

## Original Research Article

# Effect of PEM on thyroid status, serum total protein and A/G ratio in pre-school going children

Sumesh Prasad Sah<sup>1\*</sup>, Manisha Arora<sup>1</sup>, Sudeep Kumar<sup>1</sup>, Jyoti Batra<sup>2</sup>, Imran Mustafa<sup>1</sup>, Lalendra Yadav<sup>3</sup>

<sup>1</sup>Department of Biochemistry, Muzaffarnagar Medical College, Muzaffarnagar, Uttar Pradesh, India

<sup>2</sup>Department of Biochemistry, Santosh Medical College, Ghaziabad, NCR, Uttar Pradesh, India

<sup>3</sup>Department of Pharmacology, Muzaffarnagar Medical College, Muzaffarnagar, Uttar Pradesh, India

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### \*Correspondence:

Dr. Sumesh Prasad Sah,

E-mail: [sumesh.sah@gmail.com](mailto:sumesh.sah@gmail.com)

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## ABSTRACT

**Objective:** The objective of the study was to evaluate and compare serum total protein, serum albumin and thyroid hormones in children with Protein Energy Malnutrition (PEM) and in healthy controls.

**Methods:** Present study was a cross sectional hospital based case control study, total 75 children of age group 1-5 years were included in this study. Triiodothyronine (T<sub>3</sub>), thyroxine (T<sub>4</sub>) and thyroid stimulating hormone (TSH) was estimated by electro-chemiluminescence immunoassay method, serum total protein by biuret method, albumin by BCG method and plasma hemoglobin by CMG method.

**Result:** In malnourished children, there is significant decrease in serum total protein (4.76 gm %), albumin (2.24 gm %) and Hb (10.57 gm %) as compared to normal healthy children. Serum T<sub>3</sub> (0.51 ng/ml), and T<sub>4</sub> (3.93 µg/ml) levels were significantly decreased and non-significant changes in TSH (4.26 µUI/ml) levels in children with PEM was observed as compared to healthy controls.

**Conclusion:** The reduction in protein is due to decreased intake of proteins and reduced biosynthesis. The decreased in T<sub>3</sub> and T<sub>4</sub> levels in malnourished children is probably due to a decrease in circulating plasma proteins.

**Keywords:** PEM, T<sub>3</sub>, T<sub>4</sub>, Thyroid stimulating hormone, Total proteins

## INTRODUCTION

According to World Health Organization (WHO), Protein Energy Malnutrition (PEM) refers to “an imbalance between the supply of protein and energy and the body's demand for them to ensure optimal growth and function. The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor, and intermediate states of marasmus-kwashiorkor.<sup>1</sup> Marasmus is a form of starvation that occurs during childhood. Marasmus occurs most commonly during the first year of life and is found in most developing countries. A common cause is early cessation of breast feeding with lack of food intake.<sup>2</sup>

Kwashiorkor is caused due to nutritional imbalance, consisting in protein deficiency and adequate or high carbohydrate intake. The disease occurs mainly in children 6 months to 3 years of age. It usually follows weaning when the infant is fed the poor and limited foods of the area (corn, other grains and vegetables).<sup>3</sup>

In children with PEM, there are marked changes in secretion and metabolism of thyroid hormones and in the structure of thyroid gland. This results in reduction of activity of the gland and hence decreases in T<sub>3</sub> and T<sub>4</sub> level. In children with PEM, concentrations of all three thyroid hormone binding proteins are extremely low, and the serum T<sub>4</sub> and T<sub>3</sub> levels decline abruptly, often into

clearly hypo thyroid range. However, serum TSH concentration is unchanged.<sup>4,5</sup> Children with PEM have greater deficient of total protein and in severe cases the total protein may be reduced to around 50%. The reductions of total serum protein and albumin were more marked in kwashiorkor than in marasmus.<sup>6</sup> This study was conducted to know about thyroid hormones level in children with PEM and its correlation with serum total protein and albumin.

**METHODS**

The present study was a cross sectional hospital based case control study, carried out in the Department of Biochemistry and Department of Pediatrics, MGM Medical College and Hospital, Navi Mumbai during the term January 2015 to January 2016. The total no of 75 (60 PEM children and 15 healthy control) children in age group 1-5 years were included in the study. 46 children included in this study were male and 29 were female. As per Indian Academy of Pediatrics, total 60 protein energy malnourished children further subdivided in to Grade-I to IV.<sup>7</sup>

**Exclusion criteria**

- Patients more than 5 years of age and below 1 year of age
- Patients with chronic infectious diseases like nephrotic syndrome
- Chronic glomerulonephritis and acute renal failure
- Patients with lead poisoning, thalassemia, HIV, asthma and with congenital anomalies were excluded from the study.

**Sample collection, separation and preservation**

Aseptically 4 ml of venous blood (3 ml blood was transferred in plain vial and 1 ml in EDTA vial) was collected with due consent from the parents of patients. As soon as the blood was collected from the patients, it was carried to the laboratory in an ice-container. The blood was allowed to clot and serum was separated by centrifugation at 3000 rpm for 5 minutes.

Serum was used to estimate various parameters:

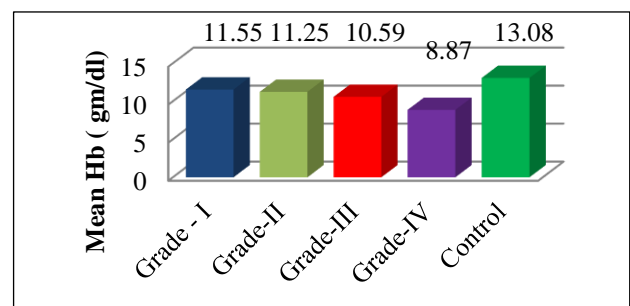
- T<sub>3</sub>, T<sub>4</sub> and TSH were analyzed by Cobas e-411 analyzer by Electro-chemiluminescence immunoassay
- Serum total protein was estimated by biuret end point method by semi-automated analyzer (state fax-100)
- Serum albumin was estimated by BCG dye end point method by semi-automated analyzer (state fax-100)
- Hemoglobin was estimated by CMG method.

**Statistical Analysis**

Results were statistically analyzed by ‘Graph Pad Quick Cals’ t-test calculator. The results were expressed in mean±standard deviation. P value less <0.05 considered as statistically significant.

**RESULTS**

The mean hemoglobin levels in cases were significantly lower (p<0.0001) as compared to controls (Figure-1).



**Figure 1: Mean hemoglobin levels in various grades of PEM and controls.**

Mean T<sub>3</sub> (p<0.001), T<sub>4</sub> (p<0.001), albumin (p<0.001) and globulin (p=0.005) levels were significantly lower in malnourished children as compared to control while mean TSH insignificantly higher in malnourished children as compared to control (Table 1).

**Table 1: Mean T<sub>3</sub>, T<sub>4</sub>, TSH, serum total protein, albumin and globulin in malnourished children and healthy controls.**

Variables	PEM children (60)	Control (15)	p-value
T <sub>3</sub> (ng/ml)	0.51±0.12	1.68±0.35	<0.0001 S
T <sub>4</sub> (µg/ml)	3.93±0.80	9.79±2.40	<0.0001 S
TSH (µUI/ml)	4.26±0.38	4.09±0.22	= 0.118 NS
Hemoglobin (gm/dl)	10.57±1.30	13.08±2.73	<0.0001 S
Albumin (gm/dl)	2.24±0.35	4.0±0.21	<0.0001 S
Globulin (gm/dl)	2.52±0.69	3.04±0.29	= 0.0056 S

S: Statistically Significant; NS: Statistically non-significant

Mean T<sub>3</sub> and T<sub>4</sub> levels negatively correlated with the severity of disease i.e. mean T<sub>3</sub> and T<sub>4</sub> level higher in grade-1 PEM and lower in grade-4 PEM (Table 3). Mean

total protein, albumin, globulin and A/G ratio negatively correlated with the severity of disease (Table 2).

**Table 2: Mean serum total protein, albumin and A/G ratio in different grades of PEM and controls.**

Variable	Total protein (gm/dl)	Albumin (gm/dl)	A/G ratio
Grade I	5.19±0.67*	2.48±0.32*	1.06±0.41****
Grade II	1.86±0.42*	2.35±0.33*	1.02±0.40***
Grade III	4.57± 0.36*	2.19±0.23*	0.99±0.35**
Grade IV	4.41±0.64*	1.93±0.22*	0.88±0.36*
Control	7.04 ±0.44	4.00±0.21	1.33±0.11

\* p-value <0.0001; \*\*p-value < 0.001; \*\*\*p-value <0.007; \*\*\*\*p-value <0.02

**Table 3: Mean T<sub>3</sub>, T<sub>4</sub> and TSH levels in different grades of PEM and controls.**

Variable	T <sub>3</sub> (ng/ml)	T <sub>4</sub> (µg/dl)	TSH (µUI/ml)
Grade I	0.67±0.04*	4.72±0.33*	4.16±0.32**
Grade II	0.54±0.02*	4.28±0.56*	4.00±0.53**
Grade III	0.45±0.03*	3.54±0.67*	4.19±0.43**
Grade IV	0.35±0.04*	3.17±0.47*	4.25±0.47**
Control	1.67±0.34	9.78±2.39	4.09±0.22

\*p-value <0.0001 (statistically significant when compared to control); \*\*p- value >0.05 (statistically insignificant when compared to control)

## DISCUSSION

Malnutrition is a state of an inadequate or improper nutrition, which may be caused by a combination of insufficient intake of protein, calories, vitamins, and minerals as well as frequent infection. Protein energy malnutrition is a potentially fatal depletion disorder; it is the most common nutritional problem in developing countries.

In the present study, we found significantly decreased level of haemoglobin as compared to control. Present results are in accordance with the study performed by Adegbusi HS et al, Sandeep M et al, Gamit AM et al.<sup>8-10</sup> Decreased haemoglobin level in malnourished children is due to the deficiency of iron, vitamin, trace elements and protein.

In the present study, we found significantly decreased levels of serum total protein, albumin and A/G ratio in children with PEM as compared to controls. The reduction in serum total protein, albumin and A/G ratio were positively correlated with the severity of malnutrition. It may be due to decreased protein intake and reduced biosynthesis. Adegbusi HS et al, Mishra SK et al, Rahman MA et al and Chowdhury et al obtained the same results.<sup>8,11-13</sup>

In the present study mean T<sub>3</sub> and T<sub>4</sub> levels were significantly decreased in malnourished children as compared to control. The mean T<sub>3</sub> and T<sub>4</sub> levels decrease with increase in severity of malnutrition. Abrol P et al

and Turkey et al obtained similar results.<sup>14,15</sup> Similar results are reported by Kumar S et al and Orbak Z et al.<sup>16,17</sup> Das et al in their study, found significantly decreased T<sub>3</sub> levels in malnourished children as compared to controls but there are insignificant changes in T<sub>4</sub> levels in cases and controls.<sup>14</sup>

Decreased T<sub>3</sub> levels in PEM children is probably due to low binding proteins, impaired thyroxin monodeiodination in liver which leads to decreased peripheral conversion of T<sub>4</sub> to T<sub>3</sub> and elevated corticosteroids which is often seen in children with malnutrition (acts by inhibiting 5' deiodinase system) and low T<sub>4</sub> levels in children with PEM can be due to fall in thyroid secretion rate, depletion of reserves and failure of the adaptive mechanism.

In the present study, we found insignificant changes in TSH levels in malnourished and healthy children. Studies performed by Abrol P et al, Turkey et al and Das BK et al, also find same results.<sup>14,15,18</sup> Orbak Z et al found significantly increased levels of TSH in malnourished children as compared to controls.<sup>17</sup>

Kumar S et al in their study showed that mean TSH levels showed a positive correlation with severity of PEM.<sup>16</sup> Normal TSH levels in children with PEM is possibly due to T<sub>4</sub> undergoing intracellular monodeiodination to form T<sub>3</sub> at pituitary level causing negative feedback inhibition of secretion of TSH, central unresponsiveness to low T<sub>3</sub> levels due to low intracellular receptor capacity.

## CONCLUSION

In the present study we observed, decreased levels of Hemoglobin, serum total protein, albumin, A/G ratio, T<sub>3</sub> and T<sub>4</sub> levels as compared to healthy controls and insignificant changes in TSH levels as compared to control. The reduction in protein is due to decreased intake of proteins and reduced biosynthesis. The decreased in T<sub>3</sub> and T<sub>4</sub> levels in malnourished children is probably due to a decrease in circulating plasma proteins.

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