Serum Potassium and Calcium Level in Malnourished Children of Bangladesh.

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Abstract

Protein-energy malnutrition (PEM) also referred to as protein-calorie malnutrition, is a potentially fatal body-depletion disorder. PEM develops in children and adults whose consumption of protein and energy is insufficient to satisfy the body's nutritional needs. The modified 'Wellcome classification' was used to classify the PEM in children into marasmus, kwashiorkor, marasmic-kwashiorkor and underweight. However, in most cases the deficiency is combined. It was found that among the South Asian countries (Surveyed from 1990-2000) prevalence of wasting was 11.6% in Bangladesh, 18% in India, 11% in Pakistan, 11% in Nepal, 14% in Srilanka, 4% in Bhutan and 17% in Maldives. Malnutrition increases one's susceptibility to and severity of infections, and is thus a major component of illness and death from the diseases. This, a cross sectional study for a period from July 2008 to June 2009 to explore the changes of serum electrolytes in PEM so that effective measures making availability of adequate proteins and calories to all age groups especially to under five children through the ongoing nutrition programs to save these group of children. A total of 100 subjects aged 18 months to 5 years were enrolled for this study. Out of them 50 were the severely malnourished children regarded as Group I and 50 apparently healthy children considered as Group II. Z score of weight-for-age of Group I and Group II children were calculated by using CDC growth chart: USA, 2000. Data were collected through clinical evaluation from pre selected questionnaires and blood samples were taken for laboratory investigations. Serum potassium was measured by Ion selective electrode (ISE) method & serum calcium was determined by Colorimetric method using the test kit. Statistical significance of difference between two groups were evaluated by using unpaired 't' test with the help of SPSS software package. For each analytical test, the level of significance was set at 0.05 and p-value < 0.05 was considered significant.

Analyzing the findings of the present study, it can be concluded that significant decrease of serum potassium and calcium occur in malnourished children.

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Introduction

Protein-energy malnutrition (PEM) is a potentially fatal body-depletion disorder. PEM, also referred to as protein-calorie malnutrition, develops in children and adults whose consumption of protein and energy is insufficient to satisfy the body's nutritional needs. Pure protein deficiency can occur when a child's diet provides enough energy but lacks in minimum protein[1]. The World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions".[3] The modified 'Wellcome classification' was used to classify the protein energy malnutrition in children into marasmus, kwashiorkor, marasmic-kwashiorkor and underweight. However, in most cases the deficiency is combined.[1]

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Due to inadequate consumption of daily food, the children suffer from PEM resulting in several childhood illnesses. PEM is one of the important causes of morbidity and mortality of under 5 years children in Bangladesh. Two-thirds of under 5 years children in Bangladesh are malnourished. Each year 240,000 deaths among children under 5 years of age are attributed to malnutrition (more than 600/day). The national child nutrition survey conducted in 2000 demonstrated that among children of 6-71 months of age, almost 49% were stunted and nearly 12% wasted and 52% underweight. It was found that among the South Asian countries (Surveyed from 1990-2000) prevalence of wasting was 11.6% in Bangladesh, 18% in India, 11% in Pakistan, 11% in Nepal, 14% in Srilanka, 4% in Bhutan and 17% in Maldives.[4]

Malnutrition increases one's susceptibility to and severity of infections, and is thus a major component of illness and death from the diseases. Malnutrition is the direct cause of about 3, 00,000 deaths per year and is indirectly responsible for about half of all deaths in young children worldwide.[5]

Anorexia, diarrhoea, infections and micronutrient deficiency are frequent. Potassium is the electrolyte most studied in marasmus. Total body potassium deficit is associated with decreased muscle mass, poor intake, and digestive losses. This potassium deficit, which can reach 15mEq/kg, contributes to hypotonia, apathy and impaired cardiac function.[8] In children with PEM, potassium levels were significantly higher after treatment than on admission.[9]

The present study was undertaken to explore the changes of serum electrolytes in PEM so that effective measures making availability of adequate proteins and calories to all age groups especially to under five children through the ongoing nutrition programs to save these group of children.

Methods

This, a cross sectional study, was carried out in the Department of Biochemistry, Mymensingh Medical College in cooperation with the outpatient Department of Paediatrics of Mymensingh Medical College and Community Based Medical College, Bangladesh and slum area nearby Mymensingh Medical College for a period from July 2008 to June 2009. A total of 100 subjects aged 18 months to 5 years were enrolled for this study. Out of them 50 were the severely malnourished children regarded as Group I (weight-for-age Z-score less than -3 or percentage of desired bodyweight for age and sex below 60%) irrespective of sexes. Out of them 60% of malnourished children were between 4 – 5 years of age, 18% 3 – 4 years, 10% 2 – 3 years and rest 12% below 2 years. 50 apparently healthy children considered as Group II (weight-for-age Z-score more than -1 or percentage of desired bodyweight for age and sex above 90%). Out of them 70% were between 4 – 5 years, 22% 3 – 4 years, 4% 2 – 3 years and 4% below 2 years old. Z score of weight-for-age of Group I and Group II children were calculated by using CDC growth chart: USA, 2000.

Blood samples were collected from the subjects with all the aseptic precautions. From each subjects 4ml of blood were collected in disposable syringe attached with butterfly needle. The collected blood was transferred to a dry screw capped test tube immediately after removal of butterfly needle from the nozzle. Test tubes were kept in standing position until clot formation. Then the test tubes were centrifuged. The obtained sera were kept in microcentrifuge tube (eppendrof) after proper labeling.

Most of the experiments were carried out within one hour of collection. Whenever there was delay in experiments, samples were stored by refrigeration at -20 C prior to the analysis.

Serum potassium was determined by Ion selective electrode (ISE) method and serum calcium was determined by Colorimetric method using the test kit. The biochemical analyses were done in the Laboratory of the Department of Biochemistry of Mymensingh Medical College.

Using computer software SPSS (Statistical Package for Social Sciences) data were processed and analyzed. Descriptive statistics and Student's unpaired t-Test were used to analyze data. For each analytical test, the level of significance was set at 0.05 and p-value < 0.05 was considered significant. The summarized data were presented in the form of tables and graphs with due interpretation.

Results

In the present study, a total of 100 subjects were included and biochemical analyses were conducted. Subjects were classified in two different groups: Group- (case) and Group- (control). The biochemical results were expressed as follows-

❍ Serum Potassium	in	mEq/L
❍ Serum Calcium	in	mg/dl

The mean ± SD of serum potassium in between Group-I and Group-II were 4.2 ± 0.4 and 4.5 ± 0.4, p = 0.006 respectively. The result was significantly (p<0.05) lower in group-I compared to those in the Group-II.

Status of nutritional parameters demonstrate that the mean ± SD of serum calcium in between Group-I (case) and Group-II (control) were 7.2 ± 1.0 and 8.6 ± 0.5, p < 0.001 respectively. In the group-I (case) were significantly (p<0.05) lower than the Group-II (control).

Table I. Comparison of weight between groups

Clinical characteristics	Group		p-value
	Group-I (Case) (n = 50)	Group-II (Control) (n = 50)	
Weight (Kg)	10.64 ± 2.13	14.22 ± 2.26	<0.001

Table II. Comparison of serum electrolytes between groups

Status of serum Potassium	Group		p-value
	Group-I (Case) (n = 50)	Group-II (Control) (n = 50)	
Potassium	4.2 ± 0.4	4.5 ± 0.4	0.006

Table III. Comparison of nutritional parameter between groups

Nutritional parameter	Group		p-value
	Group-I (Case) (n = 50)	Group-II (Control) (n = 50)	
Calcium	7.2 ± 1.0	8.6 ± 0.5	<0.001

Student's unpaired t-Test was employed to analyze the data and presented as Mean ± SD

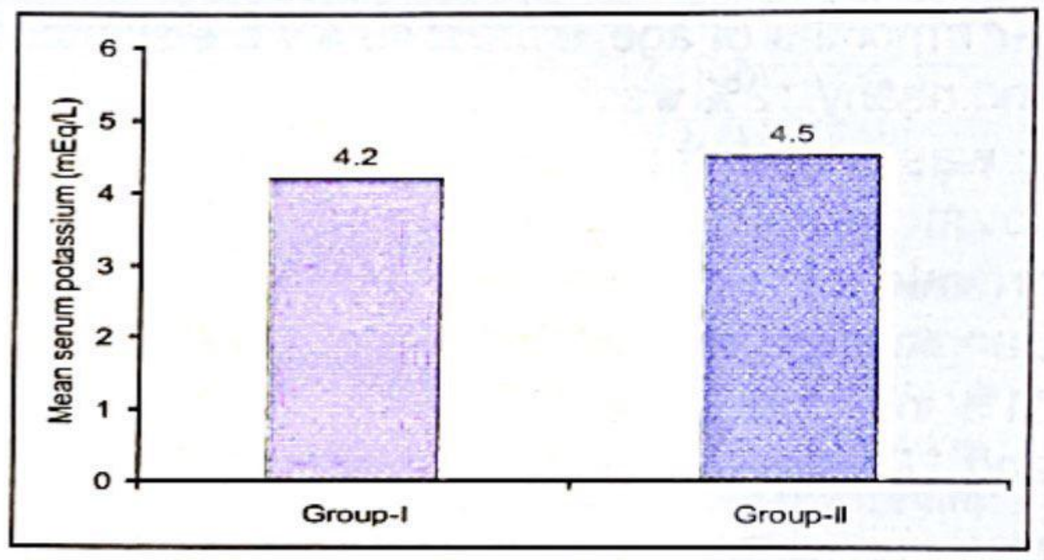

Fig-1: Comparison of mean serum potassium between groups

P value less than 0.05 taken as level of significance
Group I = Case (malnutrited children)
Group II = Control (healthy children)
SD = Standard deviation

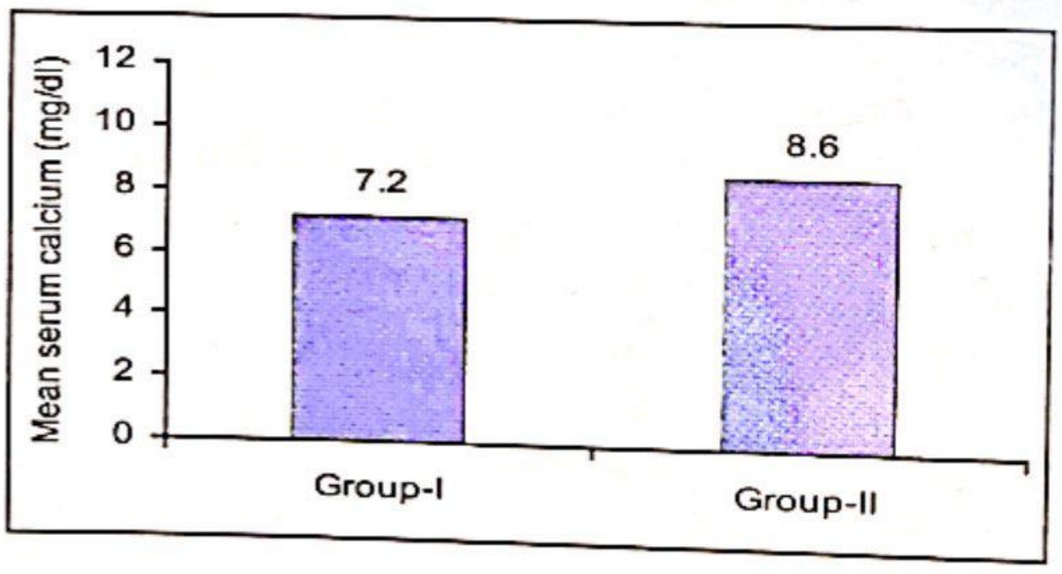

Fig-11: Comparison of mean serum calcium between groups

Discussion

This, a cross-sectional study was designed to estimate the plasma potassium levels in protein energy malnutrition in children. In this study, we estimated serum potassium concentrations in Group-I (case) and Group-II (control). There was significant (p<0.05) decrease in serum potassium concentration in cases compared to that of the control. These

may be due to insufficient dietary intake because of low socio-economic condition and also for gastrointestinal losses.

In this study, lower levels of serum potassium in patients with PEM compared to control were observed in our study which is in agreement with Taiwoo, OO & Thomas KD, 1992. They also reported that, the serum potassium levels were significantly ($p<0.05$) higher after treatment.[6,7,9]

This is also found that the plasma potassium levels were significantly lower in malnourished group than in control group ($p< 0.05$).[6,7]

In another study, children with PEM often present with protracted episodes of chronic or intermittent diarrhoea. The intestinal mucosa of such children has been shown to be leaky.[11]

Our result is also in agreement with the study where found a significant decline in serum potassium level ($p <0.001$) in PEM cases when compared to control group.[12] Similar results with low serum potassium were obtained from studies where expressed that hypokalemia may be sub clinical in malnourished children but during diarrhoeal illness it becomes obvious clinically and manifests as hypotonia, abdominal distension, paralytic ileus, cardiac arrhythmia and respiratory distress.[22,8,23] WHO on their rehydration project (1996-2000), found that hypokalemia alters function of several organs and prominently affects the cardiovascular system, neurological system, muscle and kidney. In profound potassium deficiency muscle paralysis can occur.[13]

In another study, reported that hyponatremia and hypokalemia both were more frequent in malnourished children with or without diarrhoea.[10] Malnutrition affects the severity of diarrhoea much more than it affects incidence of diarrhoea.[16] Sodium and chloride are the major ions contributing to osmolarity of extracellular fluid while potassium is in low concentration but nevertheless is essential for normal cell function.[14] The severely malnourished children have deficiencies in potassium. Low concentrations of intracellular potassium promote sodium and water retention, reduce myocardial contractility, and affect transport of ions across cell membranes.[17] Malnutrition could affect the incidence or severity of infection, including disruption of epidermal integrity and various components of the immune system.[18]

In malnutrition serum electrolytes do not reflect the body content but only the circulating concentration.

In a study they assessed the serum potassium, but found no significant ($p<0.05$) difference between child with PEM and control. These findings might be due to the facts that maximum children took colostrums, were immunized and half of the subjects from nuclear family type.[19]

Hypocalcemia reported and also stated that calcium might have been apparently low in parallel with total protein and albumin level.[19]

Total calcium concentrations were decreased in a variable degree but ionized serum calcium exhibited a normal concentration.[20]

Low serum calcium in PEM cases had also been found[8] and the calcium complex fraction, calcium bound to protein plus that in inorganic salts was the main compartment affected in the malnourished group.[21]

On the other hand in a study they expressed that, no significant changes occur in malnourished children compared with control.[22]

Conclusion

Analyzing the findings of the present study, it can be concluded that significant decrease of serum potassium and calcium occur in malnourished children.

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