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Original Article

MALNUTRITION AND ITS ATTRIBUTES IN BETA THALASSEMIA MAJOR PATIENTS IN A GOVERNMENT TERTIARY CARE CENTRE IN SOUTH INDIA

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ABSTRACT

Background and Objectives: Beta thalassemia is a hereditary hemoglobinopathy characterized by the defects in the beta globin chain of haemoglobin. In India, For about 12000 infants born every year have major form of the disease and half of these patients die before reaching adulthood. Large proportion of these early deaths are due to malnutrition. With this background, this study was conducted with the objective to know the prevalence of malnutrition in Beta thalassemia major patients.
Methods: The present cross sectional observational study was carried among 100 children aged 6 months to 18 years with confirmed beta thalassemia major patients. A detailed history taking, examination was done. Based on BMI, malnutrition was assessed using age and sex specific WHO BMI charts. Statistical data was analysed by IBM SPSS 25.0 version software and statistical significance for all analyses was set at P<0.05.
Results: Among the study participants, 50.0% were malnourished with a mean body mass index of 14.46 kg/m2. the children with higher frequency of blood transfusion (adjusted odds ratio [AOR], 17.10; 95% CI, 12.4–22.5), the children with very low (≤ 5) pre transfusion Hb% (adjusted odds ratio [AOR], 15.80; 95% CI, 10.5–21.5) had a higher risk of malnutrition.
Interpretation & Conclusion: In our study half of the study participants had malnutrition, and lower pre transfusion hb, larger spleen size, Presence of hepatomegaly are the significant predictors of malnutrition in these patients.

Keywords: *Malnutrition; Thalassemia major; Body Mass Index.*

INTRODUCTION

Thalassemia is autosomal recessive single gene disorder. About 200 million people globally are affected by thalassemia, with half of these cases having the severe form of the disease that is beta thalassemia major. [1-3]

Beta thalassemia is a hereditary hemoglobinopathy characterized by the defects in the beta globin chain of haemoglobin. Homozygous and compound heterozygous forms have an imbalance in the production of alpha and non alpha globin chains, which results in ineffective erythropoiesis and decreased production of normal haemoglobin A. [4]

In India, For about 12000 infants born every year have major form of the disease {10% of global burden} and half of these patients die before reaching adulthood. Large proportion of these early deaths are due to malnutrition. [5]

There is multi factorial association for malnutrition in thalassemia. According to the existing literature, children with thalassemia have an average energy intake lower than the recommended daily dietary allowances. Most of them belong to a more economically weaker section of the society. As a result, thalassemia patients develop multiple micronutrients deficiency which can be quoted as “hidden hunger”. So, socio economic status and literacy of parents play a major role in this regard. [5]

So, this study was taken up to assess the malnutrition status in beta thalassemia patients and various factors influencing the same in them. So that early identification of malnutrition in these patients will help in the early management of malnutrition, so that the quality of life of these patients can be improved and thereby helping to reduce the early deaths associated with malnutrition in thalassemia major patients.

METHODOLOGY

This cross sectional observational study was conducted from August 2022 to January 2025 among 100 confirmed cases of beta thalassemia major children attending department of Paediatrics, Gulbarga institute of Medical sciences, Kalaburagi in the age group of 6months to 18years. Beta thalassemia major children who are having neurological disorders, complex syndromes/genetic disorders, chronic kidney disease or chronic lung disease were excluded from the study.

The study was conducted after obtaining the ethics committee approval from Institutional Ethics committee. Informed consent was obtained from all eligible participants after explaining the objectives and nature of this study in their own language.

Malnutrition was assessed in the study subjects as soon as they are first seen and enrolled into the study. A detailed history taking, examination and relevant investigations was done. Details such as age, sex, place of residence (rural or urban), caste, per capita monthly income , socio economic status (classified based on modified B G Prasad classification)[6], were taken. On examination, Length (for children less than 2 years), Height (for children more than 2 years), Weight was measured and BMI was calculated. Based on BMI, malnutrition was assessed using WHO BMI charts [7,8] and the effect of above factors on the malnutrition was assessed.

In our study, malnutrition was assessed in beta thalassemia major patients using WHO BMI growth charts. The BMI was plotted on age and sex specific WHO BMI charts. WHO BMI charts of birth to 5 years was used for children aged 6 months to 5 years.[7] And WHO BMI charts of 5 to 19 years was used for the children aged 5 to 18 years.[8]

The nutritional status of 6 months to 5 years old children was classified according to BMI based WHO classification for birth to 5 years of age as follows: [9]

- Obese: BMI for age greater than +3 standard deviations (SD) of the median.
- Overweight: BMI for age greater than +2 SD but equal or less than +3 SD of the median.
- Normal: BMI for age equal or less than +2 SD and but more than –2 SD of the median.
- Moderate acute malnutrition: BMI for age equal or less than –2 SD but equal or more than –3 SD of the median
- Severe acute malnutrition: BMI for age less than –3 SD of the median.
- The nutritional status of 5-18 years old children was classified according to BMI based WHO classification for 5-19 years of age as follows: [8]
- Obese: BMI for age more than +2 SD.
- Overweight: BMI for age more than +1 SD but equal or less than +2 SD.
- Normal: BMI for age equal or more than -2 SD but equal or less than +1 SD.
- Thin: BMI for age less than -2 SD but equal or more than -3 SD.
- Severely thin: BMI for age less than –3 SD of the median.

Statistical data was analyzed by using statistical package for social sciences (SPSS, version 20.0). If p value is <0.05, it is considered as statistically significant.

RESULTS

Table 1: Age and gender wise distribution of children

	Males		Females		Total	
Age in years	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
0.5—5 years	20	33.9	16	39.0	36	36.0
5.1—18.0 years	39	66.1	25	60.9	64	64.0
Total	59	100.0	41	100.0	100	100.0
Mean ± SD	7.57 ± 4.48		8.05 ± 5.05		7.77 ± 4.68	

Table 1 shows that, 36 (36.0%) children were belonging to the age group of 0.5—5 years, 64(64.0%) children were belonging to the age group of 5.1—18.0 years. Minimum age of children in the study was 1.5 years and maximum age was 17.25 years. The mean age of male children was 7.57 years, and the mean age of female children was 8.05 years. Mean age of all children was 7.77 years. In the study, Male children were 59 (59.0%) and female children were 41 (41.0%).

In the study, 65 (65.0%) children were residing in rural area and 35 (35.0%) children were residing in urban area.

In the present study, 91 (91.0%) children were belonging to Hindu Religion and 9 (9.0%) children were belonging to Muslim. Among Hindu religion, 51 (51.0%) children were belonging to SC/ST (scheduled caste/scheduled tribe), followed by 34 (34.0%) children were belonging to OBC category.

Table 2: Socio-economic status wise distribution of children

Socio economic status Classification	Number of children	Percentage (%)
Upper Class	0	0.0
Upper Middle Class	4	4.0
Middle Class	23	23.0
Lower Middle Class	61	61.0
Lower Class	12	12.0
Total	100	100.0

Table 2 shows, Socio-economic status wise distribution of children (As per modified B G Prasad classification). Majority of children, 61 (61.0%) were belonging to Lower middle class, followed by 23 (23.0%) children were belonging to middle class, 12 (12.0%) children were belonging to lower class, 4 (4.0%) children were belonging to upper middle class and none of the children were belonging to upper class.

In our study, it was observed that; the mean height of children was 103.16 cm, the mean weight of children was 15.83 kg, the mean BMI of children was 14.46

Table 3: Age wise classification of BMI and prevalence of malnutrition in beta thalassemia major children

Age	BMI categories	Number of children	Percentage
6 months to ≤ 5 years	**SAM**	0	0.0
	MAM	4	11.1
	Normal	32	88.9
	Over weight	0	0.0
	Obese	0	0.0
Sub total	**Total**	**36**	**100.0**
5.1—18.0 years	**Severe Thin**	28	43.8
	Thin	18	28.1
	Normal	17	26.6
	Over weight	1	1.5
	Obese	0	0.0
Sub total	**Total**	**64**	**100.0**
Grand Total	**---**	100	100.0

Table 3 shows: In the study, out of 36 beta thalassemia major children aged 6 months to 5 years, 4 (11.1%) children were malnourished and were belonging to BMI category of MAM and 32 (88.9%) children were belonging to normal BMI category and None of the Children were seen in the BMI categories of SAM, Overweight and Obese.

Study observed that 64 (64.0%) children were belonging to the age of 5.1 to 18 years, among them 28 (43.8%) children were belonging to BMI category of severely thin, 18 (28.1%) children were belonging to BMI category of thin, 17 (26.6%) children were belonging to BMI category of normal and only 1 (1.5%) child was overweight and None of the children were seen in the obese category of BMI. In this age group of 5.1 to 18 years, malnourished children were 46 (71.9%). So in the study the prevalence of malnutrition in beta thalassemia major children in the age group of 6months to 18 years was 50.0%. Total number of malnourished children in the study was 50. The children in the age group of 5.1 to 18 years had higher percentage of malnourished children as compared to the children in the age group of 6 months to 5 years.

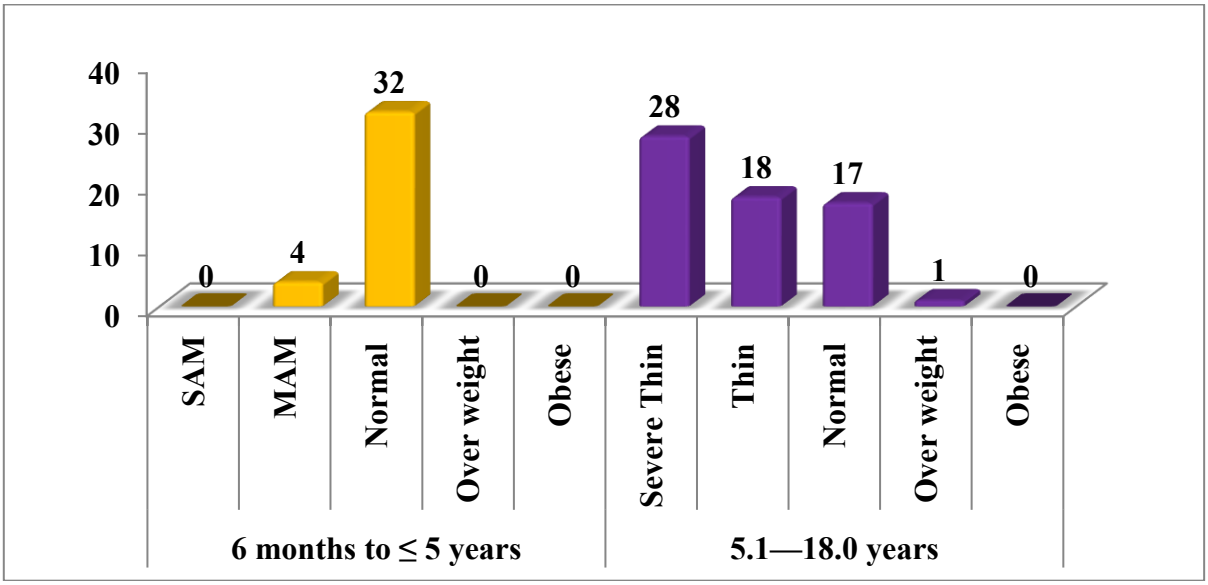

Figure 1: Age wise classification of BMI and prevalence of malnutrition in beta thalassemia major children.

Table 4: Association and predictors of malnutrition among thalassemia children with respect to various factors in relation to thalassemia.

Factors	Categories	No. of malnutrition (%)	OR (95% CI)	Adjusted OR (95% CI)	Association P-value
Blood transfusion frequency in the previous year	10—14 times/yr (N=65)	19 (29.2%)	17.05 (12.3-22.5)	17.10 (12.4-22.5)	X^2=32.055 P = 0.000, HS
	≥ 15 times/yr (N=35)	31 (88.6%)			
Pre transfusion Hb% level (in gm/dl)	≤ 5 (N=12)	12 (100.0%)	15.79 (10.3-21.5)	15.80 (10.5-21.5)	P =0.0002, HS
	5—10 (N=88)	38 (43.2%)			
Duration since taking iron chelators (in years)	< 5 (N=24)	12 (50.0%)	12.0 (7.10-16.80)	12.0 (7.15-16.90)	P =0.010, HS
	≥ 5 (N=13)	12 (92.3%)			
Undergone splenectomy	Yes (N=11)	7 (63.7%)	1.87 (1.13-2.06)	1.90 (1.15-2.10)	X^2= 0.923 P = 0.337, NS
	No (N=89)	43 (48.3%)			
Thalassemia Facies	Present (N=74)	49 (66.2%)	49.0 (38.1-59.3)	49.0 (38.5-59.5)	X^2= 29.938 P = 0.000, HS
	Absent (N=26)	1 (3.8%)			
Hepatomegaly	Present (N=29)	27 (93.1%)	28.17 (19.3-35.2)	28.20 (19.5-35.5)	X^2= 30.354 P = 0.000, HS
	Absent (N=71)	23 (32.4%)			
Taking vitamin D or calcium	Yes (N=24)	7 (29.2%)	3.16 (2.10-5.13)	3.20 (2.10-5.15)	X^2= 5.482 P = 0.019, S
	No (N=76)	43 (56.6%)			
Spleen size in cm	≤ 10 (N=60)	32 (53.3%)	-----	-----	P = 0.0035, HS
	>10 (N=11)	11 (100.0%)			

HS-Highly Significant, NS-Non Significant, S-Significant

Table 4 shows the multivariable logistic regression analysis of association and predictors of malnutrition among thalassemia children with respect to various factors in relation to thalassemia.

In our study, 31 (88.6%) children with higher frequency of transfusion (≥ 15 times/yr) were malnourished and 19 (29.2%) children with lower frequency of transfusion (10—14 times/yr) were malnourished. In the multivariable logistic regression model, the children with higher frequency of blood transfusion (adjusted odds ratio [AOR], 17.10; 95% CI, 12.4–22.5) had a highly significant risk of malnutrition (P<0.001) as compared to children with lower frequency of transfusion.

In our study, 12 (100.0%) children with very low (≤ 5) pre transfusion Hb% were malnourished and 38 (43.2%) children with low (5—10) pre transfusion Hb% were malnourished. In the multivariable logistic regression model, the children with very low (≤ 5) pre transfusion Hb% (adjusted odds ratio [AOR], 15.80; 95% CI, 10.5–21.5) had a higher risk of malnutrition (P<0.01) as compared to children with low (5—10) pre transfusion Hb% .

In our study, 12 (92.3%) children on iron chelators for longer duration (≥ 5 years) were malnourished and 12 (50.0%) children on iron chelators for shorter duration (< 5 years) were malnourished .In the multivariable logistic regression

model, the children on iron chelators for longer duration (adjusted odds ratio [AOR], 12.0; 95% CI, 7.15–16.90) had a higher risk of malnutrition (P<0.01) as compared to children on iron chelators for shorter duration.

In our study, 7 (63.7%) children who have undergone splenectomy were malnourished and 43 (48.3%) children who have not undergone splenectomy were malnourished. In the multivariable logistic regression model, the children who have undergone splenectomy (adjusted odds ratio [AOR], 1.90; 95% CI, 1.15–2.10) had statistically no significant association with malnutrition (P>0.05) as compared to children who have not undergone splenectomy.

In our study, 49 (66.2%) children who have thalassemia facies were malnourished and 1(3.8%) child who don't have thalassemia facies was malnourished. In the multivariable logistic regression model, the children with presence of thalassemia facies (adjusted odds ratio [AOR], 49.0; 95% CI, 38.5–59.5) had a higher risk of malnutrition (P<0.001) as compared to children who don't have thalassemia facies .

In our study, 27 (93.1%) children having hepatomegaly were malnourished and 23 (32.4%) children who were not having hepatomegaly were malnourished. In the multivariable logistic regression model, the children who were having hepatomegaly (adjusted odds ratio [AOR], 28.20; 95% CI, 19.5-35.5) had a higher risk of malnutrition (P<0.001) as compared to children who were not having hepatomegaly.

In our study, 7 (29.2%) children taking vitamin D or calcium were malnourished and 43 (56.6%) children who were not taking vitamin D or calcium were malnourished. In the multivariable logistic regression model, the children who were not taking vitamin D or calcium (adjusted odds ratio [AOR], 3.20; 95% CI, 2.10–5.15) had a higher risk of malnutrition (P<0.05) as compared to children who were taking vitamin D or calcium.

In our study, 11 (100.0%) children with larger spleen size (>10 cm) were malnourished and 32 (53.3%) children with smaller spleen size (≤ 10 cm) were malnourished. And there was also statistically highly significant association of malnutrition with larger size of spleen (P<0.01).

DISCUSSION

In India, For about 12000 infants born every year have major form of the disease {10% of global burden} and half of these patients die before reaching adulthood. Large proportion of these early deaths are due to malnutrition. [5]

There is multi factorial association for malnutrition in thalassemia. According to the existing literature, children with thalassemia have an average energy intake lower than the recommended daily dietary allowances. Most of them belong to a more economically weaker section of the society. As a result, thalassemia patients develop multiple micronutrients deficiency which can be quoted as "hidden hunger".[5]

So, this study was taken up to assess the malnutrition and various factors influencing malnutrition in beta thalassemia patients, So that early identification of malnutrition in these patients will help in the early management of malnutrition.

The sample size in the present study is comparable to the other studies like Mirhosseini et al,[10] Upadhye et al,[11] and Fahim et al.[12] except for study conducted by Bijit Biswas et al,[5] where the sample size was larger compared to our study. In our study, about 36.0% children were belonging to the age group of 0.5—5 years and 64.0% children were belonging to the age group of 15.1-18.0 years.

The mean age of male children was 7.57 years, and the mean age of female children was 8.05 years. Mean age of all children was 7.77 years.

In our study, Male children were 59.0% and female children were 41.0%.

In a study conducted by Bijit Biswas et al,[5] Most of the study participants (37.2%) were aged between 11 and 12 years (range, 5–12 years). The mean age in the study was 8.0 years. There was almost equal representation of both sexes that is 54.0% were males and 46.0% were females.

The study conducted by Mirhosseini et al,[10] had participants aged 8-18 years. The mean age in the study was 13.5 years and this study included 56.4 % boys and 43.6 % girls. In a study conducted by Sheikh et al.[13] age range of the patients of thalassemia major was 2 to 16 years with mean age of 7.88 years.

In our study, Majority of children, 61.0% were belonging to Lower middle class, followed by 23.0% children were belonging to middle class. Similar observations were seen in a study conducted by Bijit Biswas et al, [5] where 48.8% were belonging to lower middle class followed by 24.1% were belonging to middle class.

In our study, Majority of children, 61.0% were belonging to Lower middle class, followed by 23.0% children were belonging to middle class. Similar observations were seen in a study conducted by Bijit Biswas et al, [5] where 48.8% were belonging to lower middle class followed by 24.1% were belonging to middle class.

Prevalence of malnutrition in beta thalassemia major children

In our study, out of 36 beta thalassemia major children aged 6 months to 5 years, 11.1% children were malnourished and were belonging to BMI category of MAM and 88.9% children were belonging to normal BMI category and None of the Children were seen in the BMI categories of SAM, Overweight and Obese. 64.0% children were belonging to the age of 5.1 to 18 years, among them 43.8% children were belonging to BMI category of severely thin, 28.1% children were belonging to BMI category of thin, 26.6% children were belonging to BMI category of normal and only 1.5% child was overweight and None of the children were seen in the obese category of BMI. In this age group of 5.1 to 18 years, malnourished children were 71.9%. So in our study the prevalence of malnutrition in beta thalassemia major children in the age group of 6 months to 18 years was 50.0%. Total number of malnourished children in the study was 50. The children in the age group of 5.1 to 18 years had higher percentage of malnourished children as compared to the children in the age group of 6 months to 5 years.

The mean BMI of children in our study was 14.46. Similar to our study, In the study conducted by Bijit Biswas et al,[5] mean BMI was 13.9 and in the study conducted by Sheikh et al, [13] mean BMI was 14.03. Where as slightly higher mean BMI was reported in a study conducted by Mirhosseini et al,[10] which is about 17.6.

In our study, BMI was plotted on age and sex specific WHO growth charts and other studies like Qaisar I et al,[16] and Pemde et al,[14] also have used WHO growth charts.

In the present study, half (50.0%) of the study participants were malnourished, which was higher than the value reported in a study of Pemde et al, [14](24.2%), study of Mirhosseini et al, [10](33.6%) and a study of Trehan et al, [15] (26.7%) and similar to the value reported in a study of Qaisar I et al, [16] (50.6%) study of Sheikh et al, [13] (58.69%) ,study of Bijit Biswas et al, [5] (48.2%) and a study of Fahim et al, [12] (47.0%).The variability of the findings may be attributed to the differences in the participants' age, ethnicity, and geographical plausibility.

Association and predictors of malnutrition among thalassemia children with respect to various factors in relation to thalassemia.

In our study, the children with higher frequency of blood transfusion and the children with very low (≤ 5) pre transfusion Hb% had a highly significant risk of malnutrition ,which was similar to the findings of a study of Bijit Biswas et al.[5]

Similarly, those who had higher pre-transfusion Hb level had significantly lower chances of being malnourished, which was similar to the reports of Saxena.[17]

The children on iron chelators for longer duration had a higher risk of malnutrition as compared to children on iron chelators for shorter duration, the children with presence of thalassemia facies had a higher risk of malnutrition and there was also statistically highly significant association of malnutrition with larger size of spleen in our study. It may be because splenomegaly, longer duration on iron chelators and thalassemia facies all indicate the severity of the disease. Those who had larger spleen size and thalassemia facies were more likely to be malnourished as observed by Tantawy et al, [18] and Bijit Biswas et al.[5]

In our study, the children who were not taking vitamin D or calcium had a higher risk of malnutrition as compared to children who were taking vitamin D or calcium. In a study conducted by Fahim et al,[12] the mean total serum calcium and 25-hydroxycholecalciferol (25-OH Vit D) levels were significantly lower in beta thalassemia major patients than in controls .This suggests that one of the risk factors for malnutrition in thalassemia major patients is underlying vitamin D or calcium deficiency which can be secondary to micronutrient deficiency in these patients as a result of poor intake or it can be secondary to disease process itself leading to chronic hypoxia, hepatic dysfunction due to iron overload and endocrine dysfuction. So these patients are in great need for supplementation with vitamin D, calcium and Iron chelators to overcome iron overload.

CONCLUSION

In our study the prevalence of malnutrition in beta thalassemia major children in the age group of 6months to 18 years was 50.0%. So periodic growth assessment once in every 3 months is necessary for early detection and management of malnutrition in these patients for better outcome.

In our study, The children on iron chelators for longer duration had a higher risk of malnutrition as compared to children on iron chelators for shorter duration, the children with presence of thalassemia facies had a higher risk of malnutrition and the children who were not taking vitamin D or calcium had a higher risk of malnutrition as compared to children who were taking vitamin D or calcium, so all these are the significant predictors of malnutrition in these children indicating need for optimal management of these children is necessary to prevent malnutrition in them.

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