

## **Assessment of Plasma Levels of Proteins, Total Cholesterol and High Density Lipoprotein Cholesterol in Sudanese Malnourished Children**

**Sana Abd Elgany Yousif Fageer<sup>\*1</sup>, Tarig Ahmed Hassan Karar<sup>2</sup>, Sawda Mohammed Al Hag<sup>3</sup>**

\*1. Ministry of Health - White Nile State-Sudan. Email: sanafageer@yahoo.com

2. Clinical Chemistry Department, College of Medical Laboratory Science - Sudan University of Science and Technology.

3 Jazan, Kingdom of Saudi Arabia.

### **ABSTRACT**

This cross sectional study was conducted during the period from April to July 2012 on sixty (60) children under five years with malnutrition from Gaafer EbnAwf hospital and Omdrman teaching hospital for children in Khartoum state and sixty (60) apparently healthy children to determine and to assess the plasma levels of total protein, albumin, cholesterol and high density lipoprotein cholesterol in Sudanese malnourished children. Colorimetric methods were used with commercial kits from Biosystems and Spinreact companies for measuring plasma total protein, albumin, total cholesterol and high density lipoprotein cholesterol. Statistical Package for Social Science (SPSS version 11.5) computer software was used for data analysis. Results of this study indicated that, there was a significant decrease in the means of plasma levels of total protein ( $p = 0.004$ ), albumin ( $p = 0.000$ ), total cholesterol ( $p = 0.000$ ) and high density lipoprotein cholesterol ( $p = 0.000$ ) in three types of malnutrition diseases {marasmus (46), kwashiokor (6) and marasmic kwashiokor(8)} when compared with the control group ( $5.2 \pm 1.2$  g/dl) versus ( $5.8 \pm 0.9$  g/dl), ( $3.5 \pm 0.9$  g/dl) versus ( $4.5 \pm 0.7$  g/dl), ( $79.9 \pm 28.4$  mg/dl) versus ( $111.2 \pm 49.4$ mg/dl), ( $22.0 \pm 15.0$  mg/dl) versus ( $38.4 \pm 14.8$  mg/dl) respectively. Lowering of total protein levels being maximum in kwashiokor when compared with marasmus ( $p = 0.031$ ). There is insignificant difference ( $p = 0.118$ ) in plasma levels of albumin in edematous ( $3.1 \pm 0.9$  g/dl) when compared with non edematous malnourished children ( $3.6 \pm 0.9$  g/dl). So the edema in malnourished children was not solely due to hypoalbuminemia and kwashiokor was the most common type of malnutrition that needs monitoring. In conclusion, the present study indicated that, the plasma levels of total protein, albumin, total cholesterol and high density lipoprotein cholesterol are important markers for evaluation and assessment of malnourished children because there are significantly decreased in malnourished children. So these evaluations make these

malnourished children more controlled and decrease the mortality rate among them by determining the severity of malnutrition and give suitable doses for treatment.

### المستخلص

اجريت هذه الدراسة المقطعية في الفترة ما بين ابريل حتى يوليو 2012 على 60 طفلاً بعمر أقل من خمس سنوات مصابين بسوء التغذية في مستشفى جعفر بن عوف وام درمان التعليمي للاطفال بولاية الخرطوم و 60 طفلاً من الأصحاء تم إختيارهم كمجموعة ضابطة لتحديد وتقييم البروتين الكلي، الألبومين، الكولستيرول الكلي وكولستيرول البروتين الدهني عالي الكثافة في البلازما لدى الاطفال السودانيين المصابين بسوء التغذية. تم استخدام جهاز قياس الضوء بأجهزة تجارية من شركة Biosystem و شركة Spinreact التجاريتين لقياس البروتين الكلي، الألبومين، الكولستيرول و كولستيرول البروتين الدهني عالي الكثافة في البلازما. كما تم استخدام برنامج الحزمة الاحصائية للعلوم الاجتماعية (SPSS) لتحليل النتائج. أشارت نتائج هذه الدراسة الى نقصان ذي دلالة إحصائية في متوسطات مستويات بلازما البروتين الكلي(ب=0.004)، البيومين (ب=0.000)، الكولستيرول (ب=0.000) و كولستيرول البروتين الدهني عالي الكثافة (ب=0.000) في ثلاثة أنواع من أمراض سوء التغذية (المراسماس(46)، كواشيوكور(6) و المراسميك كواشيوكور(8)) من سوء التغذية عند مقارنتها مع المجموعة الضابطة (5.2±1.2 جرام/دل) مقابل (5.8±0.9 جرام/دل)، (3.5±0.9 جرام/دل) مقابل (4.5±0.7 جرام/دل)، (79.9± 28.4 ملجرام/ دل) مقابل (111.2±49.4 ملجرام/ دل)، (22.0±15.0 ملجرام/ دل) مقابل (38.4±14.8 ملجرام/ دل) على التوالي. النقصان في مستويات البروتين الكلي أقصاه كان في أنواع الكواشيوكور مقارنة بالمراسماس (ب=0.031)، ليس هنالك فرق ذي دلالة احصائية (ب=0.118) في متوسط مستوى بلازما الألبومين لدى الاطفال المصابين بسوء التغذية ولديهم وزمة (3.1±0.9 جرام/دل) مقارنة بالاطفال المصابين بسوء التغذية وليس لديهم وزمة (3.6±0.9 جرام/دل) لذا الوزمة لدى الاطفال المصابين بسوء التغذية ليست فقط نتيجة لنقصان الألبومين في الدم كما ظهر أن الكواشيوكور هو أكثر أنواع سوء التغذية الذي يحتاج الى متابعة. خلصت هذه الدراسة الى ان مستويات بلازما البروتين الكلي، الألبومين، الكولستيرول الكلي وكولستيرول البروتين الدهني عالي الكثافة مؤشرات مهمة لتقييم صحة الاطفال المصابين بسوء التغذية ذلك لوجود نقصان ذي دلالة احصائية عند الاطفال المصابين بسوء التغذية وهذه التقييمات تجعل الاطفال المصابين بسوء التغذية اكثر تحكماً ويقلل معدل الوفيات بينهم بتحديد خطورة سوء التغذية واعطاء الجرعات المناسبة للعلاج.

**KEYWORDS:** marasmus, marasmic kwashiokor, edematous.

### INTRODUCTION

Severe acute malnutrition remains a major killer of children under five years of age. The World Health Organization cites malnutrition as the greatest single threat to the world's public health. Decreasing child mortality and improving maternal health depend heavily on reducing malnutrition. Although the median under-five case-fatality rate for severe acute malnutrition typically ranges from 30% to

50%, it can be reduced substantially when physiological and metabolic changes are taken into account<sup>(1)</sup>.

Protein-energy malnutrition (PEM) is a global public health problem, affecting children from African, Asian, Latin American and Caribbean regions. PEM is directly or indirectly responsible for about half of the 10.8 million

deaths per year in children under five years in developing countries <sup>(2)</sup>.

Presently, the world produces enough food to feed the 6 billion inhabitants of the planet. Food production has increased by 25% over the past decade reaching a daily availability of 2,750 cal and 76 g of protein per person. Yet, under-nutrition affects close to a billion people, stunting and underweight affects close to 180 million children under 5 years of age, especially in South Asia and sub-Saharan Africa. Saharan Africa shows a rising prevalence of malnutrition <sup>(3)</sup>.

The three main clinical syndromes of severe childhood undernutrition (SCU) are marasmus, the non edematous syndrome, and the edematous syndromes kwashiorkor and marasmic kwashiorkor. Marasmus is relatively straight forward to treat and has a low mortality rate, but the edematous syndromes have more complex causes, are difficult to treat, and have high rates of morbidity and mortality <sup>(4)</sup>. In the modern age, malnutrition remains as a devastating problem in certain parts of the world, although the proportion and absolute number of chronically under-nourished people have declined. Under-nutrition is the most serious form of malnutrition and is universal among the poor families and nations resulting from consumption of poor diet over long periods of time <sup>(5)</sup>.

Malnutrition is generally a nutritional problem that results from varying proportions of protein and calorie deficiency in infants and young children of developing countries. Sudan being one of developing countries and malnutrition is widely distributed among children. The essence of nutritional assessment is to identify nutritional disorders and determine which individuals need nutritional instruction and or nutritional support. Malnutrition is an important public health problem; however, little information is available on assessment of severe acute malnutrition.

So it is very important to evaluate essential parameters as proteins and lipids. This study has been conducted to estimate the levels of total protein, albumin, total cholesterol and high density lipoprotein cholesterol in Sudanese malnourished children in addition to assess the correlation between age of patients with both total cholesterol and high density lipoprotein cholesterol.

### **MATERIALS and METHODS**

A cross-sectional study was conducted during the period from April to August 2012 to determine and to evaluate the plasma levels of total protein, albumin, cholesterol and high density lipoprotein in Sudanese malnourished children. Sixty Sudanese malnourished children were selected as a test group from Gaafer EbnAwf Hospital and Omdrman Teaching Hospital for children in Khartoum State. Their mean age was 27.4 months (up to five years). The test group was compared with a control group which included sixty apparently healthy volunteers; their mean age was 36.8 months (up to five years).

Detailed history including birth history, past and present infections, treatment history and socio-economic status of both the groups were taken and other demographic data questionnaire was conducted.

Permission on of this study was obtained from the local authorities in the area of the study. The objectives of the study were explained to the local authorities in the area of the study and to all individuals in the study.

A written consent was obtained from all parents of participants in this study.

Inclusion criteria: children had protein energy malnutrition up to five years as test group and apparently health children as control group up to five years with normal weight and growth attending several hospitals for checkup.

Exclusion criteria: children without malnutrition, adult patients with malnutrition and children with liver disease or chronic diseases.

### **Sample collection, separation and preservation**

The patient and his/her attendants were given a detailed briefing about the purpose of the study. With all aseptic precautions 5 ml of venous blood had been collected from each child with malnutrition and controls without fasting using a disposable sterile plastic syringe and voided into a container with heparin anti coagulant immediately after collection. Plasma was separated from blood cells after centrifugation for 10 minutes at 5000 r.p.m (round per minute) at room temperature. The separated plasma was kept at  $-20^{\circ}\text{C}$  in vials till used for analysis.

### **Analytical procedure**

Plasma total protein, albumin, total cholesterol and high density lipoprotein cholesterol were estimated by colorimetric technique.

Estimation of total protein, albumin, total cholesterol and high density lipoprotein cholesterol (HDL.c) were performed by using Biuret method, Bromo Cresol Green (BCG) method, enzymatic method and Polyethylene Glycol-CHOD-PAP method respectively <sup>(6-9)</sup>.

### **Statistical analysis**

All data were expressed as mean  $\pm$  SD, t. test was used for comparison of groups. Statistical analysis was done using SPSS 11.5. P-value  $\leq 0.05$  was considered significant and  $\leq 0.001$  was taken as highly significant.

### **Quality control**

The precision and accuracy of all methods used in this study were checked with each batch of analysis by commercial prepared control sera.

### **RESULTS**

This study was conducted during the period of April to July 2012 study included sixty (60) children under five years with protein energy malnutrition and sixty (60) apparently health children matched age to measure plasma levels of proteins, total cholesterol and high density lipoprotein cholesterol. 95% (n = 57) of patients had low socio economic status and 5% (n = 3) had medium socio economic status based on medical analysis of physicians, 15%

(n = 9) of patients had edema, while 77% of the patients (n = 46) had marasmus, 10% had kwashiokor (n = 6) and 13% had marasmic kwashiokor (n = 8).

In the present study, males were 48% (n = 29) of the test group and 65% (n = 39) of the control group, while female account 52% (n = 31) from test group and 35% (n = 21) from the control group. The malnourished children aged more than 24 months were 11.7% (n = 7) and less than 24 months account 88.3% (n = 53).

Table (1) shows a significant difference between the mean of weight in study group and control group ( $6.2 \pm 1.1 \text{Kg}$ ) versus ( $9.3 \pm 3.1 \text{Kg}$ ) and there is significant difference (p = 0.000) between the mean of Z. Score weight for age in study group and control group ( $-4.3 \pm 1.2$ ) versus ( $-1.4 \pm 1.5$ ) (p = 0.000).

Table (2) shows a significant difference between the means of plasma levels of total protein, albumin, total cholesterol and high density lipoprotein cholesterol in study group and control group ( $5.2 \pm 1.2 \text{ g/dl}$ ,  $3.5 \pm 0.9 \text{ g/dl}$ ,  $79.9 \pm 28.4 \text{ mg/dl}$  and  $22.0 \pm 15.0 \text{ mg/dl}$ ) versus ( $5.8 \pm 0.9 \text{ g/dl}$ ,  $4.5 \pm 0.7 \text{ g/dl}$ ,  $111.2 \pm 49.4 \text{ mg/dl}$  and  $38.4 \pm 14.8 \text{ mg/dl}$ ) respectively (p < 0.05).

Table (3) shows insignificant difference between the means of plasma levels of albumin in edematous and non edematous malnourished children ( $3.1 \pm 0.9 \text{ g/dl}$ ) versus ( $3.6 \pm 0.9 \text{ g/dl}$ ) (p = 0.118).

Table (4) shows a significant difference between the means of plasma levels of total protein in children with marasmus and children with kwashiokor ( $5.4 \pm 1.0 \text{ g/dl}$ ) versus ( $4.3 \pm 1.8 \text{ g/dl}$ ) (p = 0.031), whereas plasma levels of albumin, total cholesterol and high density lipoprotein cholesterol had no significant difference between these two groups. Also there was insignificant difference of plasma levels of total protein, albumin, total cholesterol and high density lipoprotein cholesterol between marasmus and marasmic kwashiokor and also between kwashiokor and marasmic kwashiokor.

Figure (1) shows insignificant correlation between age in months and plasma levels of

total cholesterol in mg/dl among the test group ( $p = 0.066$ ). Figure (2) shows insignificant correlation between age in months and plasma

levels of high density lipoprotein cholesterol in mg/dl among the test group ( $p = 0.057$ ).

*Table 1: Comparison of base-line characteristic of test group and control group*

Variable	Test group (n = 60)	Control group (n = 60)	p-value
Age (months)	18.1 ± 9.3	20.4 ± 16.4	0.345
Weight (kg)	6.2 ± 1.1	9.3 ± 3.1	0.000**
Z. score weight /age	-4.3 ± 1.2	-1.4 ± 1.5	0.000**

- The table shows the mean ± Std. deviation in brackets and probability (P).
- Independent t- test was used for comparison.
- \*  $p < 0.05$  (Significant); \*\*  $p < 0.001$  (Highly significant)

*Table 2: Comparison of means of the plasma levels total protein, albumin, total cholesterol and HDL.c of the test group and the control group*

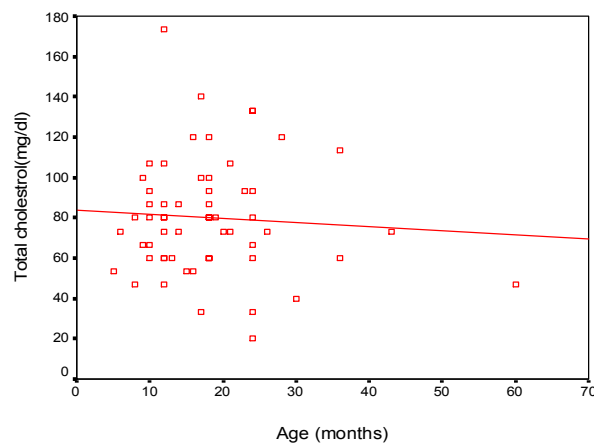
Variable	Test group	Control group	p-value
T. protein (g/dl)	5.2 ± 1.2	5.8 ± 0.9	0.004*
Albumin (g/dl)	3.5 ± 0.9	4.5 ± 0.7	0.000**
T.cholesterol (mg/dl)	79.9 ± 28.4	111.2 ± 49.4	0.000**
HDL.c (mg/dl)	22.0 ± 15.0	38.4 ± 14.8	0.000**

*Table 3: Comparison of means of the plasma levels of albumin between edematous and non edematous malnourished children*

Variable	edematous (n = 9)	Non edematous (n = 51)	p-value
Albumin (g/dl)	3.1 ± 0.9	3.6 ± 0.9	0.118

*Table 4: Levels of significant (p value) for the comparison of pairs of the three groups of PEM children (M: marasmus, K: kwashiokor and MK: marasmic kwashiokor)*

Group compared	Plasma total protein (g/dl)	Plasma albumin (g/dl)	Plasma total cholesterol (mg/dl)	Plasma HDL (mg/dl)
M & K	0.031 *	0.138	0.324	0.245
M & MK	0.628	0.298	0.295	0.332
K & MK	0.402	0.672	0.589	0.115



*Figure 1: The relationship between the age and the plasma levels of total cholesterol among the test group ( $r = - 0.616$ ,  $P = 0.066$ )*

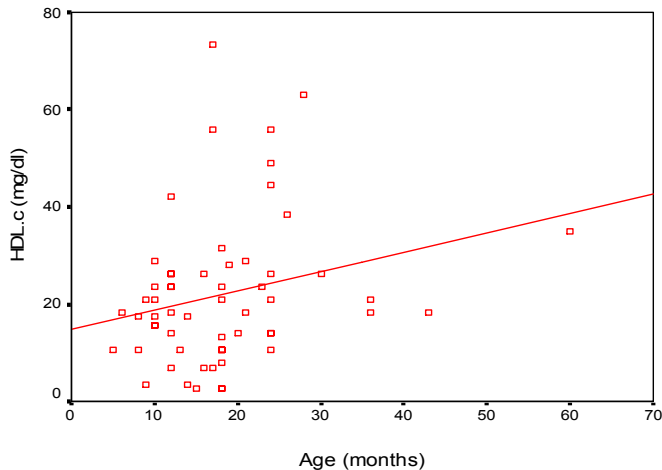


Figure 2: The relationship between the age and the plasma levels of high density lipoprotein cholesterol among test group ( $r=0.247$ ,  $P= 0.057$ )

## DISCUSSION

Protein-energy malnutrition (PEM) is a major public health problem affecting a high proportion of infants and older children worldwide and accounts for a high childhood morbidity and mortality in the developing countries<sup>(1)</sup>. In the present study there was 95% of patients with low socio economic status, 5% of patients had medium socio economic status. This result was concordance with the results reported by Sadaf, *et al.*<sup>(10)</sup>. In this study malnutrition was more common in the age group less than 24 months (80%) when compared with children more than 24 months (20%). This agrees with the results obtained by Sadaf, *et al.* who indicated that loss of weight was more rapid and that children below 23 months of age suffered more frequently from serious illnesses<sup>(10)</sup>.

In this study there was a significant decrease in the mean of body weight of the test group when compared with the control group ( $p = 0.000$ ). This result agrees with the results of Sadaf, *et al.* and Oladunni, *et al.*<sup>(10,11)</sup>. In the present study there was a significant decrease ( $p=0.000$ ) between the means of Z. score

weight for age in the study group and control group ( $-4.3\pm 1.2$ ) versus ( $-1.4\pm 1.5$ ). The study group was considered severely underweight or stunting by WHO<sup>(12)</sup>. From these data there was a significant decrease in the means of plasma levels of total protein in test group when compared with the control group ( $p = 0.004$ ) and this was due to insufficient nutrition. These results are similar to results obtained by Chatterjee *et al.*, Ibrahim, *et al.*, Hsoro, *et al.*<sup>(13-15)</sup>.

The present data demonstrated that there was a significant decrease ( $p = 0.000$ ) in the means of plasma levels of albumin when compared with control group due to insufficient nutrition too. These results agreed with results of Rahman, Begum and Serajul, *et al.*<sup>(16, 17)</sup>. In the present study there was insignificant difference ( $p = 0.118$ ) between the means of plasma levels of albumin in edematous and non edematous malnourished children. This result is compatible with results of Morlese, *et al.*

These results suggested that the edema of was not the only cause of hypoalbuminemia<sup>(18)</sup>.

In this study there was a significant difference ( $p = 0.000$ ) between the means of plasma levels of total cholesterol of test group and control group this results agreed with that of Akuyam, *et al.*<sup>(19)</sup>.

In the current study there was a significant difference ( $p = 0.000$ ) between the means of plasma levels of high density lipoprotein cholesterol and control group. This result agrees with the result of Akuyam, *et al.*<sup>(19)</sup>.

There was a significant ( $p = 0.031$ ) increase the means of plasma levels of total protein in children with marasmus than children with kwashiorkor. this result agrees with the result of Oladunni, *et al.* The main cause of kwashiorkor type is the low intake of proteins and in marasmus type the cause is the low intake of all parts of nutrition<sup>(11)</sup>.

In this study there was insignificant difference ( $p > 0.05$ ) between the means of plasma levels of total protein in children with marasmus when compared with marasmic kwashiorkor and children with kwashiorkor when compared

with marasmic kwashiorkor. This result disagrees with Oladunni, *et al.* Also there was insignificant difference ( $p > 0.05$ ) between the means of plasma levels of albumin, total cholesterol and high density lipoprotein cholesterol when comparing pairs of three types of malnourished children (marasmus, kwashiorkor and marasmic kwashiorkor) these results were disagree with Oladunni, *et al.* (1982), these results may be vary with different population of caparisoned study (Nigerian)<sup>(11)</sup>. In conclusion, malnourished children, plasma levels of total protein, albumin, total cholesterol and high density lipoprotein cholesterol in three types of protein energy malnutrition were lower than control group, lowering of total protein levels being maximum in kwashiorkor type more than marasmus. On the other hand, there was insignificant difference in plasma level of albumin in edematous when compared with non-edematous malnourished children.

## REFERENCES

1. [http://who.int/nutrition/publications/en/manage\\_severe\\_malnutrition\\_eng](http://who.int/nutrition/publications/en/manage_severe_malnutrition_eng), (retrieved Jan. 2007).
2. Kazeem AO, and Idowu OS. (2009). Pathophysiological changes that affect drug disposition in protein-energy malnourished children. *Nutrition & Metabolism Journal* **6**:50-53.
3. Gerardo W, Magdalena A, Ann H, and Ricardo U. (2008). Prevention and Control at the National Level. *Childhood Malnutrition Journal* **20**(9):143-151.
4. Farook J, Asha B, Marvin R, and Terrence F. (2006). Sulfur amino acid metabolism in children with severe childhood undernutrition, methionine kinetics. *American Journal of Clinical Nutrition* **82**(4):792-800.
5. Muhamad SA, Nighat B, Hina A, and Sadaf H. (2005). Nutritional Status of Pre-Schooling Children of Different Socio-Economic Statuses as Influenced by Various Diseases. *Medical Journal of Islamic World Academy of Sciences* **15**(3):95-104.
6. Gornall AG, Bardawill CS and David MM. (1949). Determination of serum proteins by means of the Biuret reaction. *Journal of chemical biology* **177**:751-766.
7. Doumas BT. (1972). Standard methods of Clinical Chemistry, *Journal of Academic Press of Chicago* **7**:173-175.
8. Allain CC, Poon LS, Chan SG, Richmond W, and Fu PC. (1974). Enzymatic determination of total serum cholesterol. *Journal of Clinical Chemistry* **20**:470-475.
9. Burstein M, Scholnick HR, and Morfin R. (1980). Rapid method for the isolation of lipoproteins from human serum by precipitation



- with polyanions. *Scand Journal of Clinical Laboratory Investigation* **40**:583-595.
10. Sadaf HM, Tariq JM, Nighat B, Hina A, and Shazia A (2001). Levels of Serum Total Proteins and Fractions along with Serum Cu, Fe and Zn in Diseased Malnourished Children of 0-4 Years of Age. *Journal of Medical Sciences* **1**:282-287.
11. Oladunni G, Agbedana EO, and Johnson AK. (1982). High Density Lipoprotein-Cholesterol in Protein-Energy Malnutrition. *British Journal of Nutrition* **41**:489-494.
12. <http://who.int/nutgrowthdb/about/introduction/en/index5.html> (retrieved May 2012).
13. Chatterjee K, and Chaudhuri J. (1960). Serum Lipids in Malnutrition of Children. *Indian Journal of Pediatrics* **28**(5):195-202.
14. Ibrahim SA, Eltom AM, Abdul-Rahman AM, and Saeed B. (1994). Correlation of Some Biochemical Parameters with Clinical Features of Protein Energy Malnutrition. *East African Medical Journal* **71**(2):77-83.
15. Hsoro CO, Udoh AE, and Ntui I. (2002). Biochemical Changes in Serum of Protein Energy Malnourished Children Following Dietary Protein Repletion. *Global Journal of Pure and Applied Sciences* **9**(1):43-46.
16. Rahman MZ, and Begum BA. (2005). Serum Total Protein, Albumin and A/G Ratio in Different Grades of Protein Energy Malnutrition. *Mymensingh Medical Journal* **14**(1):38-40.
17. Serajul IC, Nayeema A, Mahmudul H, Rehana A, and Nazibun N. (2008). Serum Total Protein and Albumin Levels in Different Grades of Protein Energy Malnutrition. *Journal of Bangladesh Society of Physiologist* **(3)**:58-60.
18. Morlese JF, Forrester T, Badaloo A, Del Rosario M, Frazer M and Jahoor F. (1996). Albumin Kinetics in Edematous and Nonedematous Protein-Energy Malnourished Children. *American Journal of Clinical Nutrition* **64**(6):952-959.
19. Akuyam A, Isah HS, and Ogala WN. (2008). Serum Lipid Profile in Malnourished Nigerian Children in Zaria. *Niger Postgrad Medical Journal* **15**(3):192-196.