

Original Research Article

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Serum albumin and total protein level as plausible marker for diagnosis of protein energy malnutrition in children under age 5 years

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ABSTRACT

Background: The circulating concentration of transport protein, traditionally albumin, has been used to define protein deficiency. However, few studies have been conducted to see if there is any correlation between serum total protein and albumin levels in children with PEM. Hence the study was planned to estimate serum total protein, serum albumin levels in children with PEM and healthy controls.

Methods: All the children were divided in two groups. Case Group A consist of 250 children with protein energy malnutrition and control Group B consist of healthy 250 children. Venous blood of amount 3 ml was collected with full aseptic precautions. The blood was collected in the EDTA vacutainer and test tube. Serum total protein was estimated by Biuret method, serum albumin was estimated by Bromocresol green dye method (BCG dye).

Results: When the mean serum levels of albumin levels and the total protein levels were measured in the controls as well as case groups, there was decrease in levels in case group as compared to control group. This difference of decrease when evaluated statistically it was found to be statistically significant. When the albumin/globulin ratio was calculated in both the groups, it was found to be statistically lower in case group as compared to control group. PEM children have low serum total protein and albumin levels as compared to healthy controls ($p<0.001$), this is probably due to decreased intake of proteins and reduced biosynthesis. PEM children have lower hemoglobin levels as compared to healthy controls; this is probably due to deficiency of iron and other micronutrients, which is often found in a child with malnutrition.

Conclusions: Early diagnosis and prompt management of PEM and its complications can prevent development of permanent physical and mental retardation.

Keywords: Albumin, Protein energy malnutrition, Serum level, Total protein

INTRODUCTION

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."¹ The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor and intermediate states of marasmus-kwashiorkor. Protein-energy undernutrition (PEU), previously called protein-energy malnutrition, is

an energy deficit due to deficiency of all macronutrients. It commonly includes deficiencies of many micronutrients.²

PEU can be sudden and total (starvation) or gradual. Malnutrition has a substantial clinical and socioeconomic significance; it increases rates of complications in hospitalized patients and healthcare-associated costs. Its prevalence has been estimated in hospitals of Western countries to be 30-50% and in long-term care facilities up to 85% depending on the definition and the type of

population studied. One of the problems of diagnosing malnutrition is the lack of a unified definition and of standard methods for screening and diagnosis.^{3,4}

Child malnutrition is a widespread public health problem having international consequences. Protein energy malnutrition (PEM) is one of the most common nutritional problems of developing countries of the world and an important cause of childhood mortality and morbidity leading to permanent impairment of physical and mental growth.^{5,6} Severe acute malnutrition remains a major cause of mortality in children under five years of age. 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. In cases of severely malnourished wasted children, serum total protein and albumin are reduced. Studies have also shown that PEM is associated with iodine, vitamin A and iron deficiencies leading to anemia, increasing the risk of death and disability from diarrhea, acute respiratory infection and vaccine preventable diseases particularly measles. Conversely diarrhea, parasitic infections and other childhood ailments diminish a child's ability to utilize those nutrients available in diet.^{7,8}

Only 2-5% of pre-school age children suffer from severe PEM while the majority of cases (60-70%) are mild to moderate where features of florid PEM are not easily recognizable. The clinical parameters are subjective and time consuming, hence some biochemical markers would help to easily and objectively identify mild to moderate cases. Protein energy malnutrition is marked by low plasma protein concentration. The use of serum protein measurement is widespread for the assessment of nutritional status. The circulating concentration of transport protein, traditionally albumin, has been used to define protein deficiency.⁹

Several studies have been done to estimate the individual biochemical parameters in PEM. However, few studies have been conducted to see if there is any correlation between serum total protein and albumin levels in children with PEM. Hence the study was plan to estimate serum total protein, serum albumin levels in children with PEM and healthy controls.

METHODS

A total of 500 children who meet the criteria requirement of the study were included in the study. All the children were divided in two groups. Case group A consist of 250 children with protein energy malnutrition and control group B consist of healthy 250 children. All the children were equal in number, belongs to same age groups.

Inclusion criteria

- Children with protein energy malnutrition as per IAP classification of PEM (which is based on weight for

age) i.e. whose weight for age was less than 80% of expected for age constituted cases (PEM group) they were further subdivided into Grade I-IV as per IAP classification of PEM. 82 children whose weight was more than 80% of expected weight formed control group.

Exclusion criteria

- Children with chronic infection like tuberculosis, HIV
- Malabsorption syndrome, protein losing nephropathy
- Endocrine disorders
- History of preterm or low birth weight delivery
- Congenital anomalies.

All the children's parents or the guardians were informed about the study protocol and the informed consent was signed by them. The predesigned proforma was prepared for the recording of the history and data. Previous history of hospitalization for the illness like acute diseases, measles, history of nutrition was recorded, presence of any lower tract infection along with systemic body examination as done. Height/ length along with weight was recorded.

Venous blood of amount 3 ml was collected with full aseptic precautions. The blood was collected in the EDTA vacutainer and test tube. The blood sample collected in test tube was centrifuged at 5000 rpm (rotation per minute) for 5 minutes; serum thus obtained was used to estimate serum total protein and albumin. Serum total protein was estimated by Biuret method, serum albumin was estimated by Bromocresol green dye method (BCG dye).¹⁰ Hemoglobin was estimated by using auto analyser. Other relevant investigations were done as needed based on the underlying problem.

Statistical analysis

The Chi-square test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values. The independent- samples 'T' Test procedure compares the mean for two group of cases. Ideally, for this test the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not due to other factors. All the statistical methods were performed through SPSS for windows version 16, p value of <0.05 was considered statistically significant.

RESULTS

The present study is the hospital base study. The following results were derived from the results. The case study Group A consist of 250 children and in Group B

consist of 250 children who were healthy formed the control group. Appropriate statistical methods were used to analyse the study method.

Table 1: Distribution of cases in Group A as per IAP classification.

Grade of PEM	Cases (n=250)
Grade I	64
Grade II	68
Grade III	82
Grade IV	36
Total	250

Majority of the children belong to age group of 2 to 3 years. In the control group as well as case group youngest of the child included in the study was of age 1 year were as oldest child was of age 5 years. The mean age in the case group was found to be 31.26 ± 10.12 months where as in control group it was 29.19 ± 11.31 months. When the statistical analysis of age was done, no difference was found. Owing to the sex ratio majority of the children in both the groups were male. There was no statistical difference between the groups for gender distribution. All the children in the case group were divided into four grades as per the IAP classification. As shown in table 1 majority of the children belonged to grade III that was followed by grade II.

When the mean serum levels of albumin levels and the total protein levels were measured in the controls as well as case groups, there was decrease in levels in case group as compared to control group. This difference of decrease when evaluated statistically it was found to be statistically significant. When the albumin/globulin ratio was calculated in both the groups, it was found to be statistically lower in case group as compared to control group. Values in the case group are the total mean of values obtained for children divided in the four categories as per IAP classification.

Table 2: Mean serum total protein level and serum albumin level in case and control group.

Variables	Case group (n=250)	Control group (n=250)	p value
Total protein	5.23 ± 0.34	8.10 ± 0.23	<0.001
Albumin	3.13 ± 0.45	5.10 ± 0.43	<0.001
Albumin/globulin ratio	1.02 ± 0.12	1.97 ± 0.14	<0.001

Table 2 describes mean serum total protein level and serum albumin level in case and control group. In case group mean total protein was 5.23 ± 0.34 , while in control it was 8.10 ± 0.23 . difference between case and control group was significant statically ($p \leq 0.05$). Similarly, statistically significant difference was observed in

albumin and albumin/globulin ratio between case and control group ($p \leq 0.05$) (Table 2).

DISCUSSION

Protein energy malnutrition continues to be a major problem throughout the developing world. In India almost half of children under the age of 5 years are suffering from various grades of PEM.¹¹ As already stated effects of PEM on the body are protean involving almost all the organ systems, PEM leads to failure in homeostatic mechanism of the body leading to increased susceptibility of an individual to infections. Globally, nearly half of under-five deaths are attributed to PEM either as direct/indirect cause. PEM is associated with reduction in synthesis of plasma proteins.¹²

In the present study 250 children of age group 1 to 5 years with grade I to grade IV PEM as per IAP classification of PEM were enrolled as cases, equal number of healthy children formed the control wing. Majority of children enrolled were in the age group 2 to 3 years. Higher prevalence of PEM in this age group explains the importance of the need for continued breast feeding and appropriate introduction of complementary feeds. Both cases and control group were age and sex matched. Majority of the children in the present study were in grade III followed by grade II. In the previous study conducted by Turkey et al, had enrolled 107 malnourished children of which majority of them had grade I PEM (53) followed by grade II PEM (37) and only 10 children had grade III PEM, 7 children had Grade IV PEM.¹³

In the present study mean hemoglobin level in cases was significantly lower as compared to controls. When mean hemoglobin level of each grade of PEM was compared to controls it was observed that values of grade I PEM were identical to controls ($p=0.814$), but the values showed a statistically significant difference in grade II-IV with p-value of 0.004 in grade II and <0.001 in grade III, IV. Study conducted by Adegbusi HS et al, found that mean hemoglobin level in undernourished group was significantly lower in comparison to that of well-nourished children.¹⁴ Lower hemoglobin in PEM children is due to iron, vitamin, trace elements and protein deficiencies, which is often found in children suffering from PEM.

In the present study mean serum total protein, albumin levels and A/G ratio were all significantly lower in cases as compared to controls with a p value of <0.001. When serum total protein, albumin levels and A/G ratio of each grade of PEM was compared to controls it was observed that in all grades the parameters were significantly lower in comparison with controls. On comparison of these parameters in different grades of PEM among each other it was observed that the reduction in total protein, albumin and A/G ratio were correlating well with severity of malnutrition (One-way ANOVA; $p < 0.001$) with

maximal decrease been noted in Grade IV PEM. Study conducted by Mishra SK et al, found that mean serum protein and albumin levels were significantly lower in cases as compared to controls ($p<0.05$).¹⁵ They found that mean total protein and albumin had a significant correlation with weight for height parameter.

CONCLUSION

PEM children have low serum total protein and albumin levels as compared to healthy controls ($p<0.001$), this is probably due to decreased intake of proteins and reduced biosynthesis. PEM children have lower hemoglobin levels as compared to healthy controls; this is probably due to deficiency of iron and other micronutrients, which is often found in a child with malnutrition. Early diagnosis and prompt management of PEM and its complications can prevent development of permanent physical and mental retardation.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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