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Serum total protein and albumin levels among malnourished children aged 6- 59 months in Zaria

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Abstract*: Background:* Children with PEM have greater deficiency of total protein and albumin and in severe cases the total protein may be reduced to about 50 percent.
Objective: To determine the serum protein and albumin levels among children with Protein Energy Malnutrition and the controls at Institute of Child Health, Ahmadu Bello University Teaching Hospital (ABUTH) Zaria.
Method: This study was a case control health- based descriptive study to estimate the prevalence of serum protein and serum albumin in undernourished children in Zaria.
Using systematic sampling method, a total of 132 children (cases and controls) between 6 and 59 months of age were selected for assessment of their serum protein and serum albumin. Both the total serum protein and albumin levels were analysed on the Boerhringer Mannheim Automated Hitachi system 704 using the Biuret and colour change methods respectively.
Results: The prevalence of low serum protein levels (<60g/l) in this study among the cases was 46.9% with highest prevalence of 33.3% seen in severe wasting. While the prevalence of low serum proteins for the control was 1.5%. The prevalence of low serum albumin levels (< 25 g/l) among the cases was found to be 24.2% with severe stunting accounting for 15.2%, while for the controls, a low serum albumin levels of 3.0% occurred in this study.
Conclusion: This study has been able to establish low serum levels of protein and albumin among under-nourished children in Zaria.

Keywords: Serum protein; Albumin; under-nutrition; children.

Introduction

Malnutrition (Under-nutrition) is defined as an imbalance between nutrient requirements and intake resulting in cumulative deficits of energy, protein or micronutrients that may negatively affect growth, development and other relevant outcomes.[1] Stunting , underweight and wasting are indices of malnutrition,[2] These are defined respectively as anthropometric measurements that fall below minus two standard deviation (<-2SD) of normal height/length-for-age, weight-for-age, weight-for-height/length of the median World Health Organization (WHO) child growth standards.[2,3] Severe acute malnutrition (SAM) is defined by a weight-for-height/length below - 3z-scores of the median WHO growth standard, (<-3SD) by visible severe wasting or by the presence of nutritional oedema.[4] Severe acute malnutrition remains a major cause of mortality in children under five years of age.[4] It has been estimated that more than 20 million children of the world mostly developing nations suffer from severe malnutrition and 150 million children are underweight.[3,4,5] Globally, in 2012, 51 million children under five years were wasted, 17 million had severe wasting and twenty-eight per cent of all severely wasted children are living in Africa.[6] In Nigeria, 24% of children under five years of age are underweight (9% severely), 36% are stunted (19% severely) and 10% are wasted (3% severely).[7] Malnutrition rates in the North Western and North Eastern regions of Nigeria are higher than in the Southern parts of the country. The National Demographic Health Survey (NDHS) reports of 2003, 2008 and 2013 show declining prevalence of stunting in children under-five years of age at 42%, 41% and 37% respectively. Prevalence of wasting however was rising at 11%, 14% and 18% respectively. Underweight was 24%, 23% and 29% in those respective years. The trend shown in the statistics on malnutrition depict significant malnutrition in the regions mentioned. The figures are compelling and create a need for further research on factors and associations that may be playing a part. Children with PEM have greater deficiency of total protein and albumin and in severe cases the total protein may be reduced to around 50 per-cent.[10] The reduction of total serum protein and albumin were marked in kwashiorkor than in marasmus.[10] Physical findings generally help in the diagnosis of advanced malnutrition but is not fre-

quently positive in children in mild and moderate degree of malnutrition.[10] Early diagnosis of these cases is very useful as they are amenable to early rehabilitation and have better prognosis.[10] The assay of total protein and albumin will prove very useful in the diagnosis of PEM before clinical manifestations are established and thus help in reducing problems created by PEM.[10]

Malnutrition (under-nutrition) is a public health problem in the tropical and subtropical regions of the World. It has been estimated that more than 20million children of the World)mostly developing nations) suffer from severe malnutrition and 150 million children are underweight.[10] Under-nutrition has lasting effects on immune functions, growth and development of children, learning ability, social adjustment, work efficiency and productivity of labour.[9,10] Under-nutrition is associated with low serum protein an albumin. The degree of severity of serum protein and albumin have not been widely determined. It is hoped that this study will help provide some insight into this so as to guide therapeutic intervention. The objective of this study was to determine the serum total protein and albumin in malnourished children aged 6-59 months at Institute of Child Health Zaria.

Materials and methods

This was a case-control hospital-based descriptive study conducted over a period of 10 months between June, 2010 and March, 2011.

The study was carried out at the Institute of Child Health (ICH) Banzazzau, Zaria. The Institute of Child Health serves the community/ children mainly from Zaria and its environs and is the Primary Health Care outlet of Ahmadu Bello University Teaching Hospital (ABUTH), Zaria. The ICH offers out-patient service and receives an average of 100 patients in a day. ICH is located in Banzazzau area within the walled city of Zaria. Systematic sampling method was adopted to select 132 children between 6 and 59 months of age in Zaria. The study population consisted of consecutive malnourished children between the age of 6-59 months who presented to ICH. WHO Z-score classification was used in the classification of malnutrition in this study into mild, moderate and severe malnutrition using weight, height/length, MUAC and presence or absence of oedema, serum total protein <60g/l and serum albumin <25g/l were considered low. Age matched non malnourished children who presented to the ICH with clinical features of malaria, ARIs, acute diarrhoeal diseases among others were enrolled as controls. Informed consent was duly obtained from each child's parents or care givers before recruitment in the study. The sample size was determined using the following formular:[11]

$$S = [Z1 - \frac{\alpha}{2} \sqrt{2P\ (1-P)} + Z_1 - \beta \sqrt{P\ (1-P) + P(1-P)}\ ]^2$$
$$\frac{}{(P_1 - P_2)}$$

Relevant data using a proforma which included patient's name, age, sex, parental occupation and educational status, dietary history with particular emphasis on frequency of ingestion of protein – rich foods were collected from all children enrolled for the study. The socio-economic scores as well as social class (1-5) were given to each child based on the scores awarded to the occupation and educational qualification of each parent of a child as described by Ogunlesi et al.[12]

History of preceding illnesses within two weeks such as measles, diarrhoeal diseases and acute respiratory infections were recorded. Physical examination looking for skin changes, hair changes and oedema was carried out and also the anthropometric measurements.[8,9,10]

Approval for the study was obtained from ethical committee of Ahmadu Bello University Teaching hospital Zaria.

Four millilitres of venous blood were collected into a plain bottle from the patients and the sera were separated by centrifugation. The specimens were then frozen at – $20^{O}C$ until analysis. The pooled samples were analysed for total serum protein and albumin by Boehringer Mannheim Automated Hitachi System[13] in chemical pathology laboratory ABUTH, Zaria.

Obtained data was compiled and analysed using statistical package for social sciences (SPSS) version 15.4. Comparison of mean values was done using Student t-test and level of significance was set at p<0.05.

Results

A total of 66 each for the cases and age-matched controls were sampled for the study. The socio-demographic variables for both groups are as shown in table 1. Twenty six (39.4%) were males and 40 (60.6%) were females with a male: female ratio of 1:1.5 among cases while for the controls, 30 (45.5%) were males and 36 (54.5%) were females.

Among the cases, all were wasted, out of which 13 (19.7%), 9 (13.6%) and 44(66.7%) had mild, moderate and severe wasting. Similarly, all the cases were stunted with the severity ranging from mild, 11 (16.7%) moderate, 19 (28.8%) and severe, 36 (54.5%). All the controls had normal anthropometry.

Table 2 shows the nutritional status of the cases and controls. Among the cases, all were wasted, out of which 13 (19.7%), 9 (13.6%) and 44(66.7%) had mild, moderate and severe wasting. Similarly, all the cases were stunted with the severity ranging from mild, 11 (16.7%), moderate, 19 (28.8%) and severe, 36 (54.5%). All the controls were nutritionally normal.

Table 3 shows serum protein levels among cases and controls. Thirty-one (47.0%) of cases with wasting had low serum protein as compared to 1 (1.5%) of the controls. Similarly 31 (47.0%) of stunted cases had low serum protein as compared to 1 (1.5%) of the controls. There were statistical difference (P=0.0001) in serum

Table 1: Socio- demographics of the population, age, social class and educational levels distribution

Variables	Cases n (%)	Control n (%)	X^2	P value
Gender				
Males	26 (39.4)	30 (45.5)	0.49	0.48
Females	40 (60.6)	36 (54.5)		
Tribe				
Hausa	50 (75.7)	52 (78.8)		0.82*
Fulani	12 (18.3)	10 (15.2)		
Yoruba	2 (3.0)	3 (4.5)		
Others	2 (3.0)	1(1.5)		
Age				
6-12	18 (27.5)	18 (27.5)		1.000*
13-24	38 (57.5)	38 (57.5)		
25-36	6 (9.0)	6 (9.0)		
37-48	2 (3)	2 (3)		
49-59	2 (3)	2 (3)		
Social class				
I	1 (1.5)	3 (4.5)		0.09*
II	8 (12.2)	19 (28.7)		
III	19 (28.8)	12 (18.4)		
VI	28 (42.4)	22 (33.3)		
V	10 (15.1)	10 (15.1)		
Educational levels				
None	1 (1.5)	0 (0.0)		
Islamic	28 (42.4)	7 (10.6)	18.47	0.0009
Primary	10 (15.2)	13 (19.7)		
Secondary	25(37.9)	34 (51.5)		
Tertiary	2 (3.0)	12 (18.2)		

Table 2: Nutritional status of cases and controls

Nutritional status	Cases, n= 66	Controls, n=66
Normal	0 (0.0)	66 (100.0)
Wasting	66 (100.0)	
Mild	13 (19.7)	0 (0.0)
Moderate	9 (13.6)	0 (0.0)
Severe	44 (66.7)	0 (0.0)
Stunting	66 (100.0)	
Mild	11 (16.7)	0 (0.0)
Moderate	19 (28.8)	0 (0.0)
Severe	36 (54.5)	0 (0.0)

Table 3: Serum protein levels among cases and controls

Nutritional status	Serum protein levels (g/l) Low* n (%)	Normal# n (%)	Total n (%)	p value (fishers exact test)
Wasting	31 (47.0)	35 (53.0)	66 (100.0)	0.0001
Stunting	31 (47.0)	35 (53.0)	66 (100.0)	0.0001
Controls	1 (1.5)	65 (98.5)	66 (100.0)	

*Low serum protein = < 60g/l #Normal serum protein= 60 - 82g/

Table 4: Serum albumin levels among cases and controls

Nutritional status	Serum albumin (g/l) Low* n (%)	Normal# n (%)	Total n (%)	p value (Fishers exact test)
Wasting	16 (24.2)	50 (75.8)	66 (100.0)	0.0006
Stunting	16 (24.2)	50 (75.8)	66 (100.0)	0.0006
Controls	2 (3.0)	64 (97.0)	66 (100.0)	

*Low serum albumin = <25 g/l #Normal serum albumin= 25 – 30g/l

Discussion

In the present study, the serum protein and albumin values in all grades of PEM are significantly reduced than control. Lowering of these serum total protein and albumin values in PEM could be explained on the basis of generalized protein deficiency leading to impaired synthesis. These results are in agreement to that of other workers.[10,14-16] In the final stage of wasting, low plasma albumin concentration can appear because of diet deficiency in protein. In the development of marasmus, there occur deficiencies of energy in the diet reselling in the change of normal pattern.

It is also observed that reduction in serum albumin and total protein in PEM was due to reduced synthesis of protein because of inadequate intake of dietary protein. The prevalence of low serum protein levels obtained from malnourished patients were significantly lower than those obtained from non- malnourished patients, while there was statistically significant difference in serum protein between malnourished and non-malnourished children. Similarly, the concentrations of serum protein obtained from malnourished and non-malnourished children were statistically different. These results therefore demonstrate that serum protein was decreased in malnourished children.

The under-nutrition was confirmed with lowered levels of serum total protein and albumin levels in malnourished were significantly($p<0.05$) lowered than that of well nourished children. This is in agreement with the finding with Chowdbury et al 2008 in Bangladesh.[10] It could be due to reduced intake of protein rich diet resulting in reduced synthesis of protein.

Lowered serum total protein and albumin values in undernourished children could be explained on the basis of inadequate intake of dietary protein particularly first class protein, leading to impaired synthesis: at weaning, Only plain pap or fura which is mainly carbohydrate based was given to children 1-3times daily and only sugar, if only was added to the pap 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.

Conclusion

In conclusion, the serum total protein and albumin values in all grades of PEM are significantly reduced than control. The under-nutrition was confirmed with lowered levels of serum total protein and albumin levels in malnourished were significantly(<0.05) lowered than that of well-nourished children.

It is therefore recommended that a follow up study should be conducted in the area to re-analyse the serum protein level in children and compare the result with the rural 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.

Limitation of the study was the inability to estimate pre-albumin level which could have provided valuable information on nutritional status.

Acknowledgements

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