



Thyroid Status and Serum Protein Levels in Severe and Moderate Acute Malnourished Children

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ABSTRACT

Aims And OBJECTIVES;

1. To estimate and compare blood thyroid hormone levels and proteins in Protein Energy Malnutrition (PEM) patients with normal values
2. To find correlation between blood thyroid hormone levels and protein abnormalities in children with PEM and to compare it with normal values.

STUDY DESIGN: It was a Prospective Observational Study done at a tertiary care hospital in a metropolitan city over a period of 3 years. This study comprised Of 100 patients who were divided on the basis of WHO staging for PEM into SAM (severe acute malnutrition) and MAM (moderate acute malnutrition) on the basis of weight for height ,height for age ,mid arm circumference and wasting or oedema. Assessment of total Serum Proteins was done with Albumin and Globulin Albumin /Globulin ratio estimation, Thyroid Function test –TSH, Free T3, Free T4 was done. These values were compared in children with PEM and the values were correlated with children with PEM.

RESULTS: Serum proteins were low in both SAM and MAM ,the decrease in the serum proteins was more with the severity of malnutrition that is more decrease in SAM and borderline low in MAM ,there was highly significant correlation ($p<0.001$) between the decreased serum proteins and the type of malnutrition. Serum Free T3 values was low in SAM patients and normal in MAM, showing highly significant correlation ($p<0.001$) between the decreased Free T3 and the severity of malnutrition.

Serum Free T4 values were within normal limits both in SAM and MAM patients, but there was highly significant correlation ($p<0.001$) between the low value in SAM as compared with MAM patients i.e., the value was less in SAM patients as compared with MAM patients .Serum TSH values were normal in both SAM and MAM patients and there was no correlation between the TSH values and the malnutrition.

CONCLUSION: Serum albumin and globulin levels were low along with a decrease in A:G ratio in PEM cases and severity of hypoproteinemia was directly proportional to severity of PEM. Free T3 was decreased indicating that there was low conversion of T4 to T3. There was a direct correlation with the decrease in A:G ratio and decrease in Free T3 and Free T4 values.

KEY WORDS: Hypoproteinemia, Thyroid function test, hypoproteinemia, severe acute malnutrition

INTRODUCTION

Globally, PEM continues to be a major health problem in developing countries and the most important risk factor for illnesses and death especially among young children^[1]. The World Health Organization estimates that about 60% of all deaths, occurring among children aged less than five years in developing countries, could be attributed directly or indirectly to malnutrition^[2].

Protein energy malnutrition (PEM) is a range of pathological conditions arising from a deficiency of protein and energy, and is commonly associated with infections^[3].

In children, PEM is defined by measurements that fall below minus two standard deviations of the normal weight for age (underweight), height for age (stunting) and weight for height (wasting)^[4,5]. Wasting, Stunting and underweight are often used as indicators of PEM. Two severe nutritional clinical conditions involving PEM are Marasmus and Kwashiorkor^{[6][7]}.

Three anthropometric indices are used to define child nutritional status: weight-for-height, height-for-age, and weight-for-age. For any one of these indices, malnutrition is defined as a z-score below -2.0^[8].

There are two forms of acute malnutrition/wasting:

(1) Severe acute malnutrition (SAM), defined as weight-for-height below -3.0 z scores of the median World Health Organization (WHO) standards in children 6–59 months of age, and/or mid-upper arm circumference (MUAC) less than 11.5 cm, and/or the presence of bilateral pitting oedema^[9,10]

(2) Moderate acute malnutrition (MAM), defined as weight-for-height ≥ -3.0 z and < -2.0 z scores, or MUAC ≥ 11.5 cm and < 12.5 cm and no oedema^[9,10].

A variety of endocrine abnormalities have been reported in PEM, like changes in growth hormone, insulin, glucocorticoids and thyroid hormones. The changes in thyroid homeostasis have not been enough focus. In PEM, there are marked changes in secretion and metabolism of thyroid hormones

and in the structure of thyroid gland. This results in reduction of the activity of the gland, as the body tries to adapt to low calorie intake^[11]

PEM is a range of pathological condition arising from coincident lack of protein and calories and usually associated with infections and deficiency of micronutrients^[12]

PEM affects every organ system. As PEM progresses, organ dysfunction develops. Multiple system affection and several metabolic derangements are expected. Hepatic synthesis of serum proteins decreases and depressed levels of circulating proteins are observed. Thyroid hormones play an important role in the regulation of lipid and carbohydrate metabolism and necessary for normal growth and maturation. Absence of thyroid hormones causes mental and physical slowing, mental retardation and dwarfism^[13].

Studies have shown that in 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 decrease in T3 and T4^[14]

Though few studies have been done on status of thyroid hormones, the studies on free thyroid hormones levels (FT3/ FT4) in children are not many^[15,16].

With this view the aims and Objectives of this study was to estimate the concentration of serum thyroid hormone levels and proteins in PEM patients and healthy controls and to find out if there is any correlation between serum thyroid hormones and serum proteins levels in PEM cases.

MATERIALS AND METHODS

It was a Prospective Observational Study done at a tertiary care hospital in a Metropolitan city over a period of 3 years. Approval of Institutional Ethical Committee was obtained before conducting the study. Study group comprised Of 100 patients which were divided on the basis of WHO staging for PEM into SAM and MAM on

the basis of weight for height ,height for age ,mid arm circumference and wasting or oedema.

Anthropometry:

Weight (>1 yr) was taken on a digital weighing scale and for infants it was taken on Infant digital weighing scale. Height (>2 yr) was measured by Stadiometer and for infants length was taken by Infantometer Patients more than 2 years were made to stand upright with heel, buttocks, shoulder blade and occiput touching the wall and Frankfurt plane parallel to floor. Mid arm circumference was taken over the left triceps, with the arm hanging by the Side, a non-stretchable tape passed around the circumference of the arm at the Midpoint of left arm ,midway between acromion process and olecranon process . Weight for height was calculated by dividing weight of

the child by ideal weight of a normal child of same height X100

Assessment of Serum Proteins and thyroid function tests:

It was done initially by determining serum albumin and globulin, Albumin /Globulin ratio was then calculated,

Thyroid Function test –TSH, Free T3, Free T4 was done.

OBSERVATIONS AND RESULTS

Amongst the 100 sample size which was studied mean free T3 in SAM patients was 2.38 pmol/l (**low**) and mean free T3 in MAM patients was 3.71 pmol/l (normal).There was a **very highly significant (P<0.001)** correlation between decreased free T3 and the type of malnutrition.

GRAPH 1: Thyroid Profile and the type of Malnutrition

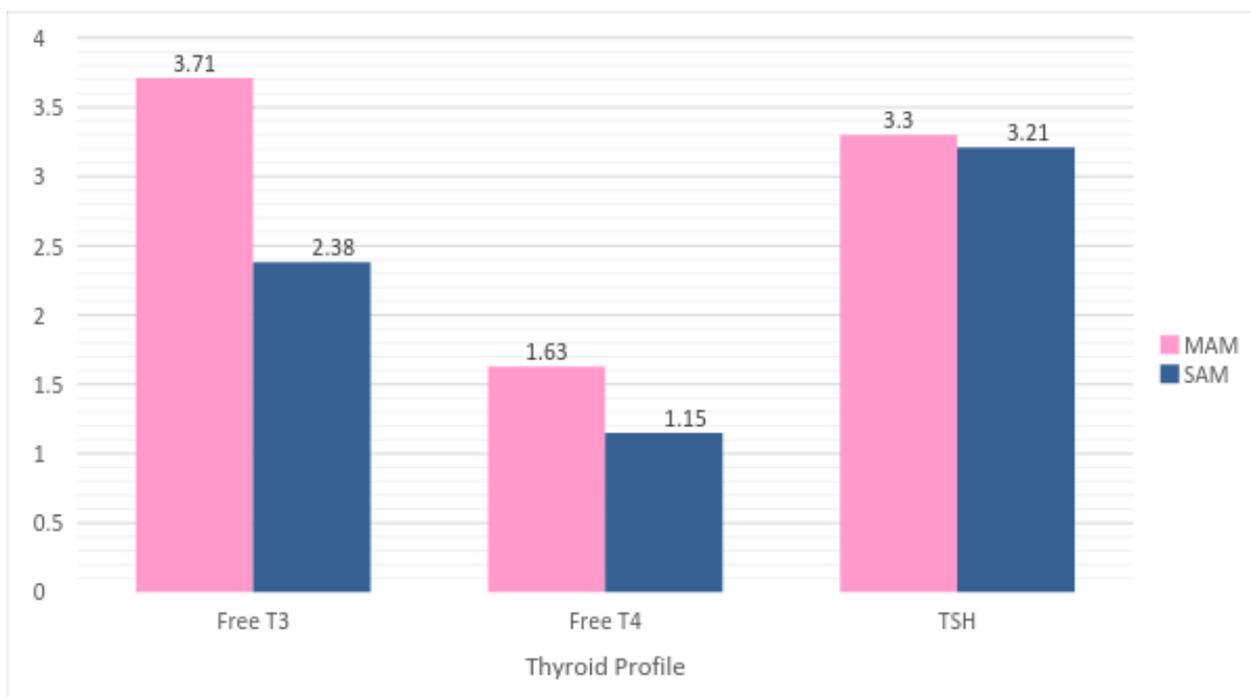


Table no 1 : Association of Free T3 with type of Malnutrition

Malnutrition	Free T3 (pmol/l)		p value
	Mean	SD	
MAM	3.71	1.76	<0.001 (Very Highly Significant)
SAM	2.38	0.84	
Unpaired t test t= 4.881 df=98			

Amongst the 100 sample size which was studied. Mean free T4 in SAM patients was 1.15 ng/dl (normal) and mean free T4 in MAM patients was 1.63 ng/dl (normal). Though the levels were within normal limits there was a **very highly**

significant (p<0.001) correlation between the value of free T4 and the type of malnutrition i.e.,the value was low in SAM as compared to MAM patients.

Table no 2 : Association of Free T4 with type of Malnutrition

Malnutrition	Free T4 (in ng/l)		p value
	Mean	SD	
MAM	1.63	0.66	<0.001 (Very Highly Significant)
SAM	1.15	0.62	
Unpaired t test t= 3.687 df=98			

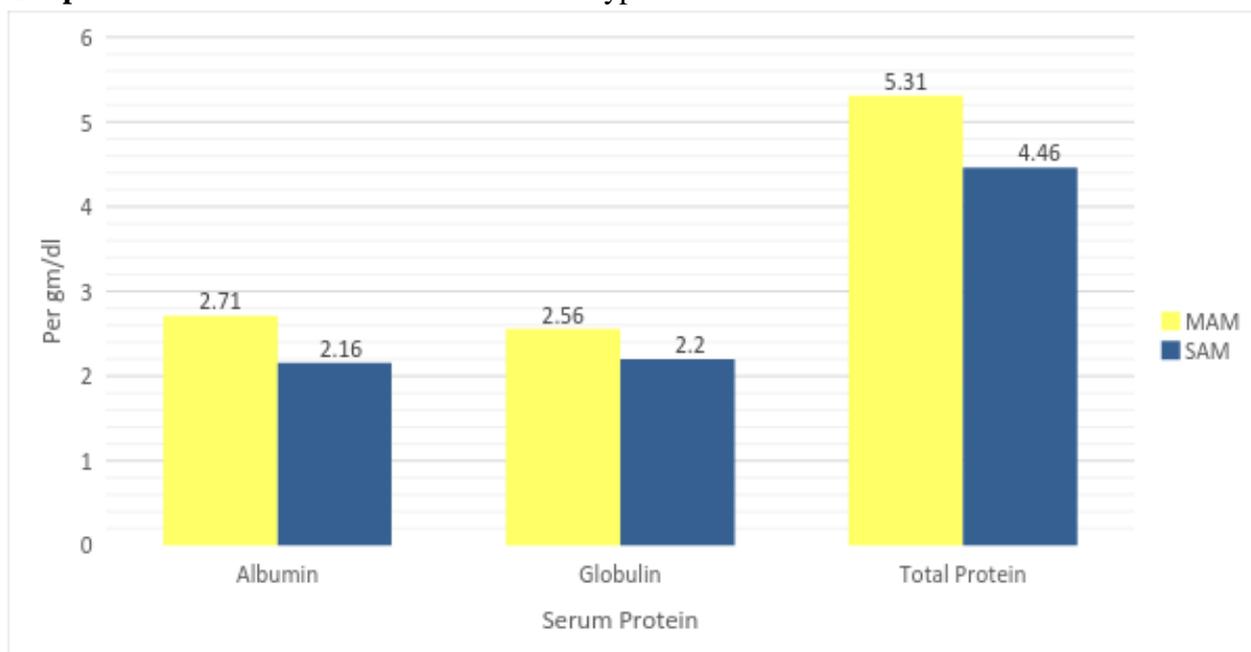
Amongst the 100 sample size which was studied mean TSH among SAM patients was 3.21 mIU/l (normal) and mean TSH among MAM patients was 3.3 mIU/l (normal)

There was **no correlation** between TSH values and the type of malnutrition.

Table no 3 : Association of TSH with type of Malnutrition

Malnutrition	TSH (mIU/l)		p value
	Mean	SD	
MAM	3.30	1.5	0.810 (Non Significant)
SAM	3.21	2.1	
Unpaired t test t= 0.241 df=98			

Graph 2 : Association of Total Protein with type of Malnutrition



Amongst the 100 sample size which was studied mean values of total protein in MAM and SAM patients were 5.31gm/dl (**low**) and 4.36 gm/dl

(**low**) respectively ,showing a positive correlation **very highly significant (p<0.001)** between decreased proteins and type of malnutrition.

Table no 4 : Association of total proteins with type of Malnutrition

Malnutrition	Total Protein (gm/dl)		p value
	Mean	SD	
MAM	5.31	0.92	<0.001 (Very Highly Significant)
SAM	4.36	0.63	
Unpaired t test t= 5.931 df=98			

Mean albumin values in MAM and SAM patients were 2.71 gm/dl (**low**) and 2.16 gm/dl (**low**) respectively ,there was a **highly significant**

(**p<0.003**) positive correlation between decreased albumin and the type of malnutrition.

Table no 5 : Association of Sr Albumin with type of Malnutrition

Malnutrition	Albumin (gm/dl)		p value
	Mean	SD	
MAM	2.71	0.57	0.003 (Highly Significant)
SAM	2.16	0.42	
Unpaired t test t= 3.051 df=98			

Mean globulin in SAM and MAM patients was 2.2 gm/dl (**low**) and 2.56 gm/dl (**low**) respectively showing **highly significant (p<0.003)** positive

correlation between the decreased globulin and the type of malnutrition.

Table no 6 : Association of Sr.Globulin with type of Malnutrition

Malnutrition	Globulin (gm/dl)		p value
	Mean	SD	
MAM	2.56	0.68	0.003 (Highly Significant)
SAM	2.20	0.47	
Unpaired t test t= 3.051 df=98			

Mean albumin to globulin ratio among SAM and MAM patients was 1.02 (**low**) and 1.15 (**low**) There was **nonsignificant** correlation between

A:G ratio and the type of malnutrition but it was decreased in both SAM and MAM patients.

Table no 7 : Association of Albumin-Globulin ratio with type of Malnutrition

Malnutrition	Albumin-Globulin Ratio		p value
	Mean	SD	
MAM	1.15	0.44	0.104 (Non Significant)
SAM	1.02	0.31	
Unpaired t test t= 1.643 df=98			

Serum proteins were low in both SAM and MAM ,the decrease in the serum proteins was more with the severity of malnutrition that is more decrease in SAM and borderline low in MAM ,there was highly significant correlation ($p<0.001$) between the decreased serum proteins and the type of malnutrition .Serum albumin was low in both SAM and MAM and the decrease in serum albumin was more with the severity of malnutrition that is more decrease in SAM and borderline low in MAM , there was highly significant correlation($p<0.003$) between the decreased serum albumin and the severity of malnutrition .Serum globulin values were decreased in both SAM and MAM ,but globulin was more decreased in SAM than MAM showing highly significant correlation($p<0.003$) between serum globulin and the type of severity of malnutrition Serum Free T3 values was low in SAM patients and normal in MAM , showing highly significant correlation ($p<0.001$) between the decreased Free T3 and the severity of malnutrition .Serum Free T4 values were within normal limits both in SAM and MAM patients

,but there was highly significant correlation ($p<0.001$) between the low value in SAM as compared with MAM patients i.e., the value was less in SAM patients as compared with MAM patients .Serum TSH values were normal in both SAM and MAM patients and there was no correlation between the TSH values and the malnutrition .A:G ratio was decreased both in SAM and MAM patients ,and there was no correlation between the decreased value of A:G ratio with the type of severity of malnutrition .When A:G ratio was decreased even Free T3 was found to be decreased showing a highly significant($p<0.007$) correlation between the decrease in Free T3 and A:G ratio

When A:G ratio was decreased even the value of Free T4 was found less showing significant correlation ($p<0.014$) between the decreased value and the A:G ratio

There was no correlation found between TSH and A:G ratio.

DISCUSSION

Our study has shown that serum proteins, serum albumin and serum globulin are low in SAM and MAM cases. The severity of hypoproteinemia increases as the severity of PEM increases and hypoproteinemia is significant in cases of SAM and there was a positive correlation between severity PEM and degree of hypoproteinemia.. There was decrease in A:G ratio both in SAM and MAM cases. Similar observations were made in studies conducted by maccomG¹⁷,sarah bart et al¹⁸ and Freemark M¹⁹

In our study we found that Free T3 is decreased in PEM cases indicating that there is low conversion of T4 to T3 ,the reasons may be proteins required for the enzyme which converts T4 to T3 are decreased in PEM cases

Sanjeev kumar²⁰ studied effect of malnutrition on thyroid Hormone, he drew a correlation between serum concentration of thyroid hormones and grade of malnutrition among 60 children between 1-5 year having PEM. With increasing severity of malnutrition, the serum concentration of T3 and T4 progressively decreased and that of serum TSH increased,The results of this study support our results ,in which serum concentration of Free T3, Free T4 were progressively decreased with the severity of malnutrition .

Pankaj abrol et al²¹ studied thyroid hormone status in PEM in INDIAN children -Thyroid status was measured in 80 malnourished children of different grades of PEM .serum total T3 T4 TSH were measured by radioimmunoassay.the results were compared with 20 healthy, age and sex matched controls.levels .T3 and T4 were significantly lower in PEM cases where as TSH was similar to controls.This study supports our study in which T3 , T4 was lower in PEM cases ,and TSH was normal,but this study didn't study the correlation of severity of malnutrition with the decrease in the values of Free T3 ,Free T4 and also this studied total T3 and total T4 and not free T3 and free T4 . Shaheen B²² Serum Free T3, Free T4,TSH And Proteins In Children With Protein Energy Malnutrition –the aim of this study was to

assess the thyroid hormone levels and to correlate the levels with serum protein levels in the PEM patients with that of healthy controls. Serum thyroid hormones and serum proteins were measured in 30 protein energy malnourished children of different grades (I-IV).Serum levels of free triiodo thyronine(FT3),Free thyroxine(FT4) and thyroid stimulating hormone (TSH) were measured by chemiluminometric assay, serum total proteins by biuret method and serum albumin by BCG Dye method. The results were compared with 30 healthy, age and sex matched controls. There was a significant decrease in serum Free T3, Free T4 and TSH and serum total proteins in PEM patients, when compared to the control group. There was a significant positive correlation between serum thyroid hormones and serum albumin levels in PEM cases

Our study also had decrease serum proteins in PEM cases,and also there was decrease in Free T3 ,but the Free T4 and TSH values were found to be normal .

CONCLUSIONS

Serum proteins, serum albumin and serum globulin are low in SAM and MAM cases correlating more decrease with the severity of malnutrition.

There was decrease in A:G ratio both in SAM and MAM cases.

Free T3 is decreased indicating that there is low conversion of T4 to T3 ,the reasons may be proteins required for the enzyme which converts T4 to T3 are decreased in PEM cases

There was a direct correlation with the decrease in A:G ratio and decrease in Free T3 and Free T4 values (inspite of Free T4 values being within normal limits.

AREA OF CONFLICTS: NIL

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