



ORIGINAL ARTICLE

## A comparison of skeletal age of thalassemic patients of 9–15 years with chronological age by radiography.

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**ABSTRACT... Objective:** To compare bone/skeletal age of thalassemic children with chronological age by hand-wrist radiography to assess possible growth retardation. **Study Design:** Descriptive Cross-sectional study. **Setting:** In collaboration of Radiology & Pathology Department of Sahiwal Teaching Hospital and Ali Zaib Foundation, Sahiwal. **Period:** January 2021 to June 2021. **Material & Methods:** Three hundred and fifty patients were purposively recruited for the study. Among them 250 were registered children of thalassemia at Ali Zaib Foundation, Sahiwal and 100 were non-thalassemic children taken as control group to make comparison of the findings from thalassemia patients. After approval from institutional review board (IRB) and taking written informed consent of the parents, the researchers get their hand-wrist radiographs done. Ossification centers were evaluated to assess bone age that was compared with chronological age. Data was analyzed using SPSS-24. **Results:** The statically significant difference was seen in bone age between the two groups as compared to their chronological age that remained statically non – significant. **Conclusion:** To evaluate possible growth retardation in thalassemia children, hand-wrist X-ray can be considered a standard modality.

**Key words:**  $\beta$ -Thalassemia Major, Chronological Age, Growth Hormone, Growth Retardation, Skeletal Age.

### INTRODUCTION

Thalassemia is a hereditary hemoglobinopathy, that is common in Asian population. It results in hemolytic microcytic hypochromic anemia due to defect in synthesis of  $\alpha$  or  $\beta$  globin chains. Deletions or mutations of the globin genes leads to decreased or absent production of  $\alpha$  or  $\beta$  globin chains.<sup>1,2</sup> Clinical manifestations of thalassemia major appears in the early years of childhood. Infants suffering usually grow slowly and experience poor appetite and often develops jaundice and organomegaly. Delayed puberty is seen in adolescents.<sup>3</sup> Transfusion therapy remains the main stay of treatment for thalassemia children. Although it has improved the life expectancy in these patients, however it is associated with iron overload in various organs. Therefore Proper iron chelation should be commenced.<sup>4</sup> Delay in growth and puberty is seen in thalassemia adolescents after 9 – 10 years of

age. Before this age, these children grow almost at a normal rate for this age.<sup>1,4</sup> Multiple factors attribute to low height in thalassemia children usually less than 3 percentiles than mean age 13 or 2 SD less, like delayed growth, deterioration in height and secondary sex characteristics.<sup>1</sup>

Various methods have been used to assess bone age especially in children like hand and wrist radiographs evaluation, dental age by assessing the eruption of teeth and their correlation.<sup>5</sup> The bone age or skeletal maturity is being linked to various factors like disease state, hormonal status, environmental changes, nutritional conditions, and genetics and is one of the key indices of biological maturity of human being.<sup>6</sup> The stage of puberty varies in accordance with variations in the bone maturation. Those with delayed growth pattern may experience delayed puberty and those with accelerated growth may

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experience early pubertal changes. Skeletal maturity is as important as chronological age in children to make correct diagnosis and for proper investigations and treatment plan. Skeletal maturity is being assessed in pre pubertal children principally in phalanges and metacarpals.<sup>3</sup>

Growth is a tool that differentiates a child from an adult. Growth indicates a quantitative increase in size and mass while development denotes a progression of changes leading to maturation in function.<sup>7</sup>

Before 9 – 10 years of age, thalassemia children experience relatively normal growth pattern, but normal adult height not achieved in these cases as compared to normal subjects. Growth retardation is a multifactorial phenomenon in thalassemic. Various factors contributing growth retardation includes chronic hypoxia because of continuous low baseline hemoglobin levels, nutritional deficiencies, iron overload and toxicities of chelation itself.<sup>8</sup> While evaluating growth in children, their ethnicity must be kept in mind.<sup>9</sup> Inadequate nutrition plays a vital role in growth failure in thalassemia children.<sup>8,10</sup> The aim of our study is to establish an easy, accessible, and advantageous method to determine bone age in thalassemia children. The rationale of our study is that rate of growth can be monitored easily by a simple, cheap and quick modality using hand-wrist radiograph in thalassemia children.

## MATERIAL & METHODS

This descriptive cross-sectional study was conducted in collaboration of Radiology & Pathology department of Sahiwal Teaching Hospital and Ali Zaib Foundation, Sahiwal. After taking approval from Institutional Review Board (62/DME/SLMC/SWL), and taking informed consent from parents of children, data was collected. In the current study the data of 6 months i.e., from January 2021 to June 2021 was included.

Using, Yamane (1967) sample size formula with 95% confidence level and confidence interval (margin of error) of 5%. Total 350 children were recruited in this study from which 250 were

the patients of thalassemia and 100 were non-thalassemia children taken as control subjects. Only known case of registered thalassemia children of both genders between 9 – 15 years having no comorbidities like diabetes mellitus, cardiac, hepatic or renal illness or any other metabolic disorder are included in the study. The Patients whose exact birth dates were not confirmed were excluded.

Patients detailed history including demographic details were taken using a self-designed interview schedule. Height in inches was measured. Number of erupted teeth were counted. Patients were referred to radiology department of Sahiwal Teaching Hospital to get hand-wrist radiographs done. Bone age was determined by evaluation of ossification centers. Data was analyzed using the statistical package for social sciences (SPSS-24). Descriptive and inferential statistics were applied on data to make it understandable.

## RESULTS

Among 250 thalassemia patients, 143 (57.2%) were male and 107 (42.8%) were female. Figure-1. In non-thalassemia (control group) 57 (57%) were male and 43 (43%) were female. Figure-2.

The mean chronological age among the control group was 14.75 with standard deviation  $\pm 1.04$  whereas in thalassemia patients it was noted 13.92 with standard deviation  $\pm 1.16$ , that is statically non-significant ( $p$ -value = 0.69). The results about bone age among the control group was 12.46 with standard deviation  $\pm 1.53$  compared to the bone age in thalassemia patients group 10.92 with standard deviation  $\pm 1.16$ , that showed a significant difference statically ( $p$ -value = 0.0019). Table-I.

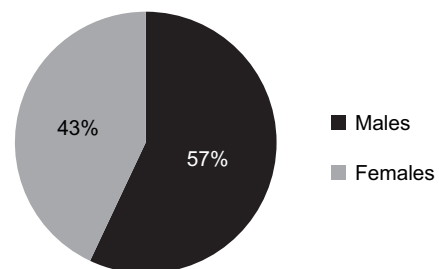


Figure 1. Thalassemia Children

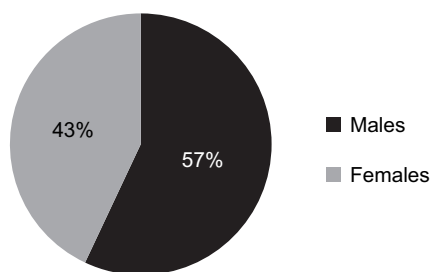


Figure 2. Non-Thalassemia Children

	Thalassemia Children Mean + SD	Non-Thalassemia Children Mean + SD	P- Value
Chronological Age	13.92+1.16	14.75+1.04	0.69
Bone Age	10.92+1.16	12.46+1.53	0.0002 *

Table-I. Comparison of bone age and chronological age among the thalassemia and non-thalassemia groups.

## DISCUSSION

Our study found that the bone age of thalassemia patients was significantly less when compared with the control subjects. Although modern medications such as better chelation therapy and more awareness among the patients and their families regarding the dietary plans of the patients have elevated the health status of the patients with thalassemia, however, with the growing age especially in puberty, still many of these patients face growth retardation. Short stature was seen to be most common along with other endocrine disturbances.<sup>11</sup>

A study by Goldberg EK et al, showed that in iron overloaded patients of thalassemia due to transfusion dependence, nutritional deficiency is common. Decreased intake as well as increased consumption due to hepatic iron overload, resulting in functional nutrient deficiency causing growth retardation in these children.<sup>12</sup>

Some previous studies also mentioned low bone mass density among the patients of thalassemia when compared with the normal population<sup>1,4</sup> Our study also found less weight and height of the patient's compared to their control group. Similar

to the finding of the previous studies by Moayeri H, & Oloomi Z.<sup>2</sup> who stated that less bone mass leads to low weight and height among thalassemia patients along with the delayed puberty and growth retardation among thalassemia patients.

Similarly a study conducted by Moiz B et al, also supported that growth retardation and delayed puberty is observed in transfusion dependent thalassemia children. The etiology is multifactorial such as chronic hypoxia, deficiency of various nutrients, toxicity due to iron overload and endocrinopathies.<sup>8</sup>

In another study, it was shown that iron overload in thalassemia patients, reflected as high serum ferritin levels were correlated with growth retardation leading to short stature in these children.<sup>13</sup>

## CONCLUSION

Our study demonstrated that in thalassemia patients, bone age can be evaluated through hand-wrist X-ray. This would be helpful to assess the incidence of growth retardation in thalassemia children as repeated transfusions leading to iron overload in various organs of the body including pituitary gland causing decreased secretion of growth hormone.




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### AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	M. Saleem Akhtar	Principal contributor, Conceptualization and design of research work, data collection.	
2	Amna Arooj	Conceptualization and design of research work, Data collection, writing of manuscript.	
3	Yasmeen Batool	Literature search, review of results and final approval.	
4	Muhammad Nafees	Results analysis, Statistical analysis, interpretation of data.	