Research Article

Assessment of Anthropometric Parameters and Selected Macronutrients Status in Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

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ABSTRACT

Malnutrition is an independent risk factor for patient morbidity and mortality as a result of socioeconomic challenges. The aim of the study is to assess the anthropometric indices and some selected macronutrients status in children attending clinic at Primary Health Care Centre Babban Dodo Zaria, Kaduna State. Sixty (60) participants were recruited for socio-demographic study using structured questionnaire. Anthropometric parameters (Body Mass Index, Mid Upper Arm Circumference and Hip), total protein, serum albumin and globulin were determined from the children attending the clinic. It was observed that, children of 8 months old and above showed significant decrease ($p<0.01$) in serum total protein compared to the children of lesser ages. Similarly, children of 1 month 5 months and 8-55 months showed significant decrease ($p<0.01$) in serum albumin. Significant decrease ($p<0.01$) in serum globulin level was seen in Children of 2-3 months, 6 months and 8-55 months compared to the children of less than 2 months. The Body Mass Index (BMI) shows that 58.33% were underweight, 25.00% were normal and 16.67% were overweight. Significant increase ($p<0.01$) in head circumference were seen in children of 8-55 months old compared to the children of below 8 months. Children of 20-25 months old and also showed significant decrease ($p<0.01$) in Waist/Hip ratio compared with other group of children. Results indicate that, stunted growth, Protein energy malnutrition symptoms were seen in most of the children which in turn will affect their mental state.

Keywords: Malnutrition: Macronutrients; Anthropometry Indices; Public Health; Obesity

INTRODUCTION

Malnutrition, as defined by the World Health Organization [WHO, 2011], refers to a state of cellular-level imbalance between the availability of nutrients, energy, body's development, maintenance, and physiological requirements. The clinical definition of malnutrition encompasses the inadequate intake of protein, calories, and vital micronutrients [Steve *et al.,* 2000]. The current occurrence of malnutrition among children under the age of five is estimated to be 195 million. Majority of these children, accounting for around 90%, are located in the regions of Sub-Saharan Africa and South Asia. Based on the findings of Black *et al.* [2008], it is estimated that around 20 million children suffer from severe acute malnutrition, with an additional 175 million children being impacted by undernutrition. Maitland *et al.* [2006] found that there is a notable increase in the mortality rate of children admitted to hospitals in Saharan Africa as a result of acute malnutrition. Mortality rates and the

factors contributing to mortality are significant indicators of social advancement and disparities, operating at both intra-societal and inter-national levels Razum and Breckenkamp, [2007]. Wasting is a term used to describe the state of present or imminent malnutrition, either from the catastrophe to achieve weightiness growth or from actual weight loss [Bruce, 2001]. The presence of stunting can be used as an indicator of prior growth impairment, which may reflect a historical pattern of insufficient nutrient intake. According to Bruce [2001], previous studies have demonstrated that stunting is a result of long-term malnutrition, inadequate caregiving, and adverse environmental and socio-cultural conditions. These factors contribute to inferior academic achievement and reduced self-esteem among afflicted children. The World Health Organization [2011] has reported that children who encounter undernourishment and have low body weight are prone to demonstrating inferior cognitive ability in comparison to their adequately nourished peers. Sufficient nourishment is a fundamental requirement for the normal progression of physical growth, the attainment of optimal well-being, and the overall welfare of individuals.

Anthropometry is a scientific practice that involves the methodical measurement of human persons. Its primary goals are to identify and understand the various physical features displayed by the human population. Anthropometry is a reliable and systematic method employed to quantify bodily dimensions and proportions through the assessment of many characteristics, including body length, width, circumference, and skinfold thickness [Wang *et al.*, 2000]. Pheasant [1996] posits that the examination of overall body size and physical proportions enables the identification of variations in body dimensions among diverse groups. Anthropometric traits, such as stature and sitting height, have been widely recognized as distinguishing variables among diverse ethnic groups. Lin *et al*. [2004] have uncovered an additional significant ethnic disparity in relation to body measures, specifically the ratios of physical proportions. The concept of bodily proportion involves the establishment of a scaling relationship by quantifying the ratio between a specific body dimension and a selected reference dimension.

Prior research has established a robust correlation between anthropometric attributes and reproductive traits, as well as body composition [Lassek and Gaulin, 2006]. A valuable contribution to the government's efforts in addressing malnutrition among children in the Babban Dodo Zaria region of Using the formula above

Kaduna State could be made by conducting a study that evaluates the nutritious status of kids under the age of five years. This study would utilize specific anthropometric variables and selected macro-nutrients, providing important insights for the formulation, monitoring, and implementation of strategies.

MATERIALS AND METHODS

Materials

Socio-Demographic Questionnaire

The socio-demographic questionnaire was designed based on gathered literature from various authors. The questions were all inclusive and precise.

Ethical Clearance

Ethical approval for the study was obtained from the Kaduna State Ministry of Health Research Ethics Committee, Kaduna State.

Instruments for Anthropometric Assessments Include: Weighing scale, height measuring scale (Stadiometer and infantiometer), MUAC Tape (Mid Upper Arm Circumference), Hip and waist meter rule.

Instrument for Macronutrient (Total Protein, Albumin and Globulin) Assay: Serum

Methods

Inclusion and Exclusion Criteria

Inclusion criteria: Children aged 0-5 years.

Exclusion criteria: Children below 0 years.

Sample Size

The study population will be 60 children between the ages of 0-5years.

Sample Size Determination

The sample size for the study was determined from a standard formula for the calculation of minimum sample size [Oyejide, 1992].

Sample size n is given by the formula:

$$n = \frac{z^2 pq}{d^2}$$

Where n = minimum sample size; Z^2 = value of the standard normal deviate which at 95% confidence level has been found to be 1.96; P = the best estimate

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$Z_{1-\alpha/2}^2 = 1.96$

P = 0.041 (Abdullahi *et al*., 2021)

d = 0.05

$$\text{Sample size (n)} = \frac{(1.96)2 \times 0.041\,(1 - 0.041)}{0.5\quad^2}$$

= 3.8416 x 0.16 x 0.959

= 60.419

Anthropometric Indices

Mid Upper Arm Circumference

Measurement of mid-upper arm circumference (MUAC) provides a simple and reliable tool which enables rapid assessment of large populations in epidemiological field study. This analysis was done using the method of Dolan *et al*. [2007]

Hip Circumference

Hip circumference was measured around the widest portion of the buttocks. It provides a more specific measure of subcutaneous gluteofemoral adipose tissue [Berber *et al*., 2001]. The method was carried out using the method of de Koning *et al*. [2007].

Waist Circumference

Waist circumference effectively measures both visceral and subcutaneous adipose tissue. Waist circumference is a good measure of fat around the middle. This type of fat builds up around the organs, and is linked to high blood fat levels, high blood pressure and diabetes [Balgi *et al*., 2019]. The analysis was done using the method of Cavelaar *et al*. [2000].

Height

The method of Ulasi and Ebenebe, [2007] was employed. Measuring height and weight accurately is important when monitoring an infant or child's health. Height is used to calculate body mass index, or BMI, a measure of healthy versus unhealthy weight. They are also important when tracking a child's growth [Marfell *et al*., 2006].

Weight

The weight of an object can be determined by balancing it against a known weight. It is a useful non-invasive method of assessing their wellbeing. It detects deviations in growth from the norm A counteracting force is created to be compared to the unknown mass. The weighing pan is attached to an electromagnetic coil, through which electric current

is flowing [EEHIS, 2007]. The method of Marfell *et al*. [2006] was employed.

Head Circumference

The method of Bundy *et al*. [2017] using the Frankfort Plane was employed. Measuring head circumference (HC) is a quick, non-invasive method of determining if infant head size is too large (megacephaly) or too small (microcephaly). When compared with normative growth curves, serial head circumference measurements are extremely important in monitoring infant health [Amuta and Houmsou, 2009].

Macro-Nutrients Assessment Status

Estimation of Serum Total Protein

The biuret method was used to assay for total protein [George, 2009]. Serum proteins react with copper sulphate in sodium hydroxide to form a violet biuret complex. The intensity of the violet colour was measured using a DRE 3000 HACH spectrophotometer which is proportional to the concentration of protein.

Estimation of Serum Globulin

Bromocresol green method was used to assay for serum globulin. Bromocresol green (BCG) - albumin complex absorbs light at different wavelength from the unbound dye. The method may overestimate albumin by binding to other proteins [George, 2009] Hence, globulin fraction is generally determined by subtracting the albumin fraction from the total protein fraction [Du *et al*., 2014].

Estimation of Serum Albumin

Albumin is generally measured by a dye-binding technique which utilizes the ability of albumin to form a stable complex with bromocresol green dye [George, 2009]. Absorbance of samples and standard were measured against reagent blank at 546 nm. These tubes and their contents were mixed and incubated for 90 minutes at 37°C. Estimation of serum albumin level (g/dl) was obtained using a DRE 3000 HACH spectrophotometer.

Data Analysis

Data were represented as mean ±SEM where applicable. A 95% confidence interval were used and a probability value of $p \leq 0.01$ were considered significant [WHO, 2012b]. Graph pad and Statistical Package for Social Sciences (SPSS) was used for data analysis of descriptive statistics (means, standard deviations, frequencies) on all variables.

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RESULTS

The mid upper arm circumference of children attending primary health care centre Babban Dodo Zaria was highest in age bracket 1-3 months old, while 25 months old children had significantly lower (P< 0.01) mid upper arm circumference status with exception of 15 months children who had the least mid-upper arm circumference (Table 1).

The waist /hip ratio in children attending primary health care centre Babban Dodo Zaria was highest in age bracket 3-6 months and 55 months old, while age bracket of 20-25 months old had significantly lower (P< 0.01) waist /hip ratio (Table 2).

Table 3 showed the body mass index in which, 35(58.33%) are underweight, 15(25.00%) are normal, 10(16.67%) are overweight and 0(0.00%) are obese.

Children of age 20- and 40-months old showed significant increase (P<0.01) compared with children of other ages. Children of ages 1-5months and 7 months old show significant decrease (P<0.01) compared with children of other ages (Table 4).

Table 5 showed the socio-demographic characteristics of the participants with male 27(45.00%) and female 33(55.00%). Also, 1-2 years were 44(73.35) and 3-5 years were16 (26.75).

The total protein concentration in children attending primary health care centre Babban Dodo Zaria was highest in 7 months old, while age bracket of 8-55 months old had significantly lower (P< 0.01) protein status compare with children of 1-6 months age bracket except children of 15 months who had the last protein concentration (Table 6).

The albumin concentration in children attending primary health care centre Babban Dodo Zaria was highest in 2-3 and 6-8 months old, while age bracket of 1 month, 5 months and 8-55 months old had significantly lower (P< 0.01) albumin status (Table 7).

The globulin concentration in children attending primary health care centre Babban Dodo Zaria was highest in 1 month, 5 months and 7 months old children, while age bracket of 2-4 months, 6 months and 8-55 months old had significantly lower (P< 0.01) globulin status except children of 25 months who had the last protein concentration (Table 8).

Table 1. Mid Upper Arm Circumference of Under Five Years Old Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

Months	Mid Upper Arm Circumference (cm)
1	16.80± 0.60[c]
2	14.10± 0.90[c]
3	15.03± 0.16[c]
5	11.23± 0.30[b]
6	12.02± 0.44[b]
7	11.37± 0.37[b]
8	11.67± 0.19[b]
9	11.40± 0.14[b]
10	10.80± 4.34[a]
15	10.20± 3.34[a]
20	10.65± 1.79[a]
25	9.03± 1.66[a]
35	10.87± 3.31[a]
40	10.40± 5.51[a]
55	10.01± 0.28[a]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

Table 2. Waist/Hip Ratio of Under Five Years Old Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

Months	Waist/Hip Ratio
1	1.04 ±0.018[a]
2	1.04±0.008[a]
3	1.17±0.006[b]
5	1.15±0.008[b]
6	1.15±0.005[b]
7	1.10±0.005[a]
8	1.09±0.004[a]
9	1.09±0.004[a]
10	1.08±0.008[a]
15	1.01±0.008[a]
20	0.89±0.004[a]
25	0.95±0.008[a]
35	1.04±0.005[a]
40	1.10±0.006[a]
55	1.17±0.010[b]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

Table 3. Nutritional Status of Children attending clinic at Primary Health Care Centre Babban Dodo Zaria City using Their Body Mass Index

STATUS n=60	FREQUENCY	PERCENTAGE
UNDER WEIGHT	35	58.33
NORMAL	15	25.00
OVER WEIGHT	10	16.67
OBESE	0	0.00

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Table 4. Head Circumference of Under Five Years Old Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

Months	Head Circumference (cm)
1	39.36± 1.89[a]
2	39.09± 0.35[a]
3	38.07± 0.44[a]
5	38.49± 0.24[a]
6	40.00± 0.09[a]
7	39.26±0.32[a]
8	43.36± 0.25[b]
9	47.21± 3.16[b]
10	42.61±0.21[b]
15	46.01± 0.09[b]
20	50.20±1.01[c]
25	49.93±0.37[b]
35	49.28± 0.28[b]
40	51.19±0.41[c]
55	48.02± 0.62[b]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

Table 5. Socio-Demographic Characteristics of Participants (Children Under 5 Years)

CHARACTERISTICS	FREQUENCY	PERCENTAGE
GENDER		
MALE	27	45.00
FEMALE	33	55.00
AGE GROUP		
1-2 YEARS	44	73.30
3-5 YEARS	16	26.70

Table 6. Total Protein Status of Under Five Years Old Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

MONTHS	TOTAL PROTEIN (g/L)
1	62.06±0.83[c]
2	61.61±2.68[c]
3	64.16±0.64[c]
5	61.28±0.46[c]
6	62.40±0.83[c]
7	71.29±0.43[d]
8	50.84±0.71[b]
9	57.99±1.97[bc]
10	50.53±0.28[b]
15	51.93±0.68[b]
20	53.11±0.80[b]
25	37.22±1.11[a]
35	45.43±1.10[b]
40	52.61±1.63[b]
55	48.41±1.43[b]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

Table 7. Serum Albumin status of under five years old children attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

Months	Albumin (g/L)
1	27.83±2.45[a]
2	32.95±0.25[b]
3	34.93±0.77[b]
5	28.19±0.82[a]
6	38.49±0.41[b]
7	32.01±1.75[b]
8	37.67±1.01[b]
9	40.02±0.29[c]
10	27.35±0.53[a]
15	37.66±0.18[b]
20	28.05±0.99[a]
25	25.80±1.24[a]
35	27.37±0.57[a]
40	24.77±0.79[a]
55	25.47±1.30[a]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

Table 8. Serum Globulin Status of Under Five Years Old Children Attending Primary Health Care Centre Babban Dodo Zaria, Kaduna State

Months	Globulin (g/L)

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1	34.23±2.97[c]
2	28.67±2.83[b]
3	29.23±0.95[b]
5	33.10±0.48[c]
6	23.91±1.05[b]
7	39.28±1.93[d]
8	13.17±1.42[a]
9	17.98±2.03[a]
10	23.48±0.55[b]
15	14.27±0.63[a]
20	25.06±1.19[b]
25	11.42±1.04[a]
35	18.06±0.73[a]
40	27.84±0.97[d]
55	22.94±1.60[b]

∗ Values are in means ± SEM. Means with the same superscripts alphabet along the column are not significantly different P>0.01

DISCUSSION

Anthropometry is very useful in clinical and epidemiological studies. In this study weights, heights, mid upper arm circumference and head circumference were used to determine prevalence of malnutrition, and the results were compared to WHO standards. The ethnic distribution is reflective of the predominant ethnic group at the location of study. It was observed that more than a third of the study population belong to the lower social class [WHO, 2008].

The nutritional status of children, is a vital component with synergistic relationship with health, economic, social developments, maternal health and political system of the country. Malnutrition state of children has great influence on cultural, social, economic and community food practices. Therefore, Primary health care is the entry point for community healthcare needs.

In the present study, children in the age group of 0-5 years were interviewed and examined with the help of their parents /care givers. A significant difference between the anthropometric status and some selected macronutrients (P<0.01) was found. Moreover, children of age 7 months and above are more vulnerable to malnutrition than younger aged children. The study conducted by Abdullahi *et al.* [2022], had comparatively similar findings with the present study, namely, that 25% of the children were normal, 16.67% were overweight, 0.00% was obese and 58.33% were undernourished. The extent of undernutrition is higher in the present study than that reported in one Indian study (53.00%) [WHO, 2008],

Total protein concentration in children attending primary health care centre Babban Dodo Zaria was highest in 7 months old, while age bracket of 8-55 months old had significantly lower (P< 0.01) protein status compare with children of 1-6 months age bracket except children of 15 months who had the last protein concentration. This is in accordance with the preceded study done by Tathiah *et al*. [2011] that if the need for protein is not met for a long period, this will lead to protein synthesis disturbance which results in the total protein and albumin being found to be lower than the reference values. Low levels of total protein in serum can cause many alterations and harmful effects on children's growth and have a destructive impact on the future of a nation because children are the future generation. Globally, nearly half of under-five deaths are attributed to PEM either as direct/indirect cause. PEM is associated with reduction in synthesis of plasma proteins.

Low serum albumin concentration was seen in children of ages 1month, 5 months, 10 month and 20-55 months compare with children of other ages. This is in accordance with preceded study of Chowdbury *et al*., 2008 in Bangladesh. It could be due to reduced intake of protein rich diet resulting in reduced synthesis of protein. In the development of marasmus, there occur deficiencies of energy in the diet reselling in the change of normal pattern. Marasmus–Kwashiorkor (K/M): Marked protein deficiency (serum albumin < 40 g/l) and marked calorie insufficiency signs present, sometimes referred to as the most severe form of malnutrition [Scaglioni *et al*., 2020].

Children of age 2-3 months, 6 months and 8-55 months old showed significant decrease (P<0.01) compare with other groups of children. The results were in agreement with the work of Olanipekun *et al.,* [2012], who studied the nutritional status of children in Ibadan South-West Local Government Area which showed that decrease in globulin level may be a sign of liver or kidney disease, or malnutrition.

Socio-demographic characteristics have significant influence on the nutritional status of the children which may be due to the amount and quality of nutrient intakes significantly influencing the body

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mass index. Children of age 8-55 months showed a significant decrease (P<0.01) in BMI below the reference range. This is in accordance with preceded study of Duyar *et al*. [2006] that suggest that, low BMI could be caused by Socioeconomics and community and Cultural factors. This shows a state of severe acute Malnutrition.

Children of ages 1-5months and 7 months old show significant decrease (P<0.01) compared with group of children of other ages. This is in accordance with the study of Marfell jones *et al*. [2012] which shows that, some children may have microcephaly because of changes in their genes.

The mid upper arm circumference showed significant decrease (P<0.01) in children of age 25 months old compared with children of other ages. This is in accordance with the study of Caroli *et al*. [2007], which showed that low mid-upper arm circumference identifies children with a high risk of death who should be the priority target for treatment. To reduce maternal underweight status, public health strategies should focus on water, sanitation and hygiene (WASH), household food insecurity and optimal maternal healthcare practices.

Children of ages 20-25 months old showed significant decrease (P<0.01) compared with other group of children. This is in accordance with the study of Gangil *et al*. [2001]. In the present study, it was also found that the type of family, parent's education, and socioeconomic status of the children play a pivotal role in their nutritional status. Parents with higher education show significant association with the nutritional status of their children. It was also seen that the higher the socioeconomic status, the better the nutritional status of the children. This study showed the poor nutritional status among children of seven months to five years old in primary health care centre Babban Dodo Zaria. It also reveals that the problem of malnutrition is multifaceted and has links with various socioeconomic and demographic factors.

CONCLUSION

The study showed that, the health and nutritional status among the children were found to be abnormal (acute malnutrition). The prevailing dietary practices of children have not been up to the mark which may be due to poor nutritional knowledge, low income and abnormal food allocation at the family level. The macronutrients deficiencies lead to decrease in the growth spurt. Therefore, stunted growth, Protein energy malnutrition symptoms were seen in most of the children in the study area which in turn affect their physical and mental state.

RECOMMENDATION

This study recommends that, future studies should be done to estimate protein and its correlation with disease that could affect protein absorption in malnourished children. Also, early diagnosis and prompts management of PEM as follow up study is vital, and such can be compared with other urban children from another community. Government should organize awareness programs for mothers and care givers on the importance of children nutritional status.

AUTHORS DECLARATION

No potential conflict of interest was reported by the authors.

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