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Evaluation of Thyroid Profile in Children (6 Months-5 Years) with Severe Acute Malnutrition in Nutrition Rehabilitation Centre in a Tertiary Care Centre

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ABSTRACT
Thyroid hormones play a vital role in growth and development of children, modulate neuronal migration, intellectual growth and thermoregulator and absence of thyroid hormones during the critical period of brain development profoundly compromises cognitive function. Thus thyroid hormone status is important especially in these children with PEM. A total of 120 children were included in the study after considering inclusion and exclusion criteria. 60 children were taken as cases based on WHO criteria for diagnosis of severe acute malnutrition (SAM), the other 60 children were age and sex matched children attending pediatric OPD. Serum TSH, serum T3, serum T4 were assessed by chemiluminescent technique. The mean serum T3, T4, serum total protein, serum albumin, serum globulin levels among cases were 136.11+27ng/dl, 9.6+1.8mcg/dl, 6.33+0.96mg/dl, 3.6+0.96mg/dl and 2.43+0.42mg/dl respectively, which were significantly low when compared to controls with a p value <0.05 in each parameter mentioned. There was no significant difference in serum TSH levels between the two groups.

INTRODUCTION

WHO estimates that about 60% of all deaths, occurring among children aged less than 5 years in developing countries could be attributed directly or indirectly to malnutrition[1]. Three quarters of the world's stunted children live in South Asia and Sub-Saharan Africa. A variety of endocrine abnormalities have been reported in protein energy malnutrition, like changes in growth hormone, insulin, glucocorticoid, thyroid hormone as a part of reductive adaptation[2]. Thyroid hormones play a vital role in growth and development of children, modulate neuronal migration, intellectual growth and thermoregulation and absence of thyroid hormones during the critical period of brain development profoundly compromises cognitive function. Thus thyroid hormone status is important especially in these children with PEM[3,4].

MATERIALS AND METHODS

Source of Data:

Cases: Children in the age group 6 months- 60 months, diagnosed to have severe acute malnutrition according to WHO definition i.e.,

- Weight/height <-3SD.
- Mid upper arm circumference <11.5 cm.
- Bilateral pedal edema admitted in Nutritional Rehabilitation Centre.

Controls: Children in the age group 6 months-60 months found to be anthropometrically normal for age, attending outpatient department which were age and sex matched with that of children among cases.

Method of Collection of Data Sample Size: A minimum sample size of 120 subjects, 60 subjects in each group, i.e., cases and controls was calculated based on the prevalence of 17% malnourished children based on NFHS 4 survey at 0.05 significance level using the formula: n=Z2pq/d2.

Where,

Z=1.96, p is the prevalence of disease, d=90% confidence interval, q=1-p.

Sampling Method: Simple random sampling.

Type of Study: Cross sectional comparative study.

Inclusion Criteria:

Cases: Children with.

- Age 6 months-60 months.
- Diagnosed as severe acute malnutrition according to criteria given by WHO.
- Admitted in the department of Paediatrics under NRC ward.

Controls: Children with.

- Age group 6 months-60 months.
- Anthropometrically appropriate for age.
- Attending the outpatient department.
- Matched with age and sex of children included in cases.

Exclusion Criteria:

Cases:

- Severe acute malnutrition with edema, micronutrient deficiency, dermatosis.
- Previously diagnosed thyroid disease.
- Children on treatment with drugs that could interfere with thyroid function tests like glucocorticoids, furosemide, phenobarbitone, carbamazepine.

Controls:

- Children with acute illness.
- Previously diagnosed case of thyroid disease.
- Children on treatment with drugs that could interfere with thyroid function tests, like glucocorticoids, furosemide, phenobarbitone, carbamazepine.

Method of Study: A total of 120 children in the age group 6 months-60 months were randomly selected for the study. Out of these 120 children, 60 children were those who were diagnosed to be having severe acute malnutrition based on WHO diagnostic criteria and hospitalized in NRC, Cheluvamba hospital, Mysuru were considered as cases and the other 60 children who were age and sex matched, who visited OPD, who were anthropometrically normal for their age were considered as controls. Written informed consent was obtained from parents/local guardian. The demographic details, mother's anthropometry, significant antenatal, birth and postnatal history, child's past history of recurrent infection/ hospitalization, immunization status, detailed diet history, socioeconomic status, social stressors, anthropometric measurements and detailed clinical examination findings were noted in a predesigned proforma.

RESULTS AND DISCUSSIONS

In our study, majority of the children i.e., 63.4% among cases belonged to the age group 6 months-24 months. Similar distribution was also seen among the control group with 61.7% children in the age group 6 months-24 months.

Table 1: Age Wise Distribution of Study Population

Age group	Cases	Percentage	Control	Percentage
6 months - 12 months	19	31.7%	21	35.0%
13 months - 24 months	19	31.7%	16	26.7%
25 months - 36 months	5	8.3%	6	10.0%
37 months - 48 months	10	16.7%	13	21.7%
49 months - 60 months	7	11.7%	4	6.7%

Out of 120 children in the study, males and females were equal in number among cases, whereas males were more among controls i.e., 53.3%.

Table 2: Gender Wise Distribution of Study Population

Gender	Cases	Percentage	Controls	Percentage
Male	30	50.0%	32	53.3%
Female	30	50.0	28	46.7

Among cases, 65% of mothers have conceived in the age group 21-25 year and the same pattern was observed in the control group as well. Teenage pregnancy (28.3%) was noted to be more among controls. Teenage pregnancies associated with complications, preterm labor, low birth weight may have direct or indirect effect on growth of the child later.

Table 3: Distribution According to Age of Mother at Conception

Age group of mother (years)	Cases	Percentage	Control	Percentage
18-20	`9	15	17	28.3
21-25	39	65	37	61.7
26-35	12	20	6	10

Table 4: Weight Gain Noted Ding Pregnancy Among Mothers of Children Included in Cases and Controls

Weight gain (Kg)	Cases	Percentage	Controls	Percentage
4-5	15	25	29	48.3
5.1-6	29	48.3	23	38.3
6.1-7	15	25	8	13.3
7.1-8	1	1.7	0	0

Average weight gain of Indian women in pregnancy in a full term pregnancy is about 7Kg. In the present study, 48.3% of mothers of children taken as cases had a weight gain of 5.1-6Kg and 48.3% of mothers of children considered in control group had a weight gain of 4-5 Kg and no significant difference of weight gain in mothers during pregnancy was observed between the two groups.

Table 5: Comparison of Thyroid Function Tests Among Cases and Controls

	Cases	Standard deviation	Controls	Standard deviation
Mean T3 (ng/dL)	136.11	27.0	175.16	15.8
Mean T4 (mcg/dL)	9.60	1.86	10.35	1.40
Mean TSH (mIU/L)	2.38	1.05	2.411	0.64

As there is a significant difference in the circulating T3, T4 levels in children with SAM, we analyzed the levels of proteins, albumin and globulin simultaneously as they have a major role in carrying these hormones in the circulation. The mean total proteins was 6.33+/-0.96mg/dl among cases and was 7.09+/-0.26 mg/dl among controls ($p<0.05$), which was statistically significant. I also found that mean serum albumin and serum globulin levels were significantly low among cases when compared to controls ($p<0.05$ in both parameters).

Table 6: Comparison of Mean Total Protein, Mean Serum Albumin, Mean Serum Globulin Levels Between Cases and Controls

	Cases	Standard deviation	Controls	Standard deviation
Mean total protein (mg/dL)	6.33	0.96	7.09	0.26
Mean serum albumin (mg/dL)	3.644	0.51	4.034	0.32
Mean serum globulin (mg/dL)	2.438	0.42	2.845	0.32

Malnutrition is one of the causes for false negative delayed hypersensitivity reactions, as it is the common cause of secondary immune deficiency. In developing countries like India, the effect of malnutrition on tuberculin sensitivity is very relevant. As these malnourished children have lower immunity, the cutoff for taking mantoux test as positive has been reduced from 10mm-5mm. In this study, there were 3 children with severe acute malnutrition with isolated Mantoux positive status with no clinical history suggestive of tuberculosis, no history of contact with tuberculosis and chest X ray was normal.

Table 7: Comparison of Mantaux Test Result Among Cases and Controls

Mantaux test	Cases	Percentage	Controls	Percentage
Positive	3	5	0	0
Negative	57	95	60	100

Malnourished children were noted to have significantly higher ESR. The mean ESR among children with severe acute malnutrition is significantly higher than the controls.

Table 8: Comparison of Age Group of the Study Subjects with Other Studies

Studies	Present study	[5]Monica Lazarus	[6]Sudhir Mehta	[7]Sapna Gupta[7]	[8]Turkey	[9]Sanjeev Kumar	[10]Gurudeep
Age group	6-60 months	6-60 months	12-60 months	6-60 months	2-60 months	12-60 months	12-60 months

The present study has comparable age group with other studies. Most of the cases in the present study were in the age group of 6-12 months (31.7% among cases). 25% among cases were in the age group 24-48 months. Studies conducted by Monica Lazarius and Gurudeep show maximum number of children with severe acute malnutrition in the age group 12-48 months. This may be because children start to depend more on their complementary feeding for growth.

Table 9: Comparison of Classification System Used to Classify Malnutrition with Other Studies

Studies	Present study	[5]Monica Lazarus	[6]Sudhir Mehta	[7]Sapna Gupta[7]	[8]Turkey	[9]Sanjeev Kumar	[10]Gurudeep
Classification of malnutrition	WHO	WHO	WHO	WHO	Gomez	Gomez	WHO

The classification system used to consider as severe acute malnutrition in our study was WHO, which is consistent with other studies.

Table 10: Comparison of Sex Ratio with Other Studies

Studies	Present study	[5]Monica Lazarus	[6]Sudhir Mehta	[7]Sapna Gupta[7]	[8]Turkey	[9]Sanjeev Kumar	[10]Gurudeep
Sexratio (M:F)	1.06:1	1.105:1	1.5:1	1.6:1	1.7:1	1:1	1.5:1

Another important observation in the present study was overall male preponderance, which was consistent with many other studies. As thought before, female preponderance was not seen in our study. The reason for getting a female preponderance in the yester years would be linked to the literacy rates of parents, neglect of female child in lower socioeconomic classes. Similar female preponderance was seen in the study conducted by Chakraborthy *et al.* With the facilities provided by the government and the increasing literacy rates might have helped to reduce this trend. Though teenage pregnancies are associated with many risk factors, present study revealed that 65% of the mothers among children having malnutrition had conceived at the age of 21-24 years, but it was not a significant maternal factor for childhood malnutrition in their children. No significant difference was found with regard to the age of conception between the two study groups. Similar results were shown by Ghimire, U., Aryal, B.K., Gupta, A.K. *et al.,* where 58.3% of the mothers with children noted to have malnutrition were in the age group 21-29 years. Another study conducted by Kebogile Mokwena and Jim Kachabe showed 44.4% incidence of malnutrition among mothers who conceived at the age of 16-20 years, but this was not statistically significant. As we know, low birth weight is a risk factor for developing malnutrition later, birth weight assessed in all children involved in the study did not show any significant difference between the two study groups. Similar conclusions were also drawn in a study by Kamran Ahmad, M. M. A. Faridi, Geetika Srivastava. Malnutrition is a state of secondary immune deficiency. Malnutrition impairs cell mediated immunity, phagocytic functions, complement system. Malnutrition especially SAM affects thymic development, reduces peripheral lymphocyte counts, which further compromises immunity. Mucosal and skin barrier function, chemotaxis, bacterial killing is impaired and thus they are prone to repeated infections. Infection causes energy loss on part of the individual, reduces productivity on the community level and increases the alarming spiral of malnutrition, poverty, disease. There was no significant increase in recurrent infection or repeated hospitalization among children with SAM in our study.

Table 11: Comparison of Mean T3, T4, TSH Among Malnourished Children with Other Studies

Thyroid function tests	Present study	[5]Monica Lazarus	[6]Sudhir Mehta	[7]Sapna Gupta[7]	[8]Turkey	[9]Sanjeev Kumar
Mean T3 in malnutrition group (ng/dL)	136.11+/-27.0	91.8+/-3.5	122.58 +/-35.51	106.4	111.5	120.7+/-43.9
Mean T4 (mcg/dL)	9.60+/-1.86	5.6+/-1.2	9.18+/-9.2	7.04		10.3+/-8.52.7
Mean TSH (mIU/L)	2.38+/-1.05	2.1+/-0.9	2.51+/_1.16	2.28		0.6+2.6/-0.4

Thyroid hormones play a pivotal role in growth and development during infancy. Most of the endocrine glands show general atrophy in malnutrition, but most of the endocrine functions were preserved despite atrophic changes. The study revealed lower mean values of T3, T4 among malnourished children when compared to normal children of same age group. The difference was found to be statistically significant (T3: $p<0.05$., T4 $p<0.05$). The mean TSH values among children with severe acute malnutrition was found to be 2.38 whereas the mean TSH among normal children of same age was 2.41, which was found to be similar in both groups. Similar results were also noted in the above mentioned studies where WHO criteria was used for classification of malnutrition. In the study conducted by Turkay *et al.*, where they had used Gomez classification to grade malnutrition, it was found that mean T4 levels were significantly low in grade III and grade IV protein energy malnutrition, T3 levels were low in all grades of protein energy malnutrition, mean TSH was similar among both malnourished and normal children. In another study conducted by Pankaj Abrol, where they used IAP classification to grade malnutrition, mean T3 levels were found to be significantly low in grade II, III, IV protein energy malnutrition, mean T4 were low in grades of protein energy malnutrition and the mean TSH was normal among malnourished and normal children.

CONCLUSION

Mean total proteins, mean serum albumin, mean serum globulin values were low among children with severe acute malnutrition. Mean T3, T4 values were low among children with severe acute malnutrition.

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