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Study of Growth Parameters and Effect of Serum Ferritin and Hemoglobin Levels on Physical Growth in Thalassemic Children: A Study of 100 Cases

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Abstract: ***Background**: Beta-thalassemia major is a transfusion-dependent hemoglobinopathy associated with iron overload and growth retardation. Despite improvements in transfusion and chelation, growth failure remains a major concern. **Objectives**: To evaluate growth parameters in transfusion-dependent thalassemic children and to assess the association of pre-transfusion hemoglobin and serum ferritin with growth. **Methods**: This cross-sectional study enrolled 100 beta-thalassemic children aged 2–12 years at a tertiary-care hospital in Gujarat. Anthropometric parameters (height, weight, BMI), mid-parental height, and laboratory markers (serum ferritin, pre-transfusion hemoglobin) were recorded. Growth was assessed using WHO Z-scores. Statistical analysis was performed using SPSS v26.0, with $p<0.05$ considered significant. **Results**: Stunting (Height for Age<3rd percentile) was observed in 26% and underweight (Weight for Age<3rd centile) in 13% of children. Mean hemoglobin was 7.37 ± 1.01 g/dL; mean serum ferritin was 2973.98 ± 1997.29 ng/mL. Height-for-age was significantly associated with both pre-transfusion hemoglobin ($p=0.045$) and serum ferritin ($p=0.017$). Weight-for-age was significantly associated with serum ferritin ($p=0.014$), but not with hemoglobin ($p=0.537$). **Conclusion**: Growth retardation in thalassemic children is significantly influenced by both anemia and iron overload. Regular monitoring, optimized transfusion regimens, and effective chelation are essential for improving growth outcomes.*

Keywords: Beta-thalassemia major, growth retardation, serum ferritin, hemoglobin, pediatric hematology

1. Introduction

Beta-thalassemia major is a severe hereditary anemia requiring lifelong transfusions. While transfusion prevents early mortality, it introduces complications such as iron overload, endocrinopathies, and growth impairment.

Growth failure in thalassemia has multifactorial origins: chronic anemia, iron toxicity, nutritional deficiencies, and delayed puberty. In India, ~10,000–15,000 children are born annually with thalassemia major, with high prevalence in Gujarat, Punjab, and West Bengal. Studies suggest that over 40% of Indian thalassemic children have stunted growth. However, limited regional data exist on how anemia and iron overload jointly affect growth. This study aimed to evaluate growth parameters in transfusion-dependent thalassemic children and examine associations with pre-transfusion hemoglobin and serum ferritin levels.

2. Materials and Methods

Study Design: Cross-sectional observational study.

Setting: Department of Pediatrics, Shri M.P. Shah Government Medical College and G. G. Hospital, Jamnagar, Gujarat.

Participants: 100 transfusion-dependent children with beta-thalassemia major aged 2–12 years.

Inclusion Criteria: Diagnosed cases of beta-thalassemia major (confirmed by HPLC), transfusion-dependent children aged 2–12 years.

Exclusion Criteria: Children with other chronic systemic illnesses or congenital anomalies.

Data Collection: Anthropometric measurements (height, weight, BMI, WHO Z-scores), mid-parental height, pre-transfusion hemoglobin, serum ferritin.

Outcomes: Primary – Association of hemoglobin and serum ferritin with height-for-age. Secondary – Association with weight-for-age and BMI.

Statistical Analysis: Continuous variables expressed as mean ± SD; categorical as %. Associations tested with Chi-square and Pearson correlation. $p<0.05$ = significant.

3. Results

Table 1: Baseline Characteristics

Variable	Value
Mean Age (years)	7.4 ± 2.8
Sex (Male/Female)	56/44
Parental Consanguinity (%)	20%
Socioeconomic status	62% / 32% / 6%

Table 2: Growth Outcomes

Parameter	Findings
Stunting (Height for Age <3rd centile)	26%
Underweight (Weight for Age<3rd centile)	13%
Mean BMI	Within normal range (but skewed)

Table 3: Hematological & Biochemical Parameters

Parameter	Mean ± SD
Pre-transfusion Hemoglobin (g/dL)	7.37 ± 1.01
Serum Ferritin (ng/mL)	2973.98 ± 1997.29

Table 4: Associations between Hemoglobin, Serum Ferritin, and Growth

Growth Parameter	Association with Hb	p-value	Association with Ferritin	p-value
Height-for-age	Significant	0.045	Significant	0.017
Weight-for-age	Not significant	0.537	Significant	0.014

4. Discussion

This study demonstrates that thalassemic children experience high rates of stunting and underweight, primarily linked to low pre-transfusion hemoglobin and elevated serum ferritin. These findings align with prior Indian studies reporting growth impairment in 40–60% of thalassemic children. Iron overload damages endocrine glands and bone metabolism, while chronic anemia exacerbates hypoxia, both contributing to impaired growth. International literature similarly shows ferritin >2500 ng/mL correlates with growth hormone deficiency and delayed puberty.

Our study underscores the need to maintain pre-transfusion hemoglobin >9 g/dL and ferritin <1000 ng/mL through optimized transfusion and chelation therapy. Nutritional interventions and endocrine monitoring are also critical.

Limitations: single-center, cross-sectional design; lack of longitudinal follow-up.

5. Conclusion

Growth retardation is highly prevalent in thalassemic children and strongly influenced by anemia and iron overload. Regular monitoring, optimal transfusion, aggressive chelation, and supportive nutrition are essential to improve long-term outcomes.

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