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ANTHROPOMETRIC AND BIOCHEMICAL ASSESSMENT AMONG UNDER FIVE CHILDREN IN KUSADA LOCAL GOVERNMENT AREA, KATSINA STATE, NIGERIA

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ABSTRACT
Nutritional status of four hundred (400) children aged 1-5 years old was assessed from three communities in Kusada Local Government Area, namely, Bokosire, Dudunni C and Bauranya B. Semi-structured interview, quantitative anthropometric methodology in respect of mid-upper-arm circumference (MUAC) and weight-for-height (WFH) indices, and biochemical tests of serum calcium, albumin, total protein, and hemoglobin were used for the assessment to extract relevant data from the target population. Out of 400 assessed children (250 female and 150 male) between 1-5 years old, twenty four percent (24%) suffered from different grades of under-nutrition using MUAC measurement with a set point of 13.5 cm. Similarly, the nutritional status of the children as indicated by WFH index revealed that thirty six percent (36%) were of different grades of protein-energy malnutrition (PEM) as per Waterlow classification. However, the biochemical tests across the communities for ninety (90) children selected from the total 400 [60 under-nourished (MUAC≤ 13.5cm) and 30 well-nourished (MUAC> 13.5cm) children] revealed that serum albumin, total protein, calcium, and haemoglobin were lowered significantly (P<0.05) in under-nourished children.
Keywords: Children aged 1-5 years old, Nutritional status, Malnutrition, Serum protein.

INTRODUCTION

Nutrition is the study of food at work in our body (Healingwell, 2009). The essence of nutritional assessment is to identify nutritional disorders and determine which individuals need nutritional instruction and or nutritional support. Different age groups can be affected by nutritional disorders, especially children between 1-5 years old (Malnutrition, 2009). Children between these ages are mostly vulnerable to inadequate food intake due to increased physical growth (Aliyu, 1997). In developing countries, especially Nigeria, protein-energy malnutrition (PEM) and micro-nutrient deficiency disorders (MNDDS) are the commonest types of nutritional disorders (Son, 1987). Malnutrition is defined by World Health Organisation (WHO) as the cellular imbalance between supply of nutrients and energy, and the body's demand for them to ensure growth, maintenance, and specific function (Leo and Muhammad, 2011).

Malnutrition, in form of under nutrition is a public health problem in Nigeria. A report from the United Nations International Children's Emergency Fund (UNICEF) revealed that there are 14% low birth weight; 13% exclusive breast feeding; 14% wasting; 41% stunting and 23% underweight among children below 5 years old in Nigeria (Leo, 2011). The north of Nigeria reportedly has at least twice the level of malnutrition and child mortality than Nigerian south (Irinnews, 2007). This fact is being supported by the findings from few nutritional surveys and assessments carried out by relevant agencies in Nigeria: United States Agency for International Development (USAID) (2008) reported that the current rate of malnutrition in the northern part of Sokoto, Kebbi and Zamfara states showed a global acute malnutrition rate of 8.8% and a severe acute malnutrition rate of 2.6%, suggesting that about 51,000 children under 5 years were wasted, 15,000 severely. About 43% were stunted, indicating chronic malnutrition and 36% under weight. Doctors without Border (2009) in a field news reported that 1 or 2% and 3% of children under 5 years old were suffering from severe acute malnutrition from southern Borno and Katsina states respectively. Similarly, Food and Agricultural Organization, United Nations (FAO) (1997) found that of the 948 children aged 1-5 years assessed in some local government areas in Kano state, 13% were malnourished and 23% were at the risk of malnutrition. It was also estimated that 29.4% of women and 24.9% of children were affected by iron deficiency anemia in Nigeria (Muhammad, 1997).

Malnutrition begins with changes in nutrient levels in blood and tissues. Alteration in enzyme levels, tissue abnormalities and organ malfunction may be followed by illness and death (Fyke, 1999). In under nutrition the incidence of anemia due to hemoglobin concentration is common and lowest values have been found in children of 6-23 months, being in weaning period. Son (1987) reported that the percentage of school children having hemoglobin level below 11g% were: 76% in Jamaica, 42% in Gayman Islands, 41% in Guyama and 14.3% in Saint Lucia. In a study, Olivares *et al.* (2005) found that plasma levels of albumin, potassium and calcium were lowered in malnourished children.

Similarly, Chowdhury *et al.,*(2008) found that total protein and albumin were significantly lowered than control in any form of PEM. Micronutrient deficiencies, especially iron and iodine cause delayed psychomotor development and impaired cognitive function (Leo, 2011). There are many under nourished children in Katsina State (Doctors without Border, 2009). Consequently, this study was designed to estimate the prevalence of malnutrition among children aged 1-5 years old in Kusada Local Government Areas with a view to developing a nutrition programme that would improve the situation.

MATERIALS AND METHODS

Kusada local government is a major settlement in Katsina State that occupies part of northern Nigeria. It lies between latitudes 12°17 to 12°38 N and longitude 7°41 E to 8°08 E. It consists of 10 wards: Kusada, Bauranya, Kofa, Boko, Magama, Kaikai, Yashe, Mawashi, Dudunni and Tofa with an estimated population of 168,000 (Kusada Local Government, 2005).

Informed Consent and Ethical Approval

Children aged 1-5 years old were selected across three communities: Bokosire, Bauranya B, and Dudunni C, for this study. Permission was obtained from the local government council through the Department of Health, Kusada Local Government Area. Verbal consent were taken from parents of the children for participation in the study.

Sample Size

A minimum sample size of 369 children was derived using statistical sample size formula n = {4*P*(100-P)}/25 (Rainer *et al.* 1997). Where n = minimum sample size, P = 36% (expected prevalence of malnutrition in Nigeria). Therefore , n = {4*36*(100-36)}/25 = 369

Data Collection and Inclusion Criteria of Participants

Three villages were covered between May and July, 2009. A total of 400 children ages 1-5 years old were covered for anthropometric measurements and 90 out of the 400 children of both sexes of similar ages were selected across the communities for biochemical analysis. Sixty (60) of them well nourished (MUAC>13.5cm or WFH≥90%), apparently healthy with no digestive disorder and 30 with different grade of protein-energy malnutrition (MUAC≤ 13.5cm or WFH<90%) were selected across the areas by stratification. The different grades of malnutrition by MUAC was based on FAO classification as adapted from Abubakar (1997), while the different grades of PEM by WFH was based on Waterlow classification (Table 1) as adapted from Chowdhury *et al.* (2008). Blood was drawn with aseptic precaution and serum total protein was determined as described by Henry (1974), serum albumin was determined as described by Cheesbrough (2000a), serum calcium was determined as described by Ray and Chauhan (1967) and hemoglobin was determined as described by Cheesbrough (2000b). Attendant parents of the children were interviewed to collect data relevant to the study.

Table 1: Waterlow classification of PEM

Degree of PEM	Wasting (%) (weight for height)
Normal	90%
Mild	80-90%
Moderate	70-80%
Severe	<70%

Source: Chowdhury, *et al.* (2008).

Statistical Analysis

Statistical analysis was done by unpaired student 't' test at P<0.05 to compare between different means of biochemical parameters of the subjects.

RESULTS

Table 2 presents nutritional status of children per community based on MUAC measurement at a set-point of 13.5cm. Twenty four percent (24%) were malnourished; 8% under-nourished (MUAC< 12.5cm), 16% were at risk of malnourishment (MUAC=12.5-13.5cm). A total of 76% were well-nourished (MUAC> 13.5cm). Table 3 presents nutritional status of the same children from the same areas using Waterlow classification of PEM. A total of 36% were wasted and wasting; 6% severe, 11% moderate and 19% mild. Only 64% were well-nourished (normal).Table 4 presents result of biochemical analysis of well-nourished and under nourished children. Serum albumin, total protein, calcium, and hemoglobin were significantly (p<0.05) lowered in under nourished than well nourished children.

Table 2: Nutritional status of children based on MUAC measurement (%) using 13.5cm cut-off point

Ward	Village	No. of children per ward	MUAC Measurement (%)		
			Red MUAC<12.5cm	Yellow 12.5-13.5cm	Green MUAC>13.5cm
Boko	Bokosire	110	16	29	55
Dudunni	Dudunni C	160	6	11	83
Bauranya	Bauranya B	130	2	7	91
Average total			8	16	76

N.B: Under-nourished children and those at risk (those in Red and Yellow) = 24%. Well-nourished children are those in green = 76%.

Table 3: Nutritional status of children based on WFH measurement using Waterlow classification of PEM

Ward	Village	Severe <70%	Moderate 70-80%	Mild 80-90%	Normal 90% and above
Boko	Bokosire	10	13	23	54
Dudunni	Dudunni C	6	9	19	65
Bauranya	Bauranya B	2	12	15	72
Average total		6	11	19	64

N.B: Children that were wasted and wasting (those in severe, moderate and mild classes) = 36%
Normal children = 64%

Table 4: Mean ± standard deviation of serum albumin, total protein ,calcium, and hemoglobin in well-nourished and under-nourished children

Parameter	Well-nourished (MUAC>13.5cm); n = 30	Under-nourished (MUAC≤13.5cm); n = 60
Albumin (g/dl)	4.58^{a} ± 0.79	3.4^{a} ± 0.71
Total protein (g/dl)	6.32^{b} ± 0.65	5.19^{b} ± 0.87
Calcium (mg/dl)	8.96^{c} ± 0.71	8.52^{c} ± 0.86
Hemoglobin (g/dl)	12.29^{d} ± 1.40	10.16^{d} ± 1.55

a, b, c and d denote significant difference at $P < 0.05$.

DISCUSSION

This study had assessed the prevalence of malnutrition in Kusada Local Government Area from 3 different villages, namely, Bokosire, Dudunni C, Bauranya B and had found prevalence of 24%(MUAC) and 36% (WFH) of under nutrition among children aged 1-5 years old. This is similar to the finding of FAO (1997) and finding reported by USAID (2008). The under-nutrition was confirmed with lowered levels of serum total protein, albumin, calcium, and hemoglobin at P<0.05. Serum total protein and albumin levels in malnourished children were significantly (p<0.05) lowered than that of well-nourished children. This is in agreement with the finding of Chowdhury *et al*. (2008). Serum calcium level in malnourished children was significantly (p<0.05) lowered than that of well-nourished children. This is in agreement with the finding of Olivares *et al*. (2005). Hemoglobin level in under-nourished was significantly (p<0.05) lowered than that of well nourished children which is an agreement with the report of Son (1987). Lowered serum total protein and albumin values in under-nourished children could be explained on the basis of inadequate intake of dietary protein, particularly first class protein, leading to impaired synthesis: at weaning, only *Koko or Fura* was given to children 1-3 times daily and only sugar, if any, was added to the porridge and the food introduced next was *Tuwo* (family food). Most of the animal products obtained, especially eggs, were sold out in the market for cash. The inadequate intake of diary products such as milk, yoghurt, cheese e.t.c. particularly during the dry season when cattle are on seasonal migration could account for low level of calcium in under-nourished children. Lowered hemoglobin level in under-nourished children, suggesting iron-deficiency anemia, could be due to low consumption rate of fish, meat, green leafy vegetables and other food rich in micronutrients such as vitamins and iron during the dry season and also due to general low intake of protein, which was more pronounced during the lean period (July/August). However, in addition to the prevailing household food insecurity, mothers poor education background was responsible for the recorded underlying causes of malnutrition in the areas.

It is therefore recommended that a follow-up survey should be conducted in the areas to re-analyze the serum protein level in the children and compare the result with that of urban children or children from another ethnic group in Nigeria in order to have a better estimate of normal protein threshold in the serum among Nigerian children.

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