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Comparative Study of Growth and Nutritional Status in Children with Sickle Cell Disease and Thalassemia

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Abstract— Background*: Hemoglobinopathies such as sickle cell disease (SCD) and thalassemia are among the most common inherited blood disorders affecting children worldwide. These conditions are associated with chronic anemia, increased metabolic demands, and recurrent clinical complications, which may adversely affect growth and nutritional status. Impaired growth and malnutrition are frequently observed in children with these disorders and may influence disease progression, quality of life, and long-term health outcomes. Comparative evaluation of growth patterns and nutritional status in children with SCD and thalassemia is important for improving clinical management and nutritional interventions.* ***Methods****: This comparative cross-sectional study included 30 children aged 5–18 years diagnosed with either sickle cell disease (n=15) or thalassemia (n=15). Anthropometric measurements including height, weight, and body mass index (BMI) were recorded, and growth indices such as height-for-age, weight-for-age, and BMI-for-age Z-scores were calculated. Nutritional status was assessed using WHO criteria for stunting, underweight, and wasting. Clinical parameters including hemoglobin level, serum ferritin, vitamin D levels, frequency of blood transfusions, and disease-related crises were evaluated. Information regarding treatment practices and dietary adequacy was also collected.* ***Results****: Children with thalassemia showed relatively lower anthropometric indices compared with those with sickle cell disease. Stunting and underweight were more prevalent among thalassemia patients. Serum ferritin levels and transfusion frequency were markedly higher in thalassemia, whereas vaso-occlusive crises were more common in SCD. Disease-specific management practices differed between groups.* ***Conclusion****: Growth impairment and malnutrition are common among children with hemoglobinopathies, particularly in thalassemia. Regular growth monitoring and nutritional assessment are essential for improving clinical outcomes.*

Keywords— *Hemoglobinopathies.*

I. Introduction

Hemoglobinopathies are among the most common inherited disorders worldwide, with sickle cell disease (SCD) and thalassemia representing two major forms that contribute significantly to childhood morbidity and mortality, particularly in low- and middle-income countries. These disorders result from genetic mutations affecting hemoglobin synthesis and structure, leading to chronic hemolytic anemia and multiple systemic complications. Because these diseases begin early in life and persist chronically, they can significantly influence the physical growth, nutritional status, and overall development of affected children.[1]

Sickle cell disease is characterized by the presence of abnormal hemoglobin S, which leads to red blood cell sickling, vaso-occlusion, chronic hemolysis, and repeated episodes of pain and organ damage. The chronic inflammatory state and increased metabolic demands associated with SCD frequently result in growth retardation and nutritional deficiencies among affected children.[2] Studies have demonstrated that children with SCD commonly exhibit delayed growth, low body mass index, and micronutrient deficiencies due to increased energy expenditure, recurrent infections, and poor dietary intake.[3]

Similarly, β-thalassemia major is a hereditary hemoglobin disorder caused by reduced or absent synthesis of the β-globin chain of hemoglobin. Children with transfusion-dependent thalassemia often require lifelong blood transfusions and iron chelation therapy to prevent complications of iron overload. Despite improvements in management, growth failure remains a major clinical concern in these patients. Growth retardation in thalassemia has been attributed to chronic anemia, iron overload affecting endocrine organs, nutritional deficiencies, and complications of long-term transfusion therapy.[4]

Malnutrition is commonly observed in children suffering from chronic hematological disorders. Anthropometric indicators such as height-for-age, weight-for-age, and body mass index-for-age are frequently used to evaluate growth impairment and nutritional deficits in these patients. Research has reported a high prevalence of underweight, stunting, and wasting among children with SCD and thalassemia, highlighting the significant impact of chronic anemia and metabolic stress on growth outcomes.[5]

In children with sickle cell disease, several studies have demonstrated a considerable burden of malnutrition and impaired growth. For example, investigations assessing the nutritional profile of children with SCD have reported a high prevalence of underweight and stunting, emphasizing the role of inadequate dietary intake and increased metabolic requirements in disease progression.[6] Additionally, chronic inflammation and repeated vaso-occlusive crises may further worsen nutritional status and growth patterns in these patients.[2]

In children with β-thalassemia major, growth impairment is also widely documented. Studies have shown that a substantial proportion of children with thalassemia exhibit reduced height and weight compared with healthy peers, and these abnormalities tend to worsen with increasing age. Persistent anemia, iron overload, endocrine dysfunction, and

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nutritional deficiencies are important factors contributing to this growth failure.[7] Furthermore, complications related to repeated transfusions and iron accumulation may lead to endocrine disorders such as growth hormone deficiency and delayed puberty, which further impair growth and development.[8]

Despite the growing recognition of growth and nutritional problems in hemoglobinopathies, comparative studies evaluating the growth patterns, nutritional status, and clinical characteristics of children with sickle cell disease and thalassemia remain limited, particularly in developing countries where these disorders are highly prevalent. Understanding the differences in growth outcomes and nutritional status between these two conditions is essential for designing targeted nutritional interventions and improving clinical management strategies.

Therefore, the present study was undertaken to compare the growth parameters, nutritional status, and clinical characteristics among children with sickle cell disease and thalassemia, with the aim of providing evidence that may assist clinicians in improving the nutritional care and overall health outcomes of these patients.

II. Methodology

Study Design and Setting

This study was conducted as a comparative cross-sectional observational study to evaluate and compare the growth patterns, nutritional status, and clinical characteristics among children diagnosed with sickle cell disease (SCD) and thalassemia. The study was carried out in the Department of Pediatrics of a tertiary care teaching hospital over a specified study period.

Study Population

The study population consisted of children diagnosed with sickle cell disease or thalassemia who attended the pediatric outpatient department or were admitted to the pediatric wards during the study period.

Sample Size

A total of 30 children were included in the study, comprising 15 children with sickle cell disease and 15 children with thalassemia.

Inclusion Criteria

- Children aged 5–18 years diagnosed with sickle cell disease or thalassemia.
- Diagnosis confirmed by hemoglobin electrophoresis or high-performance liquid chromatography (HPLC).
- Children who were regularly attending the hospital for follow-up or treatment.
- Children whose parents or guardians provided informed consent to participate in the study.

Exclusion Criteria

- Children with other chronic systemic illnesses that could affect growth and nutritional status.
- Children with congenital anomalies or endocrine disorders affecting growth.
- Children with incomplete medical records or missing anthropometric data.

Data Collection

Data were collected using a structured proforma that included demographic information, clinical history, anthropometric measurements, laboratory findings, treatment history, and dietary assessment.

Anthropometric Measurements

Anthropometric parameters including height, weight, and body mass index (BMI) were recorded using standardized methods. Height was measured using a stadiometer, and weight was measured using a calibrated digital weighing scale. Body mass index was calculated using the formula:

$$BMI = \frac{Weight(kg)}{Height(m)^2}$$

Growth indicators including height-for-age Z score (HAZ), weight-for-age Z score (WAZ), and BMI-for-age Z score (BAZ) were calculated based on WHO growth reference standards.

Nutritional Status Assessment

Nutritional status was evaluated using standard WHO criteria:

- Stunting: Height-for-age Z score < −2 SD
- Underweight: Weight-for-age Z score < −2 SD
- Wasting: BMI-for-age Z score < −2 SD

Clinical and Laboratory Parameters

Clinical and laboratory data were obtained from medical records and included:

- Hemoglobin level (g/dL)
- Serum ferritin level (ng/mL)
- Vitamin D level (ng/mL)
- Number of blood transfusions per year
- Frequency of vaso-occlusive crises per year

Information regarding disease management practices, including the use of hydroxyurea therapy and iron chelation therapy, was also recorded.

Dietary Assessment

Dietary intake was assessed using a 24-hour dietary recall method, and dietary adequacy was calculated by comparing nutrient intake with recommended dietary allowances (RDA) for age.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean values, while categorical variables were presented as frequency and percentage. Comparative analysis between children with sickle cell disease and thalassemia was performed using appropriate statistical tests. Results were presented in the form of tables and descriptive statistics.

Ethical Considerations

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The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from the parents or guardians of all participating children, and confidentiality of patient information was strictly maintained throughout the study.

The present comparative study evaluated growth parameters, nutritional status, disease severity indicators, and management practices among children with sickle cell disease (SCD) and thalassemia.

III. RESULT

TABLE 1: Comparison of Mean Growth Parameters between Groups

Group	Height_cm	Weight_kg	BMI	HAZ	WAZ	BAZ
SCD	156.15	36.27	14.7	-1.17	-1.07	-0.45
Thalassemia	150.02	30.21	13.05	-1.52	-1.38	-0.83

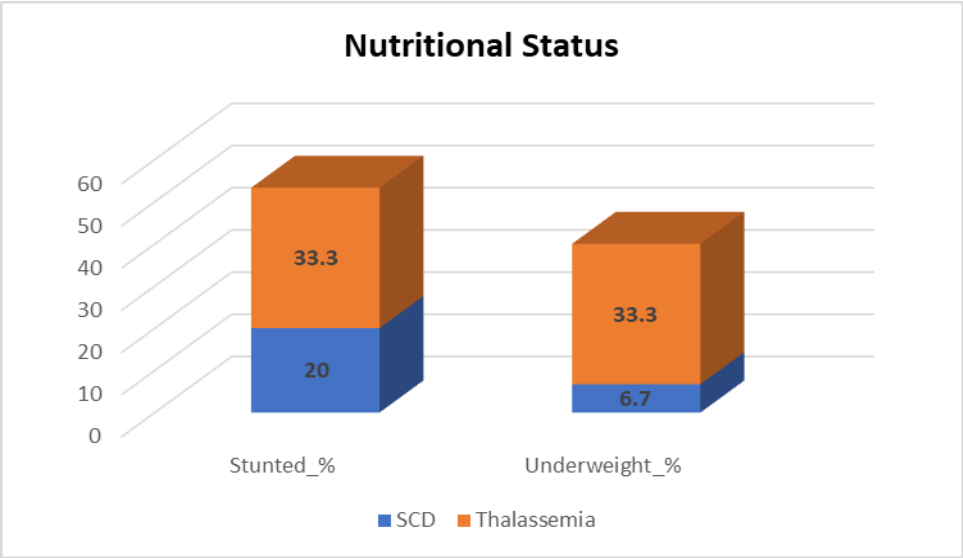

Chart No 1- Nutritional Status (Prevalence of Stunting, Underweight, and Wasting)

TABLE 2: Comparison of Disease Severity Indicators

Group	Hemoglobin_g_dL	Ferritin_ng_mL	VitaminD_ng_mL	Transfusions_per_year	Crises_per_year
SCD	8.51	306.33	17.47	1.13	4.0
Thalassemia	8.05	1700.2	18.13	12.93	0.0

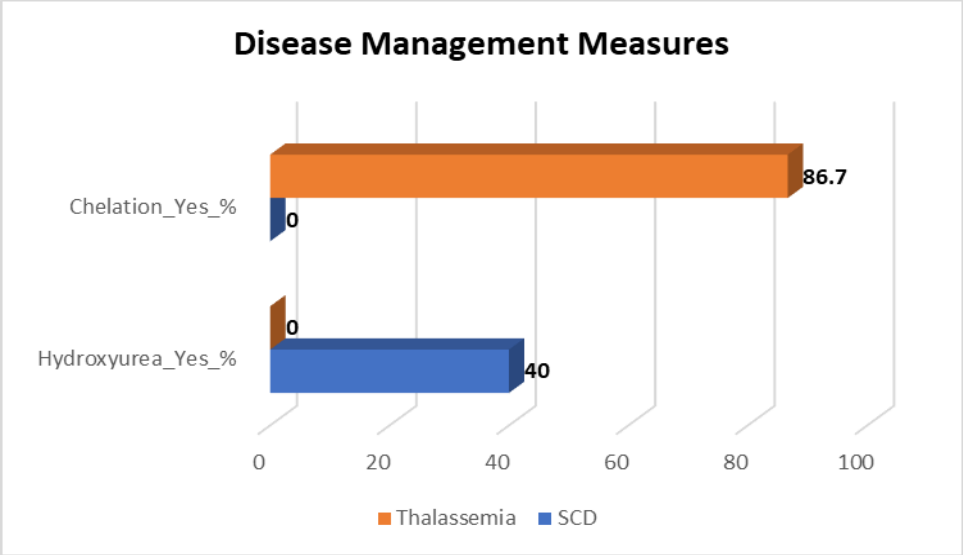

Chart No 2 - Disease Management Measures (Hydroxyurea and Chelation Use)

TABLE 3: Dietary Adequacy among Groups

Group	Mean_Diet_Adequacy_%	SD
SCD	88.47	11.29
Thalassemia	87.2	8.02

The analysis of anthropometric parameters showed that children with sickle cell disease had a higher mean height (156.15 cm), weight (36.27 kg), and BMI (14.7 kg/m²) compared with children with thalassemia, who demonstrated

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lower mean height (150.02 cm), weight (30.21 kg), and BMI (13.05 kg/m²). Similarly, the Z-score indicators for growth also suggested poorer growth outcomes among children with thalassemia, with lower values of height-for-age Z score (−1.52), weight-for-age Z score (−1.38), and BMI-for-age Z score (−0.83) compared with the SCD group.

Regarding nutritional status, stunting was observed in 20% of children with SCD and 33.3% of children with thalassemia, indicating a higher prevalence of chronic malnutrition among thalassemia patients. Similarly, underweight status was present in 6.7% of children with SCD and 33.3% of those with thalassemia, further demonstrating more pronounced nutritional impairment in the thalassemia group.

Evaluation of disease severity indicators revealed notable differences between the two groups. Children with SCD had a mean hemoglobin level of 8.51 g/dL, while thalassemia patients had a slightly lower mean level of 8.05 g/dL. Serum ferritin levels were markedly elevated in children with thalassemia (1700.2 ng/mL) compared with those with SCD (306.33 ng/mL), reflecting the impact of repeated blood transfusions in thalassemia. The frequency of blood transfusions was significantly higher among thalassemia patients (12.93 transfusions per year) compared with SCD patients (1.13 transfusions per year). Conversely, vaso-occlusive crises were observed predominantly in children with SCD (4 episodes per year) and were absent in thalassemia patients.

Regarding disease management, hydroxyurea therapy was used in 40% of children with SCD, while iron chelation therapy was administered in 86.7% of thalassemia patients, reflecting the different therapeutic approaches required for these conditions. Dietary adequacy was comparable between the groups, with mean dietary adequacy values of 88.47% in SCD and 87.2% in thalassemia, suggesting that disease-related factors rather than dietary intake alone may contribute to growth impairment.

IV. Discussion

Chronic hemoglobinopathies such as sickle cell disease and thalassemia are known to adversely affect growth and nutritional status in children due to chronic anemia, increased metabolic demands, and disease-related complications.[1] The present study demonstrated that children with thalassemia had relatively poorer anthropometric parameters compared with those with sickle cell disease, indicating a greater impact of the disease on physical growth.

Previous studies have also reported significant growth impairment among children with hemoglobinopathies. Children with sickle cell disease frequently experience delayed growth and reduced body mass index as a result of chronic hemolysis, increased metabolic requirements, and recurrent infections.[2,3] These factors increase energy expenditure and may lead to inadequate nutritional reserves, ultimately affecting growth outcomes.

In the present study, the prevalence of stunting and underweight was higher among children with thalassemia than among those with sickle cell disease. Similar findings have been reported in earlier studies where growth retardation and malnutrition were common among thalassemia patients due to chronic anemia and iron overload.[5,7] Persistent anemia may impair oxygen delivery to tissues, thereby affecting normal growth and development.

The markedly elevated ferritin levels observed among thalassemia patients in this study are consistent with previous research indicating that repeated blood transfusions often lead to iron overload in these patients.[4] Excess iron deposition in endocrine organs can result in endocrine dysfunction, including growth hormone deficiency, which further contributes to growth retardation.[8,9]

The higher frequency of blood transfusions observed among thalassemia patients reflects the transfusion-dependent nature of the disease. In contrast, children with sickle cell disease often experience recurrent vaso-occlusive crises, which were observed exclusively in the SCD group in this study. These painful crises are characteristic complications of sickle cell disease and contribute significantly to disease morbidity.[2]

Despite similar levels of dietary adequacy in both groups, growth impairment remained evident, suggesting that factors beyond dietary intake play a major role in determining growth outcomes in these patients. Previous studies have emphasized that chronic disease burden, metabolic stress, and endocrine complications significantly influence nutritional status and growth patterns in hemoglobinopathies.[6,10]

Overall, the findings of the present study highlight the complex interplay between chronic anemia, disease severity, treatment practices, and nutritional status in determining growth outcomes among children with sickle cell disease and thalassemia.

V. Conclusion

The present study demonstrated significant differences in growth parameters, nutritional status, and disease characteristics between children with sickle cell disease and those with thalassemia. Children with thalassemia showed comparatively poorer anthropometric indices and a higher prevalence of malnutrition, likely related to chronic anemia, iron overload, and transfusion dependence. In contrast, children with sickle cell disease experienced more frequent vaso-occlusive crises but had relatively better growth indicators.

These findings highlight the importance of regular growth monitoring, nutritional assessment, and appropriate disease-specific management strategies in children with hemoglobinopathies. Early identification of nutritional deficiencies and implementation of targeted interventions may help improve growth outcomes and overall quality of life in these patients.

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