

# Skeletal Maturity (Gender-Wise) in Healthy Children of Jammu Region

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## Abstract

The present study was conducted with an aim to assess the skeletal age of children by interpretation of the skeletal maturity index on a hand wrist radiograph in local Jammu population. Skeletal maturity of 500 normal children between 2 to 18 years (250 males, 250 females) was determined by the Greulich & Pyle (G&P) atlas. On an average, male children had bone-age delay of three months to one year whereas in female children the delay was of two to six months up to the age of 12 years. This delay could be attributed to malnutrition, chronic illness, parasitic load, climate, social and ethnic factors. In order to set aside regional variations, a longitudinal study on individuals in that region to establish normal standards is of vital importance.

## Key Words

Skeletal maturity, Bone-age

## Introduction

It is a well established fact that skeletal development is indicated by increase in size and maturity. Growth is a continuous biologic process and is genetically determined however pattern of skeletal maturity can be altered by environmental factors. There is a definite sequence as well as date of appearance for centres of ossification, but schedule is altered by metabolic or constitutional disturbance. Skeletal development varies between populations and depends on race and sex. The developmental status of a child is usually assessed in relation to events that take place during the progress of growth. Thus, chronological age, dental development, height and weight measurements, sexual maturation characteristics and skeletal age are some biological indicators that have been used to identify stages of growth (1). The bone age of a child indicates his/her level of biological and structural maturity better than the chronological age calculated from the date of birth (2). Evaluation of skeletal maturation is essential to estimate

the extent of aberration and guide to clinicians (3). Assessment of bone-age postnatally is based on (a) number, shape and size of epiphyseal centres and (b) size, shape and density of the ends of bones (4). Skeletal age assessment is employed in pediatric endocrinology, orthopaedics, neurology and orthodontics (4, 5). Based on radiological examination of skeletal development of the wrist, bone-age is assessed and then compared with the chronological age. A discrepancy between the two values indicates abnormalities in skeletal development.

Data regarding skeletal maturity is well documented in the west however there is paucity of such data for Indian population. The present study will focus on local population of Jammu and will include children between 2 to 18 years of age and of both sexes by evaluating the radiological age based on X-ray's of the wrist.

## Material and Methods

A total of 500 children (250 boys and 250 girls) aged between 2 to 18 years living in Jammu region of

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Jammu & Kashmir state were enrolled for current study. The children were apparently healthy and children with history of chronic illness were excluded from the study. Average income of the families included in the study was more than rupees 15000 per month. Information regarding the date of birth and informed consent for x-ray examination was obtained from the parents. Radiograph of left wrist (AP) was taken.

Skeletal age (maturity) was determined on the basis of the Greulich & Pyle atlas (5) and compared with normal X-ray's. Chi-q test was applied for comparison

between test population and normal reference X-rays. P value less than 0.05 was taken as significant.

### Results

The distribution of children enrolled for the study is depicted in table-1. Mean skeletal maturity in male children showed a delay ranging from three months to one year up to the age of fourteen years whereas female children showed a delay ranging from two to six months up to the age of thirteen years, but after the age of 14 years in males and 15 years in females bone ages were higher than the American standards indicating earlier maturity

**Table 1. Distribution of Children in Various Chronological Age Groups**

Age group (in years)	Number of male children	Number of female children
2 to 9	118	120
10 to 18	132	130
Total	250	250

**Table: 2. Mean Skeletal Age (S.A) in Relation to Chronological Age (C.A) in Children of Jammu**

C.A (in years)	Males		Females	
	S.A (S.D)	Inference	S.A (S.D)	Inference
2	1.7 (0.20)	Delayed*	1.8(0.33)	Delayed
3	2.6 (0.32)	Delayed	2.7(0.38)	Delayed
4	3.7 (0.37)	Delayed	3.4(0.42)	Delayed
5	4.2 (0.43)	Delayed	4.5(0.42)	Delayed
6	4.6 (0.47)	Delayed	5.4(0.46)	Delayed
7	6.0 (0.44)	Delayed	6.5(0.47)	Delayed
8	7.2 (0.49)	Delayed	7.6(0.49)	Delayed
9	8.3 (0.42)	Delayed	8.5(0.69)	Delayed
10	9.0 (0.83)	Delayed	9.6(0.63)	Delayed
11	10.6 (0.60)	Delayed	10.4(0.63)	Delayed
12	11.1 (0.88)	Delayed	11.6(0.57)	Delayed
13	12.4 (0.87)	Delayed	13.0(0.42)	Delayed
14	13.3 (0.64)	Delayed	14.1(0.47)	Equal <sup>^</sup>
15	15.1 (0.40)	Advanced <sup>#</sup>	15.3(0.37)	Advanced
16	16.4 (0.70)	Advanced	16.6(0.33)	Advanced
17	17.7 (0.72)	Advanced	17.8(0.43)	Advanced
18	18.9 (0.49)	Advanced	18.9(0.48)	Advanced

\*Delayed means either the number or size of ossification centres is less for age.

<sup>#</sup>Advanced means either the number or size of ossification centres is more for

age.<sup>^</sup> Equal means number or size of ossification centres is same for age.

in children of Jammu (Table-2). The delay in skeletal age was found by and large in all the bones of hand but it was some what greater in the carpal bones of both boys and girls. Boys showed complete maturity of the hand bones at the age of 18 years while most of the females showed full maturity of the hand bones at the age of sixteen and half years.

### Discussion

Skeletal maturity is suggested by the size, shape and degree of mineralization of bone. The assessment of skeletal maturity involves multiple factors and a fundamental knowledge of various processes by which bone develops (8).

In the present study retarded skeletal maturation was observed up to the age of 13 years in girls and 14 years in boys. The factors responsible for retarded growth could be chronic illness, low socio-economic background, malnutrition, ethnicity, race and genetic etc (9). To overcome these in the current study, chronic illness, low socio-economic status and malnutrition were eliminated by selecting only those children who were apparently healthy without history of any chronic illness and all these children belonged to upper middle class families, thereby, to a large extent eliminating malnutrition too. Because of the genetic differences, children grow and develop at different rates, even when they are adequately nourished and not handicapped by serious illness. Thus, only factors that are left and could come into play are genetic and racial. So reason for retarded growth in the current study could have been genetic and racial. This, points toward the need to have separate skeletal or bone-age indicator which are genetic based.

This observation is substantiated by the fact that fusion of all the epiphyses was observed at sixteen & half in girls and eighteen in boys which is earlier as compared to American standards, pointing to the fact that despite slow skeletal maturation during childhood, children of Jammu region mature earlier in adolescence. Explanation for this could again be genetic or racial make up of children of particular region.

Sex differences as judged by the median age of emergence of different post-natal centres of ossification in the present sample are in conformity with the well-known fact that the commencement of ossification occurs earlier in females than in males. Similar findings have

been reported in the literature (10). Such differences in the skeletal maturity point to the need to set up separate standards for boys and girls.

In the present study an effort has been made to generate database that can be used to formulate local standards for healthy children of Jammu region as highlighted by in table 2. Such standards provide a practical means by which the skeletal status of other children can be described in terms of the status of the normal and healthy children on whom those standards were based.

### Conclusion

In the current study children from the local population belonging to middle socio-economic status were evaluated for skeletal maturity. Retarded skeletal maturation was observed up to the age of 13 years in girls and 14 years in boys. Within the local population there was gender difference in skeletal maturity; female maturing at earlier age.

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