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*RESEARCH ARTICLE*

# STUDY OF THYROID HORMONE ALTERATIONS IN MALNOURISHED CHILDREN AGED 6 MONTHS TO 5 YEARS IN A TERTIARY CARE SETTING.

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## Abstract

**Background**: Malnutrition continues to pose a serious threat to child health in low-resource settings, contributing to high rates of disease and mortality in early childhood. This study focuses on analyzing thyroid hormone levels in malnourished children aged 6 months to 5 years admitted to a tertiary care hospital in Srinagar, Kashmir.

**Material and Methods**: This observational, cross-sectional study was conducted at the Pediatric Department of GMC Srinagar from May 2024 to April 2025. A total of 70 children with malnutrition were enrolled and classified into moderate (MAM) and severe (SAM) malnutrition based on WHO standards. Comprehensive clinical assessment, including nutritional status and anthropometric measurements, was carried out. Laboratory evaluation included serum levels of T3, T4, TSH, total protein, and albumin. Data were analyzed to identify differences between the MAM and SAM groups.

**Results:** Significantly lower levels of T3, T4, serum protein, and albumin were found in children with SAM compared to those with MAM ($p < 0.001$). TSH levels did not show a notable difference between the two groups. A significant link was also observed between low T3 levels and reduced albumin concentrations.

Conclusion: The findings suggest that thyroid dysfunction, including low T3, may be a protective metabolic adaptation in malnourished children to conserve vital resources like protein and energy.



## Introduction:-

Childhood malnutrition continues to exact a heavy toll on global health, undermining growth, immunity, and neurodevelopmental potential. Beyond the well-recognized anthropometric and immunological derangements, protein energy malnutrition exerts profound effects on endocrine function—yet the thyroid axis in particular remains understudied. Thyroid hormones orchestrate critical processes of metabolism, thermoregulation, and brain maturation; disruption of their homeostasis during key windows of development can compound the adverse sequelae of undernutrition.

The prevalence of Severe Acute Malnutrition (SAM) in India has risen from 6.6% in 2005-2006 to 7.7% in 2019-



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2021. The rates of SAM also vary across different districts in the country, ranging from 6.5% to 19.5% [1]. Children suffering from SAM are at a significantly higher risk of mortality and morbidity, with a 9-11 times greater likelihood compared to healthy children. Even with appropriate inpatient care based on WHO protocols [2], the case fatality rate for SAM children is alarmingly high, ranging between 3.4% and 35%, particularly among those with oedema [3, 1]. Malnutrition has profound effects on the overall growth, development, and organ function in children [4]. Alterations in nutritional status can influence thyroid hormone function, particularly the peripheral metabolism of these hormones, in addition to impacting various organ systems. Thyroid hormones such as triiodothyronine (T3) and thyroxine (T4) are essential for proper regulation of lipid and carbohydrate metabolism, which are vital for normal growth and development [5,6]. Nutritional deficiencies in SAM, such as insufficient iodine, vitamin A, and iron, often lead to anemia. These deficiencies, in conjunction with altered thyroid hormone metabolism and secretion, cause a reduction in thyroid gland activity. This results in lower circulating levels of triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH), leading to disturbances in thyroid function. The mechanism behind these changes is associated with inadequate intake of protein and energy, which are hallmarks of malnutrition. Additionally, shifts in iodine metabolism and a decrease in circulating proteins play a crucial role in the altered thyroid function [7].

Despite existing literature on SAM and thyroid function, there is limited research on the subject, with conflicting results, especially concerning T4 levels [3, 1]. This has prompted us to conduct this study to assess the serum thyroid hormone levels in children with SAM and explore their relationship with serum total protein and albumin levels.

**Materials and Methods:**

The study was conducted at the Nutritional Rehabilitation Centre, Department of Pediatrics, GMC Srinagar. It was a prospective, cross-sectional study carried out over one year, from May 2024 to April 2025. Ethical approval was granted by the Institutional Ethical Committee.

**Inclusion Criteria**

All children aged 6–59 months with malnutrition who were admitted to the NRC.

Exclusion criteria

Children with metabolic disorders

Children suffering from chronic infections or malabsorption syndromes

Children with major congenital anomalies

Non-consenting parents

All children meeting the inclusion and exclusion criteria were enrolled in the study. Demographic details and clinical history (such as dry skin, constipation, psychomotor retardation, and cold extremities) were recorded in a pre-designed proforma. A thorough anthropometric assessment and systemic examination were performed on all children.

SAM and MAM was defined according to the WHO criteria[8].

**Anthropometric Measurements**

For children over 1 year of age, weight was measured using a digital weighing scale, and for infants, an infant digital weighing scale was used. Weight was recorded to the nearest 100g. Height for children older than 2 years was measured with a stadiometer, while for infants, length was recorded using an infantometer.

Children above 2 years were instructed to stand with their heels, buttocks, shoulder blades, and occiput touching the wall, and the Frankfurt plane parallel to the ground.

Mid-arm circumference (MAC) was measured over the left triceps, with the arm hanging naturally by the side. A non-stretchable tape was wrapped around the arm at the midpoint between the acromion process and olecranon process.

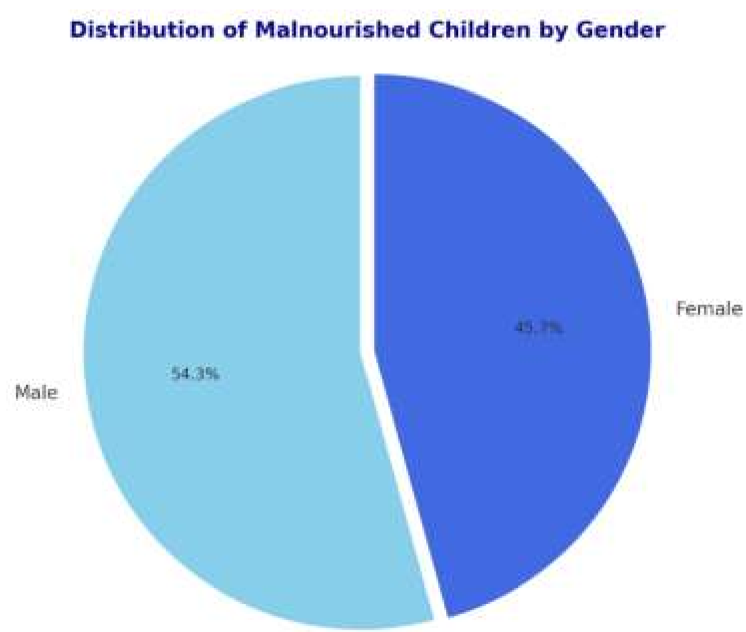
To calculate weight-for-height, the child's weight was divided by the ideal weight of a healthy child of the same

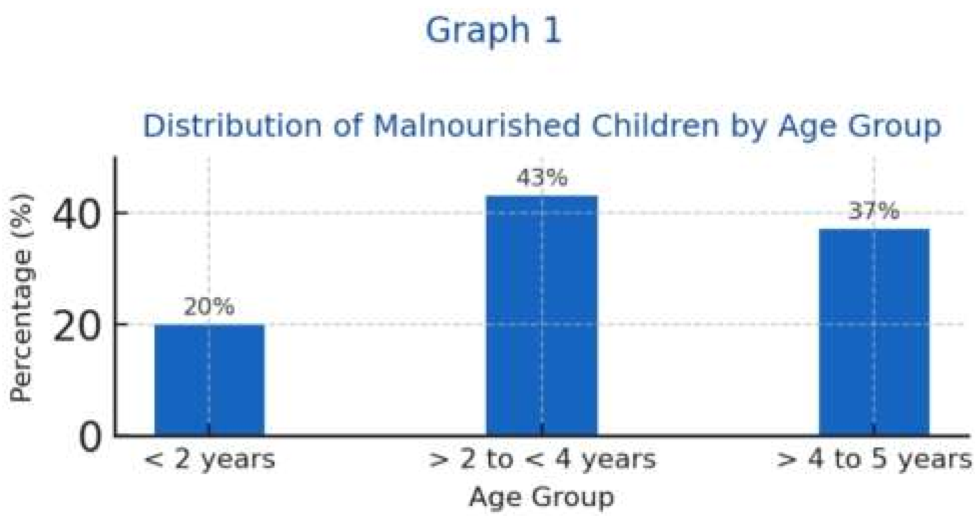
height and multiplied by 100.
The child's length/height was measured to the nearest centimeter, MAC to the nearest millimeter, and both head and chest circumference were measured to the nearest 0.5 cm.

**Sample Blood Collection**
Under strict aseptic conditions, 3 ml of venous blood was drawn and collected into a plain test tube without any anticoagulant. The sample was then centrifuged to separate the serum, which was subsequently used for the estimation of total T3 (TT3), total T4 (TT4), TSH, total protein, and albumin levels. TT3, TT4, and TSH levels were measured using the chemiluminescence technique. Serum total protein was determined using the biuret method, while serum albumin was assessed using the bromocresol green dye method.

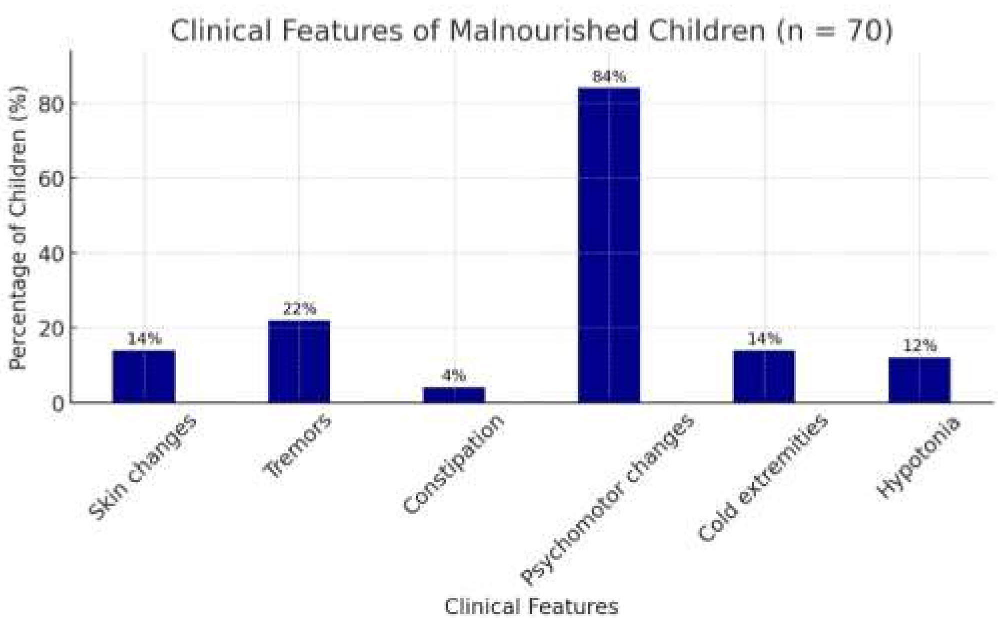
**Stastical Analysis Plan**
The data collected were compiled using Microsoft Excel. Continuous variables were summarized as mean ± standard deviation (SD), whereas categorical variables were represented as percentages. Statistical comparisons were made using the Chi-square test. All analyses were conducted using SPSS software, and a p-value of less than 0.05 was taken to indicate statistical significance. Standard reference ranges were used to interpret values of TT3, TT4, and TSH [9].

**Results**:
A total of 70 children were included in the study, with 54% being males and 46% females. As illustrated in Graph 1, 80% (56 children) were older than 2 years. Elevated TSH levels indicating hypothyroidism were observed in 4 children (7%). However, none of these children exhibited any clear clinical signs or symptoms associated with hypothyroidism.






As in table 2, the association between thyroid function (T3, T4, TSH) and serum levels of total protein and albumin was analyzed. While no statistically significant correlation was found between total protein, serum albumin, and thyroid hormones overall, a significant association was noted between low serum albumin and T3 levels ($P = 0.019$). The average values of T3, T4, and TSH were 99.3 ng/dL, 6 µg/dL, and 2 mIU/L, respectively. The maximum recorded levels were 130 ng/dL for T3, 10.9 µg/dL for T4, and 4.9 mIU/L for TSH. The minimum values observed were 84 ng/dL for T3, 1.8 µg/dL for T4, and 0.5 mIU/L for TSH. Mean total protein and serum albumin levels were 4.8 g/dL and 2.6 g/dL, respectively.



| Table 2: Demographic profile of malnourished children (n = 70) | | |
|---|---|---|
| S. No. | Variables | Results |
| 1 | Age in months (mean) | 19 ± 2.1 |
| 2 | Gender (M:F ratio) | 1.2:1 |
| 3 | Socioeconomic status Class IV and V | 70 |
| 4 | Clinical features (%) | |
| | Skin changes | 10 (14%) |
| | Tremors | 15 (22%) |
| | Constipation | 3 (4%) |
| | Psychomotor changes | 59 (84%) |
| | Cold extremities | 10 (14%) |
| | Hypotonia | 8 (12%) |
| 5 | Mean T3 (ng/dl) | 99.3 |
| | Mean T4 (mcg/dl) | 6 |
| | Mean TSH (mIU/L) | 2 |
| 6 | Mean total albumin (g/dl) | 2.6 |
| | Mean total protein (g/dl) | 4.6 |

Among the 70 children included in the study, the average T3 levels in children with Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) were 108 ng/dL and 90.26 ng/dL, respectively. A statistically significant association was found between T3 levels and the type of malnutrition ($p < 0.001$).

The mean T4 levels in the MAM and SAM groups were 6.82 µg/dL and 5.42 µg/dL, respectively. Although both values were within the normal range, the difference was statistically significant ($p < 0.05$), with lower T4 levels observed in SAM cases compared to MAM.

The average TSH levels in MAM and SAM patients were 1.87 mIU/L and 2.31 mIU/L, respectively. However, this difference was not statistically significant ($p = 0.32$).

| Table 3: Laboratory parameters of MAM & SAM children | | | |
|---|---|---|---|
| Parameters | MAM (Mean±SD) | SAM (Mean±SD) | p-value |
| T3 | 108.2 ± 13.2 | 90.2 ± 3.2 | < 0.001 |
| T4 | 6.8 ± 2.4 | 5.4 ± 1.3 | < 0.05 |
| TSH | 1.8 ± 1.0 | 2.3 ± 0.8 | 0.32 |
| Total Protein | 5.4 ± 0.3 | 4.1 ± 0.3 | < 0.001 |
| Albumin | 2.9 ± 0.3 | 2.2 ± 0.2 | < 0.001 |

The mean total protein levels in children with MAM and SAM were 5.42 g/dL and 4.11 g/dL, respectively. This difference was statistically significant ($p < 0.001$), indicating a positive correlation between reduced total protein levels and the severity of malnutrition. Similarly, the mean serum albumin levels in the MAM and SAM groups were 2.91 g/dL and 2.23 g/dL, respectively. This finding was also highly significant ($p < 0.001$), showing a strong positive association between lower albumin levels and more severe forms of malnutrition.

**Discussion**:

Malnutrition is a condition that affects multiple systems in the body, involving nearly all organs. One of its key effects is the reduced production of serum proteins, which can influence hormone levels either directly or indirectly. This study aimed to assess thyroid function in children with SAM and MAM, and to explore the relationship between thyroid hormone levels and serum total protein and albumin concentrations. In our study, most of the malnourished children (80%) were over two years of age, aligning with findings from Yadav et al. [10]. The gender distribution showed a slight male predominance, with 53% boys and 47% girls, similar to observations made by Chakraborty S et al. [11]. The mean values of T3, T4, and TSH in this study were 99.3 ng/dl, 6 µg/dl, and 2 mIU/L, respectively (Table 3), all of which were found to be lower than the normal range. These low levels suggest a reduced conversion of T4 to T3, likely due to a deficiency in the proteins needed for the enzymes responsible for this conversion. As malnutrition progresses to more severe stages, the body's protein reserves become depleted, leading to a decrease in thyroid hormone secretion and further lowering T4 levels. In a study by Chandrashekaraiah et al., the mean values of T3, T4, and TSH were 110 ng/dl, 8.2 µg/dl, and 2.5 mIU/L, respectively, while Abrol P et al. reported mean levels of 107.7 ng/dl, 8.3 µg/dl, and 2.6 mIU/L. These values were higher than those observed in our study, possibly due to a higher severity of malnutrition in other regions [12].

In our study, the mean values for total protein and albumin were 4.6 g/dl and 2.6 g/dl, respectively. The degree of hypoproteinemia increased with the severity of malnutrition, and a positive correlation was found between the severity of protein-energy malnutrition (PEM) and the extent of hypoproteinemia. Dhanjal et al. reported mean serum levels of total protein and albumin as 5.9 g/dl and 3.4 g/dl, which are comparable to our findings [13].

When comparing the thyroid hormone values between MAM and SAM children, the mean T3 levels were 108 ng/dl for MAM and 90.3 ng/dl for SAM, with a significant association observed between T3 levels and the type of malnutrition. The mean T4 levels were 6.8 µg/dl for MAM and 5.42 µg/dl for SAM, showing a significant difference ($p < 0.05$), with lower values in SAM compared to MAM. However, the mean TSH levels in MAM (1.87 mIU/L) and SAM (2.31 mIU/L) were not statistically significant. Interestingly, 7% of children had elevated TSH levels, though they did not exhibit any overt symptoms of hypothyroidism.

This could be due to an exaggerated compensatory response triggered by the stimulation of TRH or impaired breakdown of TSH in children with SAM. The findings of the current study align with those of Kumar S et al., who reported that the serum concentrations of T3 and T4 decrease progressively with the worsening severity of malnutrition [14]. In contrast, Turkay et al. examined the impact of malnutrition on T3, T4, and TSH levels, and their results suggested that children in this condition often remain euthyroid, which could be considered an adaptive mechanism to malnutrition [15].

In our study, the mean total serum protein levels were 5.4 g/dl in the MAM group and 4.11 g/dl in the SAM group, with a statistically significant difference ($p < 0.05$). The mean albumin levels were 2.9 mg/dl in MAM and 2.23 mg/dl in SAM, with a strong positive correlation ($p < 0.001$) between albumin levels and the type of malnutrition. These results were similar to those observed in the study by Valinjkar SK et al. conducted in Mumbai [16].

**Conclusion**:

Malnutrition in children is linked to reduced thyroid hormone levels, which likely represents an adaptive response that helps the body conserve energy and protein in the face of illness.

**Refrences**:

[1] Sahu SK, Kumar SG, Bhat BV, Premarajan KC, Sarkar S, Roy G, Joseph N. Malnutrition among under-five children in India and strategies for control. J Nat Sci Biol Med 2015; 6(1): 18-23. https://doi.org/10.4103/0976-9668.149072

[2] World Health Organization. Updates on the management of severe acute malnutrition in infants and children 2013. Website: who.int> severe acute malnutrition. [Accessed on Sep 16, 2023].

[3] Ulahannan SK, Wilson A, Chhetri D, Soman B, Prashanth NS. Alarming level of severe acute malnutrition in Indian districts. BMJ Glob Health 2022; 7(4): e007798. https://doi.org/10.1136/bmjgh-2021-007798

[4] Chandrashekaraiah S, Ratageri VH, Kamath L. Thyroid status in children with severe acute malnutrition. Karnataka Pediatric Journal 2022; 36(4): 165-8. https://doi.org/10.25259/KPJ_13_2021

[5] Surewad GV, Ambatipudi K, Rao AV, Rao KN. Interrelation of free thyroid hormone levels and serum proteins in malnourished children at rural tertiary care hospital in Andhra Pradesh. Journal of Advanced Medical and Dental Sciences Research 2020; 8(11): 64-8.

[6] WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children. A Joint Statement by the World Health Organization and the United Nations Children's Fund 2009. [Last accessed on 2016 Sep15].http://www.who.int/nutrition/publications/severemalnutritio n/9789241598163/en/index.html

[7] Ingenbleek Y. Thyroid dysfunction in protein-calorie malnutrition. Nutrition reviews (USA) 1986; 48(8); 253-64. https://doi.org/10.1111/j.1753-4887.1986.tb07649.x

[8] WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children. A Joint Statement by WHO and UNICEF 2009; 2021. Available from: http//www.who.int/nutrition/publications/ severemalnutrition/9789241598163-eng.pdf.

[9] Jack J, Young SB, Nalley CM. Endocrinology. In: Hughes HK, Kahl LK, editors. The Harriet Lane Handbook. 21st ed. Amsterdam: Elsevier, Inc.; 2018. p. 263.

[10] Yadav SS, Yadav ST, Mishra P, Mittal A, Kumar R, Singh J. An epidemiological study of malnutrition among under five children of rural and urban Haryana. J Clin Diag Res. 2016;10(2):LC07-LC10

[11] Chakraborty S, Gupta SB, Chaturvedi B, Chakraborty SK. A study of protein energy malnutrition (PEM) in children (0 to 6 year) in a rural population of Jhansi district (UP). Indian J Comm Med. 2006;31(4):291.

[12] Abrol P, Verma A, Hooda HS. Thyroid hormone status in protein energy malnutrition in Indian children. Indian J Clin Biochem. 2001;16(2):221-3.

[13] Dhanjal GS, Singh M. Thyroid hormone status in children with protein energy malnutrition a hospitalbased case control study. Int J Contemp Pediatr. 2017;4(2):351-5.

[14] Kumar S, Nandkarni J, Dwivedi R. Thyroid hormone status in malnourished children. Indian Pediatr. 2009;46:263-4.

[15] Turkay S, Kus S, Gokalp A, Baskin E, Onal A. Effects of protein energy malnutrition on circulating thyroid hormones. Ind Pediatr. 1995;32:193-7.

[16] Valinjkar SK, Sutay NR, Prachi, Vikas. Thyroid status and serum protein levels in severe and moderate acute malnourished children. JMSCR. 2016;4(1):5059-67.