it each year, mostly children under the age of five (10). Malnutrition may increase susceptibility to malaria, according to some, while some assert that malnutrition may increase the risk of malaria (11). Studies examining links between malnutrition and malaria have shown mixed results; some suggest that malnutrition is linked to worse outcomes for malaria morbidity and all-cause mortality, while others find no link between malnutrition and malaria (12,5).

Hence, this study aimed to determine the anthropometric and haematological parameters of children attending Federal Medical Centre Abeokuta, Ogun State, while specifically identifying their parents' socio- demographic characteristics as well as investigating the relationship between nutritional status, hematological parameters and malaria.

MATERIALS AND METHODS

Study Design

This was a descriptive, cross-sectional study. The study population comprised of children attending Federal Medical Centre Abeokuta alongside their mothers who are needed to give information on their sociodemographic characteristics of their children.

Study Area

The Federal Medical Centre Abeokuta, a regional specialized hospital, was the study area for this research due to its large number of specialized cases and specialized areas for children.

Inclusion and Exclusion Criteria:

Only Children attending Federal Medical Centre Abeokuta and their parents give an informed consent were included. Children with medical complications and without informed parental consent were excluded.

Sample size and sampling method

A total of 146 children 0-24 months attending pediatrics outpatient department of Federal Medical Centre, Abeokuta whose parents willingly gave their consent to participate in the study were included. Simple random technique was employed in selecting the respondents. Children present at the health facility between January-June 2022 were allotted numbers and balloting was done to select the participants for the study.

Data Collection

Socio-demographic variables

Validated semi-structured questionnaires were used to gather socio-demographic information for the parents and information for children was obtained from their care givers, including sex, ethnicity, socioeconomic position, level of education, and profession. Income estimate was given by the parents.

Anthropometric measurements

Standard methods defined by the World Health Organization were used to take the measurements of height and weight (13). Children were weighed using a calibrated standardized baby weighing scale and a digital weighing scale to the closest 0.1kg to check for oedema. The kids were given a MUAC reading using a Shakir MUAC strip. The baby's left arm was bent at the elbow and the MUAC strip was used to make a midway mark around the limb. Numbers were rounded to the closest millimeter WHO (14).

Children with a height-for-age (HAZ) score between -2 and -3 standard deviations (SD) below the median of the WHO reference population are considered stunted or chronically malnourished and a score more than -3 SD below the reference median are classified as severely stunted. The children with weight-for-height (WHZ) score between -2 and -3 SD below the reference median are regarded as wasted, while those with a score more than -3 SD below the reference median are classified as severely wasted. Also, children with

weight-for-age (WAZ) score between -2 and -3 SD below the reference median are considered underweight, and those with a score more than -3 SD below the reference median are classified as severely underweight (13). Mid-upper-arm circumference (MUAC) and/or the presence of bilateral oedema were used to determine malnutrition. MUAC less than 115 mm indicates severe wasting or severe acute malnutrition (SAM). MUAC greater than or equal to 115 mm and less than 125 mm indicates moderate wasting or moderate acute malnutrition (MAM) and MUAC equal to or greater than 12.5 cm is normal WHO (13).

Haematological estimations

A representative sample (twenty eight percent) of study population had 5 ml of venous blood drawn using a fixed hypodermic needle in sterile circumstances after the puncture site was cleaned with 90% alcohol. To prevent clotting, the blood sample was transferred to a sample tube containing lithium heparin, gently mixed and analysed in a laboratory. Full blood counts were used to determine haematological parameters by placing the sample in a position where the aperture was submerged in the blood and pressing the aspirator button (15). Haematological, parameters like hemoglobin (Hb) level, total white blood cell (tWBC) count, neutrophil, lymphocyte, and platelet counts, and packed cell volume (PCV) (16).

Malaria parasite density determination

Different blood smears were stained with Giemsa to assess the parasitaemia caused by P. falciparum. Parasite counts were assigned according to the criteria established by the World Health Organization (17): low (+) = 1-10/100 fields, mild (++) = 11-100/100 fields, moderate (+++) = 1-10/one field, and high (++++) = >10/one field.

Data and Statistical Analysis

The results from the dietary questionnaire, anthropometric measurements, and biochemical analyses were all entered into a database. As part of the SMART application, anthropometric data was analyzed in ENA to provide nutrition indicators and evaluate the accuracy of measurements. SPSS was used to analyze the remaining data with tabular display of result with descriptive statistics. The correlation between categorical variables was calculated using logistic regression, while the comparison of means was conducted using the Student's t-test with a 0.05 level of significance on a 2-tailed scale.

Ethical Approval and Consent

Ethical review was done and approval obtained from the ethics committee of Federal medical, centre, Abeokuta with reference number FMCA/470/HREC/01/2022/07. The parents/ Care givers of participants were duly informed about the study and consent was obtained.

RESULTS

Table 1 presents the summary of demography of children and their parents. A total of 146 children were selected for this study, more than half of the children (57.5%) were female. Around 52.1% fell within the age range of 6 to 12 months, while 45.9% were aged between 13 and 24 months, and 2.1% were aged 0 to 5 months. The predominant malaria prevention measure adopted by households was the use of mosquito nets (45.9%), followed by insecticides (29.5%), environmental cleaning (14.4%), prophylaxis (6.8%), and door and window nets (3.4%).

Anthropometric Indices of the Children

This study highlights the nutritional status among 146 children surveyed. As shown in table 2, about one-fifth of the respondents (19.9%) have severe acute malnutrition according to the MUAC assessment. About one-fifth (21.2%) were also severely stunted, (21.3%) were severely malnourished considering their weight for age, about one-third (27.4%) are severely wasted.

Occurrence of Malaria in the Respondents

Table 3 shows that 35% of the respondents tested positive for P. falciparum., 57.1% of the respondents tested positive had a low density (+) of parasitaemia, 28.6% had a mild density (++) while 14.3% had a moderate density (+++).

Table 1: Socio-demographic characteristics of the children and their parents

Sex (Children)	Frequency	Percentage		
Male	62	42.5		
Female	84	57.5		
Age group				
0 – 5	3	2		
6 – 12	76	52.1		
Marital status (Parents)				
Single	11	7.5		
Married	128	87.7		
Divorced	5	3.4		
Separated	2	1.4		
	Frequency	Percentage	Frequency	Percentage
Age (years)	Father		Mother	
20 and below	34	23.3	3	2.1
21 – 30	85	58.2	71	48.6
31 – 40	24	16.4	67	45.9
41 – 50	3	2.1	5	3.4
Above 50				
Education level	Father		Mother	
No education	6	4.1	11	7.5
Primary	3	2.1	15	10.3
Secondary	35	24	33	22.6
B.Sc/ HND	100	68.5	81	55.5
Masters	2	1.4	6	4.1
Occupation	Father		Mother	
Petty trader	37	25.3	69	47.3
Farmer	3	2.1	38	26
Civil servant	60	41.1	29	19.9
Artisans	39	26.7	10	6.8
Unemployed	7	4.8		
Monthly income	Father		Mother	
Below ₦30,000	12	8.2	56	38.4
₦31,000 - ₦50,000	74	50.7	48	32.9
₦51,000 - ₦100,000	30	20.5	27	18.5
₦101,000 - ₦200,000	29	19.9	12	8.2
Above ₦200,000	1	0.7	3	2.1
Main malaria prevention practices for the household				
	Frequency	Percentage		
Insecticides	43	29.5		
Mosquito net	67	45.9		
Environmental cleaning	21	14.4		
Prophylaxis	10	6.8		
Door and window nets	5	3.4		
Total	146	100		

Table 2: Prevalence of malnutr ition of the children

Variables	Frequency	Percentage
MUAC Classification		
Moderate Acute Malnutrition (≥115mm<125mm)	29	19.9
Normal (≥125mm)	97	66.4
Severe Acute Malnutrition (<115mm)	20	13.7
Height for Age (Stunting)		
Moderate Stunting (<-2 SD to -3 SD)	25	17.1
Normal (+2 SD to -2SD)	90	61.6
Severe Stunting (<-3 SD)	31	21.2
Weight for Age (Underweight)		
Moderate Malnutrition (<-2 SD and -3 SD)	19	13.0
Normal (+2 SD to -2SD)	95	65.1
Severe Malnutrition (<-3 SD)	32	21.3
Weight for Height (Wasting)		
At risk (+1 to -1)	16	10.9
Moderate Acute malnutrition (<-2 SD and -3 SD)	13	8.9
Normal (+2 SD to -2SD)	77	52.7
Severe Acute Malnutrition (<-3 SD)	40	27.4
Total	146	100

Table 3: Occurrence of P. falciparum malaria in respondents

Malaria	Frequency	Percentage (%)
Negative	26	65
Positive	14	35
Intensity		
Low density (+)	8	57.1
Mild density (++)	4	28.6
Moderate density (+++)	2	14.3
Total	40	100

Distribution of Haematological Parameters
The result in table 4 show higher majority (57.5%) had a PCV less than 33% while 42.5% had a higher PCV value. 67.5% respondents had haemoglobin valve less than 11g/dL, 35% of the respondents had a plasma transferrin concentration greater than 347g/dL and 50% had a white blood cell count greater than 10,000c/mm^3. The respondents observed to have a neutrophils and monocytes higher than the normal range were 30% and 8% respectively.

DISCUSSION

The nutritional status of children is a crucial factor in assessing their growth and development. This study unveils that in the research locale, 38.2% of children were stunted, 21.9% were underweight, and 27.4% were wasting. Males had been reported to suffer from malnutrition than female which has been reported in the findings from Rwanda (18), Nigeria (24), and Tanzania (12). It is not clear why males were more malnourished than females but some studies have linked it with early weaning for boys (20). This study found that the prevalence of stunting increases with age, with 44.4% of children aged 13–24 months affected, compared to 29.3% among those aged 6–12 months, and 0% among those aged 0–5 months, this is similar to findings reported by Ezeh et al., (21). About one-fifth (21.2%) were also severely stunted, (21.3%) were severely

Table 4: Haematological parameters of the children

Parameters	Frequency	Percentage (%)
Packed cell volume		
< 33%	23	57.5
> 33 %	17	42.5
Haemoglobin		
< 11 g/dL	27	67.5
> 11 g/dL	13	32.5
Plasma transferrin concentration		
> 347 g/dL	14	35
< 347 g/Dl	26	65
White blood cell		
> 10,000 c/mm3	20	50
< 10,000 c/mm3	20	50
Neutrophils		
< 45%	10	25
> 45%	30	75
Lymphocytes		
< 77%	40	100
> 77%	0	0
Monocytes		
< 2.4%	32	80
> 2.4%	8	20
Total	40	100

malnourished considering their weight for age, about one-third (27.4%) are severely wasted.

This study demonstrated a significant relationship between the level of education of the mothers and the occurrence of stunting (p=0.001) and wasting (p=0.005). More than two-thirds of the stunted children (44.2%) and more than half of the wasted children (55.9%) had mothers who had received secondary school education and above. The increase in occurrence of stunting, wasting and underweight is significant with the increase in level of education of mothers and this aligns with a study by Dosajee et al (22). This shows that the level of education of mothers might influence the intensity and formality of employment status. Less educated mothers tend to be a stay-at-home mothers or may engage in petty trades thus allowing them to spend more time caring for their children.

Packed cell volume and haemoglobin values less than normal may indicate the presence of anaemia and the mean value of the packed cell volume and haemoglobin values observed by sex and age groups are below the normal range of 31 – 41% for packed cell volume and 11 – 13.5g/dL for haemoglobin. Mean plasma transferrin concentrations were between the normal ranges of 204 – 360mg/dL. The study revealed that the mean PCV, haemoglobin, WBC and lymphocytes increased with age while neutrophils, monocytes and mean plasma transferrin concentration was observed to reduce with age. 30% of the respondents had a neutrophils > 45% which may indicate chronic bacterial infection.

The study revealed positive falciparum malaria in 35% of the children. A significant decrease in packed cell volume was observed in the children with positive malaria parasitaemia. 78.6% of the children with malaria had a packed cell volume < 33% and a haemoglobin concentration < 11g/dL. These findings align with the significant decrease in packed cell volume and hemoglobin concentration reported by Al-Salahy et al. (23) and Bawah et al. (24). Additionally, the study discovered that 28.6% of children positive for malaria parasitemia had a plasma transferrin concentration greater than 347 mg/dL. Desalegn et al. (25) have reported that plasma transferrin concentrations increase with the occurrence of malaria.

This revealed that 28.6% of the children had malaria more than twice. PCV and haemoglobin are shown to decrease due to haemolysis that occurs with malaria infection.

Anaemia is defined as a packed cell volume < 33% and haemoglobin level < 11 g/dL, while iron deficiency is defined by a plasma transferrin concentration > 347 g/dL (26). This indicates that the prevalence of anaemia in the children were higher with 57.5% having a packed cell volume < 33% and 67.5% having haemoglobin concentration < 11g/dL. This study also indicates that 28.6% of the children are anaemic and iron deficient.

CONCLUSION

Chronic malnutrition was observed in notable proportions of the children. The prevalence of stunting increased with age, peaking at among 13–24-month-olds. Maternal education significantly influenced stunting and wasting occurrences, with higher rates among less educated mothers. Blood parameters indicated a high prevalence of anemia, especially in children with positive malaria. The study underscores the complex interplay of socio-economic factors, maternal education, and health indicators on child nutrition and health outcomes. These findings emphasize the importance of comprehensive interventions addressing nutritional deficiencies among children in the studied location.

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