Original Research Article

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20181545

Study of thyroid profile in malnourished children (6 months - 5 years) admitted in the nutritional rehabilitation centre and paediatric ward NSCB Medical College Jabalpur, India

Monica Lazarus, Alok Kumar Kashyap*, Rahul Borkar, Manish Ajmariya

Department of Pediatrics, NSCB Medical College and Hospital, Jabalpur, Madhya Pradesh, India

Received: 28 February 2018 **Accepted:** 05 April 2018

*Correspondence:

Dr. Alok Kumar Kashyap,

E-mail: alokgmcj.kashyap@gmail.com

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ABSTRACT

Background: 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. The research was conducted to study the effect of thyroid profile in malnourished children (6 month-5 years) admitted in tertiary care center in Central India.

Methods: A cross sectional hospital based observational study was carried out in tertiary care hospital NSCB MCH Jabalpur. 80 malnourished children were included in the study. The cases were categorized into moderate and severe malnutrition as per WHO classification. Detailed clinical assessment of nutritional status followed by anthropometric measurement (weight for height) was recorded in predesigned proforma. Triiodothyronine (T3), Thyroxine (T4), thyroid stimulating hormone (TSH), serum total protein and serum albumin were estimated. The parameters were compared among SAM and MAM groups using appropriate tool.

Results: Mean serum protein, serum albumin, T3, T4 were significantly low in SAM group, when compared to the MAM group (p <0.001). while level of TSH was not found significant among SAM and MAM groups.

Conclusions: Malnutrition is associated with decrease level of thyroid hormone levels and were positively correlated with serum total protein and albumin levels. The decrease level of thyroid hormone may have a contributory role in retarded growth and development.

Keywords: Moderate acute malnutrition, Protein energy malnutrition, Severely acute malnutrition, Thyroid stimulating hormone, Triiodothyronine, Thyroxine

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. The WHO 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. According to estimates in the world there are about 162 million children suffering from various forms of malnutrition. It is estimated that

malnutrition is the primary or associated cause of nearly half of approximately 3 million deaths in children under the age of 5 years. Three-quarters of the world's stunted children live in South Asia and Sub-Saharan Africa; India is home to nearly one-third of world's malnourished children, as per national family health survey-4 (NFHS-4) report prevalence of malnutrition are shown in table. respectively.³⁻⁵

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 focused. 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.⁶

Table 1: Prevalence of malnutrition national and state wise.

	Under- weight	Stunting	Wasting	Severe wasting
India	35.7%	38.4%	21%	7.5%
Madhya Pradesh	42.8%	42%	25.8%	9.2%

Malnutrition is a range of pathological condition arising from coincident lack of protein and calories and usually associated with infections and deficiency of micronutrients. Malnutrition affects every organ system with subsequent organ dysfunction. 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.⁸ Studies have shown that in malnutrition, 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 T4.⁹

Few studies have been done on status of thyroid hormones, the studies on free thyroid hormones levels (FT3/ FT4) in children are also less. 10,11

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

METHODS

The present study of thyroid profile in malnourished children (6 month to 5 years) had been carried out in malnourished children admitted in NRC and ward NSCB Medical College Jabalpur from March 2016 to July 2017. The study was conducted on 80 children after obtaining informed consent from parents.

Study design

This was a prospective and observational study done in NRC unit and ward in tertiary care hospital, Jabalpur

after obtaining approval from institutional ethical committee.

Inclusion criteria

- All children suffering from malnutrition (fulfilling the WHO criteria) and admitted in the Department of Pediatrics (NRC and ward).
- Children whose parents give written consent for the same.

Exclusion criteria

- Children with severely ill and chronic illness e.g. HIV, TB etc.
- Nonconsenting parents.

Ethical issues

A written informed consent from parents was obtained at the time of admission. Clearance from Institutional ethical committee was taken prior to start of study. All participants had the option to withdraw from the study.

Data collection

Data of admitted malnourished children in NRC was analysed and categorized on the basis of severity of malnutrition by anthropometric measurements (weight, height/length, weight for height, midarm circumference). Thyroid hormone profile [T3, T4 and TSH]

Method of the study

A total of 80 children aged 1 to 5 years were included in the present study after obtaining written informed consent from parents/guardian. They were divided into two groups SAM and MAM of 40 each. Details entered in predesigned proforma. Serum triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH), serum total protein and serum albumin estimation done in both group.

Anthropometry

Detailed clinical assessment of nutritional status followed by anthropometric measurement (weight, height/length, weight for height, mid upper arm circumference) were recorded in a predesigned proforma. The cases were categorized into moderate malnutrition (z-score between -2SD and -3SD) and severe malnutrition (z-score below -3 SD) as per WHO classification (weight for height).

Weight was taken on a digital weighing scale. Height (>2 yr) was measured by Stadiometer and for infants' length was taken by infant-meter. Mid upper arm circumference was taken on the left arm, with a non-stretchable tape passed around the arm at the midpoint, between acromion and olecranon process.

Weight for height was taken through z score chart.

T₃, T₄, TSH levels was estimated by Chemiluminescence method.

Taking aseptic precaution, 3ml of venous blood was collected and was kept in EDTA (Ethylene Diamine Tetra Acetic Acid) vacutainer and test tube. The blood sample was then centrifuged at 5000 rpm (rotation per minute) for 5 minutes; serum thus obtained was used to estimate T3, T4, TSH were by using (Immulite1000 Immunoassay system- Siemens). The data obtained was entered in MS Excel spread sheet; the results were expressed in mean±standard deviation (SD) for continuous variables and as percent (%) for categorical data. Observations were statistically analyzed using Epi Info software version 3.5.1. Descriptive statistics was applied for categorical data. Independent sample- t test, used. P value of <0.05 was considered statistically significant.

Microsoft word and Excel (2007) were used to generate figures and tables. Serum total proteins level estimated by Biuret method, Serum albumin estimated by Bromocresol green (BCG dye) method.

Statistical analysis plan

The data of the present study was recorded, validated, checked for error; coding and decoding compiled and analyzed with the help of SPSS 20 software for windows. Appropriate univariate and bivariate analysis and the descriptive statistics done. All means were expressed as mean±standard deviation and the proportion in percentage (%).

RESULTS

Total 80 children, equal no. of SAM and MAM, female were 47.5% and 52.5% were male with 86% > 2-year age.

Table 2: Frequency distribution table of malnourished children with age groups.

Age group	Frequency (n)	Percentage
<2 year	11	13.8
>2 to <4 years	35	43.8
>4 year-5 years	34	42.5
Total	80	100

Table 3: Frequency distribution table of malnourished children with gender groups.

Gender	Frequency(n)	Percentage
Male	42	52.5
Female	38	47.5
Total	80	100

Age wise distribution of the study cohort is shown in Table 2. As per this table malnourished children were more (86.25%) in age group of above 2 years.

Gender wise distribution of the study cohort is shown in Table 3. We inferred that 52.5% of malnourished children were males and 47.5% children were females.

Mean value of T3, T4, TSH were 99.3 ng/dl, 6 ug/dl, and 2 mIU/l. The maximum value of T3, T4, TSH were 134 ng/dl, 11.5 ug/dl, 4.7 mIU/l and minimum value were 84 ng/dl, 1.8 ug/dl, 0.5 mIU/l respectively.

Table 4: Thyroid profile and protein level in malnourished children.

Parameters	Mean	95%CI	Median	Min. value	Max. value
Т3	99.3	96.5- 102.0	95.5	84.0	134.0
T4	6	5.6-6.5	6.0	1.8	11.5
TSH	2	1.8-2.2	1.8	0.5	4.7
T. Protein	4.8	4.7-4.9	4.9	3.8	5.0
Albumin	2.6	2.5-2.7	2.5	2.0	3.8

Mean values of total protein and albumin were 4.8 gm/dl and 2.6 gm/dl.

Amongst the 80 children mean values of T3 in MAM and SAM patients were 106 ng/dl and 91.87 ng/dl respectively. There was a statistical significant (p <0.001) association between decreased T3 and type of malnutrition. Similarly, mean values of T4 in MAM and SAM patients were 6.53 ug/dl and 5.62 ug/dl respectively i.e. within normal limits yet there was a significant (p <0.05) association between decreased T4 and type of malnutrition i.e. the value was low in SAM as compared to MAM patients.

Table 5: Laboratory parameters of MAM and SAM children.

Parameters	MAM (Mean±SD)	SAM (Mean±SD)	t- test	p- value
T3	106.7±13.4	91.8±3.5	6.7	< 0.001
T4	6.5±2.3	5.6±1.2	2.0	< 0.05
TSH	1.9±1.0	2.1±0.9	0.9	0.32
T. Protein	5.3±0.3	4.3±0.4	13.0	< 0.001
Albumin	2.8±0.3	2.3±0.2	10.2	< 0.001

The mean values of TSH in MAM and SAM patients were 1.89 miu/l and 2.11 miu/l respectively i.e. within normal limits and not statistically significant (p<0.32).

Mean value of total protein in MAM and SAM patients were 5.27 gm/dl and 4.31 gm/dl. Result is significant with (p<0.05) positive correlation between decreased albumin and the type of malnutrition.

Mean value of albumin in MAM and SAM patients were 2.84 gm/dl and 2.29 gm/dl. Result is highly significant with (p<0.001) positive correlation between decreased albumin and the type of malnutrition.

Table 6: Association of protein energy malnutrition with T3 by age (mean T3).

Age groups	SAM (Mean T3±SD)	MAM (Mean T3±SD)	Total (Mean T3±SD)
<2 year	94.83±3.5	105.6±14.6	99.72±11.1
>2 year to year	90.9±3.2	103.4±10.9	97.0±10.04
≥4 year	91.8±3.4	110.2±15.1	101.5±14.5

Table 6 represents age wise distribution of mean of T3 among SAM and MAM children low T3 value was higher among SAM children in 2 year and above age group compared to respective MAM children with p value <0.0 which is statistically significant.

Table 7: Association of protein energy malnutrition with T4 by age.

Age groups	SAM (Mean T4±SD)	MAM (Mean T4±SD)	Total (Mean T4±SD)
<2 year	6.5±0.5	5.7±2.3	6.1±1.6
>2 year to <4 year	5.3±1.1	6.4±2.3	5.8±1.9
≥4yr	5.6±1.4	6.8 ± 2.4	6.2±2.1

Table 7 represents age wise distribution of mean of T4 among SAM and MAM children. Lower values of T4 was higher among SAM children in 2 years and above age group compared to respective MAM children with p value .0.05 and high T4 value in less than 2 years age group of SAM children were both statistically insignificant.

Table 8: Association of protein energy malnutrition with TSH (mean) by age.

Age groups	SAM (Mean TSH±SD)	MAM (Mean TSH±SD)	Total (Mean TSH±SD)
<2 year	1.8±0.3	1.4±0.6	1.6±0.5
>2 year to <4 years	2.1±0.9	1.5±0.8	1.8±0.9
≥4 years	2.3±1.0	2.4±1.1	2.3±1.0

Higher mean Values of TSH was found in SAM compared to MAM children in less than 4 years age group. Among more than 4 years age group MAM children were having higher TSH value in the present study. Table 9 shows the mean values of total proteins among SAM and MAM children age wise. We observed that total protein values were lower in SAM children than MAM children of all age groups.

Table 9: Association of protein energy malnutrition with total protein (mean) by age.

Age groups	SAM (Mean T. Protein ±SD)	MAM (Mean T. Protein ±SD)	Total (Mean T. Protein ±SD)
<2 yr	4.3±0.5	5.3±0.3	4.8±0.6
>2 yr to <4 yr	2.3±0.4	5.3±0.3	4.8±0.6
≥4 yr	4.3±0.4	5.2±0.3	4.8±0.6

Table 10: Association of malnutrition with serum albumin (mean) by age.

Age groups	SAM (Mean S. albumin±SD)	MAM (Mean S. albumin±SD)	Total (Mean S. albumin ±SD)
<2 yr	2.3±0.1	2.9±0.2	2.6±0.4
>2 yr to < 4 yr	2.3±0.2	2.8±0.2	2.6±0.3
\geq 4 yr	2.3±0.2	2.8±0.3	2.6±0.4

Age wise distribution of albumin values of SAM and MAM children is shown in Table 10. Mean albumin values were lower in SAM in all age groups as compared to MAM children.

DISCUSSION

Globally protein energy malnutrition continues to be a major health burden in developing countries. In India, almost half of children under the age of 5 years suffer from PEM. PEM is a multisystem disease and involves almost all organs of the body, failure in homeostatic mechanism of the body and leading to increased susceptibility to infections. PEM is associated with a decrease in the synthesis of serum proteins has an indirect or direct effect on hormones levels in our body. The study was conducted to know the thyroid status in MAM and SAM children and the correlation of thyroid hormone with serum total protein and albumin.

In the present study, we observed that majority of malnourished children belong to above 2 years of age (86.25%) (Table 2). Similar study and results were reported by Yadav SS et al.¹²

Contradictory results were reported by Chakraborty S et al where majority of malnourished children belonged to less than 2-year age group. 13 52.5% of malnourished children were males and 47.5% children were females in the present study (Table 3) Similar results were reported by Chakraborty S et al. 13

Contradictory result was reported by Yadav SS et al where malnourishment was more common among female children.¹²

Higher incidence of PEM among males observed in the present study could be explained by gender biased presentation of children to health care facilities. Female children are usually ignored in terms of nutrition and growth in most parts of our nation.

In the present study on malnourished children mean value of T3, T4, TSH were 99.3 ng/dl, 6 ug/dl, and 2 mIU/l respectively (Table 4) which were low compared to the standard values. Low mean values in PEM cases indicates that there is low conversion of T4 to T3, the reasons may be proteins required for the enzyme which converts T4 to T3. However, when the malnutrition becomes more severe, the reserves are exhausted and there is decreased thyroid secretion rate as well, leading to lowered T4.

Mehta S et al, Mean T3, T4 and TSH levels in PEM group was 122.58 ng/dl, $9.18 \mu g/dl$ and 2.51 mIU/l.^{14}

Abrol P et al, Mean T3, T4 and TSH levels in PEM group was 107.7, 8.3 and 2.6 respectively, which were higher than the mean values of the present study.⁶ This could be substantiated by the fact that severity of malnutrition is higher in Madhya Pradesh in comparison to other Indian states.

Mean values of total protein and albumin were 4.8 gm/dl and 2.6 gm/dl in the present study, lower than the standard values. This is in accordance with the fact that as the severity of hypo-proteinemia increases the severity of PEM increases and there was a positive correlation between severity of PEM and degree of hypo-proteinemia.

Dhanjal GS et al reported the mean serum total protein and albumin in the cases was 5.9 gm/dl and 3.4 gm/dl respectively in their study which was comparable to our observations.¹⁵

Mean values of T3 in MAM and SAM patients were 106ng/dl and 91.87ng/dl respectively (Table 5). There was a highly significant (p<0.001) association between decreased T3 and type of malnutrition.

The mean values of T4 in MAM and SAM patients were 6.53ug/dl and 5.62 ug/dl respectively (Table 5). Though the levels were within normal limits there was a significant (p <0.05) association between decreased T4 and type of malnutrition i.e. the value was low in SAM as compared to MAM patients.

We observed the mean values of TSH (Table 5) in MAM and SAM patients were 1.89 mIU/l and 2.11 mIU/l respectively in the present study. The levels were within normal limits. There was a no significant (p<0.32) association between TSH and type of malnutrition.

Kumar S et al studied effect of malnutrition on thyroid Hormone, he concluded that with increasing severity of

malnutrition, the serum concentration of T3 and T4 progressively decreased and that of serum TSH increased. ¹⁶ The results of this study support the present results in which serum concentration of T3, T4 were progressively decreased with the severity of malnutrition.

Turkay et al studied effect of energy malnutrition on circulating thyroid hormones. The effect of protein energy malnutrition (PEM) in the children on serum levels of total thyroxine (TT4), total triiodothyronine (TT3) and thyrotropin (TSH) were evaluated. Their results suggest that the children remained euthyroid and represent an adaptive response to protein energy malnutrition.

Dhanjal GS et al also concluded that the levels of biochemical variables, decreases as the severity of malnutrition increases.¹⁵ The difference within the cases (moderate and severe malnutrition) was also found to be statistically significant.

Khatun FUH et al in their study on Thyroid function in children with PEM made an observation that there was decrease in serum concentration of both T3 and T4, which may possibly be due to a deficiency of protein or due to a blockade in the incorporation of iodine into thyroid hormone at some stage after iodide transport into the gland.¹⁷

In 1983 Onuora et al in their study on thyroid status with various degree of protein calorie malnutrition (PCM) noted that T3 was low in all cases of PCM. ¹⁸ T4 was low in kwashiorkor, Marasmus-kwashiorkor and they found that T3, T4 levels correlated with the levels of plasma proteins in the undernourished, marasmus and kwashiorkor states.

In the present study, mean total protein values in MAM and SAM patients were 5.27 gm/dl and 4.31 gm/dl and is significant with (p<0.05) positive correlation between decreased albumin and the type of malnutrition.

Mean albumin values in MAM and SAM patients were 2.84~gm/dl and 2.29~gm/dl and is highly significant with (p <0.001) positive correlation between decreased albumin and the type of malnutrition.

Valinjkar SK et al also in their Mumbai study calculated the mean values of the same parameters among MAM and SAM children and values were comparable to the present study.¹⁹

On further evaluating the age wise distribution (Tables 6, 7 and 8) of T3, T4 and TSH of SAM and MAM children. T3 was low in SAM children of all age groups when compared to MAM children, T4 was low in SAM children of age groups more than 2 years when compared to MAM children. High TSH level were found in all age group SAM children when compared to MAM. In less

than 2 years age group T4 was lower among MAM compared to SAM.

CONCLUSION

These findings conclude that higher the severity of malnutrition lower the thyroid hormone level irrespective of age which was statistically significant with a p value <0.01. This study need further validation.

ACKNOWLEDGEMENTS

Authors acknowledge their indebtedness to their mentor and guide Dr. Monica Lazarus, Assistant Professor, Department of Paediatrics, N.S.C.B. Medical College, Jabalpur.

Finally, Authors would like to thank all their seniors, batchmates and juniors for their support and the attendants of their patients for cooperation.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

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Cite this article as: Lazarus M, Kashyap AK, Borkar R, Ajmariya M. Study of thyroid profile in malnourished children (6 months - 5 years) admitted in the nutritional rehabilitation centre and paediatric ward NSCB Medical College Jabalpur, India. Int J Contemp Pediatr 2018;5:1072-7.