

### Original Contribution

- 222 Quality of Life in Patients with Major Depressive Disorder  
Imam MA, Salam MA, Algin S, Ali M
- 229 Methicillin-Resistant Coagulase-Negative Staphylococci (MRCoNS) by Disk Diffusion Method  
Rahman A, Hossain MA, Paul SK, Sultana S, Haque N, Kabir MR, Hoque SM
- 232 Surgical Outcome of Laparoscopic and Open Surgery of Pediatric Inguinal Hernia  
Saha N, Biswas I, Rahman MA, Islam MK
- 237 Single Layer Gastro-intestinal Anastomosis in Gastric Cancer Surgery  
Khair MA, Uddin MA, Khanam F, Bhuiyan MR, Reza E, Rahman MH, Shawon MR
- 241 Pattern of Poisoning in a Tertiary Level Hospital  
Khan NA, Rahman A, Sumon SM, Haque MF, Hasan I, Sutradhar SR, Barman TK, Rahman S, Ferdous J, Miah AH, Alam MK, Debnath CR, Islam MZ, Miah OF
- 248 Assessment of Anaemia in Patients with Rheumatoid Arthritis  
Bari MA, Sutradhar SR, Sarker CN, Ahmed S, Miah AH, Alam MK, Hasan MJ, Tariquzzaman M, Shamsi S
- 255 Ultrasound Evaluation of Traumatic Patient in a Tertiary Level Hospital  
Ara R, Khan N, Chakraborty RK, Rima SZ, Nahar N, Islam SM, Mahmud S, Hossain GA, Islam S, Uddin F
- 261 Impact of Metabolic Syndrome in Acute Myocardial Infarction at Hospital  
Islam MS, Bari MA, Paul GK, Islam MZ, Rahman MZ, Hoshneara M, Karim MA, Nabi MN, Pandit H
- 267 Nutritional Status among Primary School Children of Mymensingh  
Hasan MM, Hoque MA, Hossain MA, Mollah AH, Islam MN, Ahsan MM, Chowdhury B
- 275 Iron Status in Children with Febrile Seizure  
Choudhury MA, Zaman M, Mollah AH, Hoque MA, Fatmi LE, Islam MN, Bhuiyan KJ, Hossain MA
- 281 Sphincter Saving Surgery is the Standard Procedure for Treatment of Low Rectal Cancer  
Rahman MS, Khair MA, Khanam F, Haque S, Alam MK, Haque MM, Salam MA, Sikder AH
- 289 Comparison of Trabeculectomy with Mitomycin-C Versus Medical Treatment in Moderate Stage of Steroid Induced Glaucoma  
Khan N, Khaleque MA, Hossain MS, Islam MS, Uddin MS
- 296 Parathyroid Failure Following Thyroid Surgery  
Biswas AK, Rahman SH, Siddiquee BH, Datta PG, Haque MA, Mondol SK, Razib FA, Biswas G, Dutta UK
- 300 Cough in Systemic Lupus Erythematosus  
Azad AK, Islam N, Islam MA, Islam MS, Barua R, Haq SA
- 308 Aetiology and Risk Stratification of Patients Presenting with Atrial Fibrillation  
Islam MS, Mahmood M, Safiuddin M, Siddique MA, Banerjee SK, Islam MN, Azad AK, Arafat SM, Rumki RS

*Content continued on  
inside front cover*

*Published by*  
**Mymensingh Medical College, Bangladesh**

## Serum Zinc, Copper, Magnesium & Phosphorus Level in Children with Severe Acute Malnutrition (SAM)

\*Chowdhury B<sup>1</sup>, Hoque MA<sup>2</sup>, Hossain MA<sup>3</sup>, Chowdhury AM<sup>4</sup>, Islam MN<sup>5</sup>, Khaleque MA<sup>6</sup>, Ali MA<sup>7</sup>, Khan MR<sup>8</sup>, Bhuiyan RK<sup>9</sup>, Hasan MM<sup>10</sup>, Akhtaruzzaman M<sup>11</sup>, Akhter H<sup>12</sup>

Malnutrition is widely prevalent among hospitalized children in most developing countries including Bangladesh. Though malnutrition accounts for the high rate of under 5 mortality sometimes it is overlooked. Keeping in this in mind A comparative cross sectional study was done in Mymensingh Medical College Hospital from 1<sup>st</sup> October 2009 to 31<sup>st</sup> May 2011. Children aged 1-5 years with presence of one or more criteria WHM <70%, WHZ-score <-3SD, Bipedal edema & Mid upper arm circumference <110mm were taken as study group and children aged 1-5 years with normal growth allowable normal range of variation is between 3<sup>rd</sup> and 97<sup>th</sup> centile curve or median (50<sup>th</sup> centile)  $\pm$ 2SD of weight for age growth chart (CDC growth chart, USA, 2000) were taken as reference group. Persistent diarrhea, Patients taking medications containing zinc, copper, magnesium, phosphorus & calcium, PEM with shock were excluded from study group. Nutritional assessment was done according to WHO criteria of SAM. Serum Zinc, Copper Magnesium and Phosphorus level were determined by Atomic Absorption Spectrometry using UNICAM - AA Spectrometer, model no. 969, Spain. Total 120 study populations were taken. Ninety Out of 120 were taken as a study group (SAM) & 30 were reference group. In reference group serum Zn, Cu, Mg, P value was 103.80 $\pm$ 8.86 $\mu$ g/dl, 135.92 $\pm$ 13.57 $\mu$ g/dl, 2.31 $\pm$ 0.18mg/dl, 3.96 $\pm$ 0.22mg/dl respectively. In study group serum Zn, Cu, Mg, P value was 60.33 $\pm$ 11.08 $\mu$ g/dl, 80.60 $\pm$ 15.46 $\mu$ g/dl, 1.47 $\pm$ 0.22mg/dl, 2.00 $\pm$ 0.52mg/dl respectively. All these results show that there is significant difference between study group & reference group. Considering the decreased level of these parameters, close biochemical monitoring and follow up should be emphasized for the children with SAM.

[Mymensingh Med J 2016 Oct; 25 (4): 635-640]

**Key words:** Serum zinc, Copper, Magnesium, Phosphorus, Severe acute malnutrition (SAM)

### Introduction

Protein-energy malnutrition is a syndrome resulting from interaction between poor diets and diseases, leading to anthropometric deficits and generally with deficits in micronutrients<sup>1</sup>. Nutritional deprivation is a serious international problem that can lead to long term deficits in growth, immune function, cognitive and motor development, behavior and academic performance<sup>2</sup>. Globally, nutritional status is considered the best indicator of the well-being of young children and a parameter for monitoring progress towards the Millennium Development Goals (MDGs), especially MDG1. According to the state of the World's Children (SOWC) Report 2008, issued by the UN Children's Fund (UNICEF), eight million or 48% of all children under-five are underweight<sup>3</sup> and 13% of under 5 suffering from severe under nutrition<sup>4</sup>. Child malnutrition is prevailed in Bangladesh, with nearly one-half of all children below the age of five years being either underweight or stunted<sup>5</sup>.

Trace element deficiencies are common in children with protein energy malnutrition and as a result they may suffer from various nutrient specific

1. \*Dr Biswajit Chowdhury, Resident Physician/Junior Consultant, Pediatrics, Mymensingh Medical College Hospital, Mymensingh, Bangladesh
2. Professor Md Azizul Hoque, Ex-Head of Department, Pediatrics, Mymensingh Medical College (MMC), Mymensingh, Bangladesh
3. Professor Dr Md Anwar Hossain, Professor & Head, Department of Neonatology, MMC, Mymensingh, Bangladesh
4. Dr Ahmed Murtaza Chowdhury, Associate Professor, Department of Paediatric Hemato-oncology, MMC, Mymensingh, Bangladesh
5. Dr Md Nazrul Islam, Assistant Professor, Department of Neonatology, MMC, Mymensingh, Bangladesh
6. Dr Md Abdul Khaleque, Consultant, Pediatrics, UHC, Iswarganj, Mymensingh, Bangladesh
7. Dr Md Ayub Ali, Associate Professor, Department of Neonatology, Mymensingh Medical College (MMC), Mymensingh, Bangladesh
8. Dr Md Rakibul Hoque Khan, Assistant Professor, Department of Neonatology, MMC, Mymensingh
9. Dr Rusdul Karim Bhuiyan, Assistant Professor, Department of Paediatric Nephrology, MMC
10. Dr Mohammad Mahmudul Hasan, Consultant Paediatrics, UHC, Phurbo Dhala, Netrokona
11. Dr Md Akhtaruzzaman, Consultant Paediatrics, UHC, Trishal, Mymensingh, Bangladesh
12. Dr Hamida Akhter, Assistant Professor, Department of Gynae & Obs, MMC, Mymensingh, Bangladesh

\*for correspondence

deficiency disorders. In Malnourished children all the micronutrients specially zinc, copper, magnesium & phosphorus are decreased. They cause specific deficiency syndromes in malnourished children which ultimately increased the morbidity & mortality of under five children in our country. Serum studies on the role of micronutrients in severe acute malnutrition are being done in the different developing countries. Zinc and copper are essential nutrients for human beings as they are required for the functional activity of several enzyme systems<sup>6</sup>. It is important for the structure and function of membranes, the metabolism of essential fatty acids and immune competence<sup>7</sup>. Copper deficiency in infants fed exclusively on milk clinically manifest with anaemia, neutropenia, variable skeletal changes inclusive of osteoporosis, enlargement of the costochondral cartilage, cupping and flaring of long bones, metaphyses, spontaneous rib fractures and scurvy like bone changes<sup>8</sup>. Magnesium is the second most common intracellular cation in the body and plays an essential role in numerous cellular reactions. Its depletion in malnourished children may remain asymptomatic or may produce symptoms such as tremors, athetoid movements, seizures and psychomotor changes<sup>9</sup>. Phosphorus is an important component of body tissue and is necessary for normal functioning of blood cells, muscle and nerves<sup>10</sup>.

So the current study was done to estimate the level of serum Zn, Copper, Mg & phosphorus in children of severe acute malnutrition in a tertiary level hospital & as to compare their level in malnourished children that of healthy children.

### Methods

Total 150 children of one to five years of age were included in this study. Subjects were divided into Reference group (n=60) children with normal growth, weight for age between 3<sup>rd</sup> and 97<sup>th</sup> centile curve or median (50<sup>th</sup> centile)  $\pm 2SD$  of CDC growth chart<sup>11</sup> and Children having PEM (n =120) with MUAC <110mm or weight for height median <70% or weight for height Z score <-3SD & or bipedal edema<sup>12</sup>. Group II was subdivided into three groups according to Wellcome classification of PEM and clinical features: Group IIA: Marasmus (n=30), Group IIB: Kwashiorkor (n=30)

and Group IIC: Marasmic kwashiorkor (n = 30). Sixty (60) well nourished apparently healthy children were included in the reference group and ninety (90) children with severe acute malnutrition (based on clinical findings & anthropometric parameters) admitted in the Pediatrics wards of Mymensingh Medical College Hospital were included in the study group. Blood samples were collected in the morning from admitted and outdoor subjects with all aseptic precautions. By taking all aseptic precautions from each subject 5 ml of blood was collected from median ante-cubital vein by disposable syringe. Serum Zinc, Copper Magnesium and Phosphorus were the determined by Atomic Absorption Spectrometry using UNICAM – AA Spectrometer, model no. 969, Spain in Professor Mohammad Hossain central laboratory Bangladesh Agricultural University. Informed consent of the parents was taken.

### Results

Total 120 subjects were included in the present study. Subjects were classified into two different groups. Group I was comprised of 30 children as reference group (healthy children without PEM with normal growth). Group II included 90 children with severe acute malnutrition (SAM).

Group II was subdivided into three groups-IIA: Marasmus (n=30), IIB: Kwashiorkor (n=30) and IIC: Marasmic kwashiorkor (n=30) (Wellcome classification). Finally 120 samples of blood (90 from study group and 30 from reference group) were subjected to biochemical analysis. Serum magnesium and phosphorus were expressed in mg/dl and serum zinc and copper were expressed in  $\mu\text{g}/\text{dl}$ .

Mean $\pm$ SD of serum zinc, Cu, Mg & phosphorus of Group I were found  $103.79\pm 8.86 \mu\text{g}/\text{dl}$ ,  $135.92\pm 13.57 \mu\text{g}/\text{dl}$ ,  $2.31\pm 0.18 \text{ mg}/\text{dl}$  and  $3.96\pm 0.22 \text{ mg}/\text{dl}$  respectively and comparing to the result of Group II mean $\pm$ SD serum Zn -  $60.33\pm 11.08 \mu\text{g}/\text{dl}$ , Cu -  $80.60\pm 15.46 \mu\text{g}/\text{dl}$ , Mg -  $1.47\pm 0.22 \text{ mg}/\text{dl}$ , Phosphorus -  $2.00\pm 0.52 \text{ mg}/\text{dl}$  shown in Table I. Difference between this two groups were found statistically significant (Level of significance  $p < 0.05$ ).

Table I: Comparison of mean±SD serum zinc, copper, magnesium and Phosphorus in Group I and Group II (n=120)

Biochemical variables	Group I (n=30) Mean±SD	Group II (n=90) Mean±SD	P value
Zinc (µg/dl)	103.80±08.86	60.33±11.08	<0.001
Copper (µg/dl)	135.92±13.57	80.60±15.46	<0.001
Magnesium (mg/dl)	02.31±00.18	01.47±00.22	<0.001
Phosphorus (mg/dl)	03.96±00.22	02.00±00.52	<0.001

Unpaired "t" test was done between Group I and Group II.

Table II: Comparison of Mean serum zinc, copper, magnesium and Phosphorus in Group I and Group IIA (n=30)

Biochemical variables	Group I (n=30) Mean±SD	Group IIA (n=30) Mean±SD	P value
Zinc (µg/dl)	103.79±08.86	62.70±08.90	<0.001
Copper (µg/dl)	135.92±13.57	84.77±08.27	<0.001
Magnesium (mg/dl)	02.31±00.18	01.34±00.21	<0.001
Phosphorus (mg/dl)	03.96±00.22	01.62±00.48	<0.001

Unpaired "t" test was done between group I and group IIA

Mean±SD of serum zinc, Cu, Mg & phosphorus of Group I were found 103.79±8.86, 135.92±13.57, 2.31±0.18mg/dl and 3.96±0.22mg/dl respectively and comparing to the result of Group IIA mean±SD serum Zn - 62.70±8.90µg/dl, Cu - 84.77±8.27µg/dl, Mg - 1.34±0.21mg/dl, Phosphorus - 1.62±0.48mg/dl shown in Table II. Differences between these two groups were found statistically significant (Level of significance p <0.001).

Table III: Comparison of Mean serum zinc, copper, magnesium and Phosphorus in Group I and Group IIB (n=30)

Biochemical variables	Group I (n=30) Mean±SD	Group IIB (n=30) Mean±SD	P value
Zinc (µg/dl)	103.79±08.86	51.26±09.83	<0.001
Copper (µg/dl)	135.92±13.57	65.01±12.65	<0.001
Magnesium (mg/dl)	02.31±00.18	01.51±00.16	<0.001
Phosphorus (mg/dl)	03.96±00.22	02.30±00.34	<0.001

Unpaired "t" test was done between Group I and Group IIB.

Mean±SD of serum zinc, Cu, Mg & phosphorus of Group I were found 103.79±8.86µg/dl, 135.92±13.57µg/dl, 2.30±0.18mg/dl and 3.96±0.22mg/dl respectively and comparing to the result of Group IIB mean±SD serum Zn - 51.26±9.83µg/dl, Cu - 65.01±12.65µg/dl, Mg - 1.51±0.16mg/dl, Phosphorus - 2.30±0.34mg/dl shown in Table III. Difference between these two groups was found statistically significant (Level of significance p <0.001).

Table IV: Comparison of Mean serum zinc, copper, magnesium and Phosphorus in Group I and Group IIC (n=30)

Biochemical variables	Group I (n=30) Mean±SD	Group IIC (n=30) Mean±SD	P value
Zinc (µg/dl)	103.80±08.86	67.03±07.97	<0.001
Copper (µg/dl)	135.92±13.57	92.02±10.06	<0.001
Magnesium (mg/dl)	02.31±00.18	01.55±00.23	<0.001
Phosphorus (mg/dl)	03.96±00.22	02.09±00.48	<0.001

Unpaired "t" test was done between group I and group IIC

Mean±SD of serum zinc, Cu, Mg & phosphorus of Group I were found 103.79±8.86µg/dl, 135.92±13.57µg/dl, 2.30±0.18mg/dl and 3.96±0.22mg/dl respectively and comparing to the result of group IIC mean±SD serum Zn - 67.03±7.97µg/dl, Cu - 92.02±10.06µg/dl, Mg - 1.55±0.23mg/dl, Phosphorus - 2.09±0.48mg/dl shown in Table VI. Difference between this two groups were found statistically significant (Level of significance p <0.001).

### Discussion

This study was designed as comparative cross sectional one for better comparison of different biochemical alterations. The reference group (Group I) was comprised of healthy children without SAM with normal growth. Allowable normal range of variation in observation was between 3<sup>rd</sup> and 97<sup>th</sup> centile curves or median (50<sup>th</sup> centile) ±2SD of weight for age growth chart<sup>11</sup>.

In this study, we estimated serum zinc level in different groups of children. Corresponding mean±SD of Group I, Group IIA, Group IIB, Group IIC and Group II were 103.79±8.86µg/dl, 62.70±8.90µg/dl, 51.26±9.83µg/dl, 67.03±7.97µg/dl and 60.33±11.08µg/dl respectively. The values in all of PEM groups were significantly lowered when compared with reference group. This present finding is supported by different studies<sup>6,13,14,15</sup>. But in another study in Tanzania, found no significant difference in serum zinc levels between the control and the children with PEM<sup>8</sup> which is not consistent with our study. There is a possibility of taking any traditional food rich in zinc by the mothers of the children with PEM or the children themselves, and the children may therefore be provided with sufficient zinc. This may be the cause of normal serum zinc level in the children with PEM in this study.

In this study, we estimated serum copper level in different groups. Corresponding mean±SD of Group

I, Group IIA, Group IIB, Group IIC and Group II were 135.92±13.57µg/dl, 84.77±8.27µg/dl, 65.01±12.65µg/dl, 92.02±10.06µg/dl and 80.60±15.46µg/dl respectively. All the values of PEM groups were significantly lower when compared with the control. Our finding is supported by the several studies<sup>6,8,13,14,16</sup>.

In this study, we estimated serum magnesium level in different groups. Corresponding mean±SD of Group I, Group IIA, Group IIB, Group IIC and Group II were 2.31±0.18mg/dl, 1.34±0.21mg/dl, 1.51±0.16mg/dl, 1.55±0.23mg/dl and 1.47±0.22mg/dl respectively. The values of serum magnesium in all PEM groups were significantly lowered when compared with the control. Our finding is in agreement with the results of Linder et al.<sup>17</sup> Caddel et al.<sup>18</sup>, Praharaj et al.<sup>19</sup> and Singla et al.<sup>6</sup>.

In the present study, we also estimated the serum phosphorus level in different groups of children. Corresponding mean±SD of Group I, Group IIA, Group IIB, Group IIC and Group II were 3.96±0.22mg/dl, 1.62±0.48mg/dl, 2.30±0.34mg/dl, 2.09±0.48mg/dl and 2.00±0.52mg/dl respectively. All the values of PEM groups were significantly lowered when compared with control. Our finding is in agreement with the studies of Kalra et al.<sup>20</sup> Freiman et al.<sup>21</sup> and Waterlow et al.<sup>22</sup>.

After comparing zinc level in kwashiorkor is lowest & significantly lower in kwashiorkor than

Table I: Comparison of mean±SD serum zinc, copper, magnesium and Phosphorus in Group I and Group II (n=120)

Biochemical variables	Group I (n=30) Mean±SD	Group II (n=90) Mean±SD	P value
Zinc (µg/dl)	103.80±08.86	60.33±11.08	<0.001
Copper (µg/dl)	135.92±13.57	80.60±15.46	<0.001
Magnesium (mg/dl)	02.31±00.18	01.47±00.22	<0.001
Phosphorus (mg/dl)	03.96±00.22	02.00±00.52	<0.001

Unpaired "t" test was done between Group I and Group II.

Table II: Comparison of Mean serum zinc, copper, magnesium and Phosphorus in Group I and Group IIA (n=30)

Biochemical variables	Group I (n=30) Mean±SD	Group IIA (n=30) Mean±SD	P value
Zinc (µg/dl)	103.79±08.86	62.70±08.90	<0.001
Copper (µg/dl)	135.92±13.57	84.77±08.27	<0.001
Magnesium (mg/dl)	02.31±00.18	01.34±00.21	<0.001
Phosphorus (mg/dl)	03.96±00.22	01.62±00.48	<0.001

Unpaired "t" test was done between group I and group IIA

Mean±SD of serum zinc, Cu, Mg & phosphorus of Group I were found 103.79±8.86, 135.92±13.57, 2.31±0.18mg/dl and 3.96±0.22mg/dl respectively and comparing to the result of Group IIA mean±SD serum Zn - 62.70±8.90µg/dl, Cu - 84.77±8.27µg/dl, Mg - 1.34±0.21mg/dl, Phosphorus - 1.62±0.48mg/dl shown in Table II. Differences between these two groups were found statistically significant (Level of significance p <0.001).

Table III: Comparison of Mean serum zinc, copper, magnesium and Phosphorus in Group I and Group IIB (n=30)

Biochemical variables	Group I (n=30) Mean±SD	Group IIB (n=30) Mean±SD	P value
Zinc (µg/dl)	103.79±08.86	51.26±09.83	<0.001
Copper (µg/dl)	135.92±13.57	65.01±12.65	<0.001
Magnesium (mg/dl)	02.31±00.18	01.51±00.16	<0.001
Phosphorus (mg/dl)	03.96±00.22	02.30±00.34	<0.001

Unpaired "t" test was done between Group I and Group IIB.

Mean±SD of serum zinc, Cu, Mg & phosphorus of Group I were found 103.79±8.86µg/dl, 135.92±13.57µg/dl, 2.30±0.18mg/dl and 3.96±0.22mg/dl respectively and comparing to the result of Group IIB mean±SD serum Zn - 51.26±9.83µg/dl, Cu - 65.01±12.65µg/dl, Mg - 1.51±0.16mg/dl, Phosphorus - 2.30±0.34mg/dl shown in Table III. Difference between these two groups was found statistically significant (Level of significance p <0.001).

---

*Original Contribution*

18. Caddel JL, Goddard DR. Studies in Protein calorie malnutrition. *The New England Journal of Medicine*. 1967;276:533-40.
19. Praharaj KC, Parija AC, Rao BM. Serum and CSF Magnesium in Protein Calorie Malnutrition. *Indian Pediatrics*. 1978;15(3): 233-7.
20. Kalra K, Mital VP, Pal R, Goyal RK, Dayal RS. Serum Electrolyte Studies in Malnutrition. *Indian Pediatrics*. 1973;12:1135-40.
21. Freiman I, Pettifor JM, Moodley GM. Serum Phosphorus in Protein Energy Malnutrition. *Journal of Pediatric Gastroenterology and Nutrition*. 1982;1:547-50.
22. Waterlow JC, Golden MH. Serum Inorganic Phosphate in Protein Energy Malnutrition. *European Journal of Clinical Nutrition*. 1994;48(7):503-6.