

ASSESSMENT OF BONE AGE IN KURDISH CHILDREN IN IRAN

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ABSTRACT

Objectives: To investigate whether or not the Greulich- Pyle method is sufficient for Kurdish children for determination of the skeletal age.

Methodology: The study group consisted of 228 children (126 girls, 102 boys), with a mean age of 10 years. These radiographs were analyzed by two radiologists who were unaware of the age of the children.

Results: Mean bone ages were delayed by 2 to 21.6 months when compared to the mean chronological ages in boys aged 7 to 14 years. Mean bone ages were delayed by 6.6 to 11.9 months when compared to the mean chronological ages in girls aged 7 to 9 years and advanced by 2 to 12.2 months in girls aged 10 to 14 years.

Conclusions: The results suggest that Kurdish children may have a different pattern of skeletal maturation from that of American children from which the Greulich-Pyle standards is derived.

KEY WORDS: Bone age, Chronological age, G-P method.

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INTRODUCTION

Here are some indexes describing the chronological situations of humans, e.g. height, dental age, and bone maturity; however bone age (BA) measurement plays a significant role because of its reliability and practicability in diagnosing hereditary diseases and growth disorder. Besides, hand radiography has been widely used in the assessment of skeletal maturity in pediatrics.¹

On the other hand, skeletal age is a frequently used diagnostic tool for the evaluation of endocrine, orthopedic, genetic, and renal disorders, to monitor response to medical therapy and to determine the growth potential of children. The method most widely used for bone age determination is the reference atlas of Greulich and Pyle, consisting of radiological examinations of the left hand and wrist from subjects at different stages of skeletal maturation. While this

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method has the advantages of simplicity and availability of multiple ossification centers for the evaluation of maturity, it is, however, qualitative and was compiled solely from Caucasian children who lived in the 1930s. Nevertheless, the Greulich and Pyle standards are, at present, the most commonly used method for skeletal age assessments throughout the world, regardless of ethnic background.^{2,3}

There is evidence that skeletal maturation may vary between different ethnic and socioeconomic groups of children or among children living in various geographical locations.⁴⁻⁷ In this study, we investigated to what extent the GP method is adequate for determining the skeletal maturity of children in Kurdistan, Western of Iran.

METHODOLOGY

The study subjects were healthy children and adolescents who were recruited from schools in Sanandaj in Kurdistan state at 2007. The investigational protocol was approved by the institutional review board for clinical investigations at Kurdistan University of Medical Sciences, and informed consent was obtained from all subjects and/or their parents. All of the children were Kurd and ranged in age from 7 to 14 years. The children were excluded if they had been given a diagnosis of any chronic illness, if they had been ill for longer than two weeks during the previous six months, if they had taken any medications, vitamin preparations, or calcium supplements within the previous six

months, or if they had been hospitalized at any time since birth. All subjects were appropriately physically active for their age.

Candidates for this study underwent a physical examination by a pediatrician to determine their general health. Measurements of height and weight were obtained, and children in whom either height or weight were not within the 3rd and 97th percentiles for the mean age-adjusted normal values were excluded from further evaluation. Skeletal maturation was assessed on the basis of roentgenograms of the left hand and wrist. The radiographs were evaluated according to the method of Greulich and Pyle, and bone age was determined.² Skeletal maturation assessments were performed independently by two senior radiologists blinded with reference to the chronological age of the subjects. Radiographs from a total of 250 children (130 girls, 120 boys) were analyzed. If the interobserver variation was more than 12 months, the radiographs were excluded (22 case). The study group consisted of 228 children (126 girls, 102 boys). Paired t test and correlation coefficients were used for analysis of data.

RESULTS

We found no statistically significant difference in the interpretation of bone age between the two radiologists. Paired t test of the boys group yielded a p value of 0.408 but for girls' group p value was 0.000. The computed correlation coefficients of the two groups between the two

Table-I: Mean Chronological and Bone Ages of Boys According to Age Group

(month)	Chronological N (month) N	skeletal age (month) Mean (SD)	Difference t Mean (SD)	P value (month) Mean (SD)	Age groups	
84-95	27	88 (4.4)	70.8 (14.8)	17.2 (14.4)	-6.2	0.000*
96-107	13	101.2 (4)	79.6 (17)	21.6 (16.9)	-4.6	0.001*
108-119	8	115 (3.7)	112.2 (23.3)	2.8 (21.1)	-3.8	0.713
120-131	7	125.6 (2)	118 (27.6)	7.6 (27.2)	-0.7	0.492
132-143	6	136 (19.2)	134 (7.3)	2 (15.7)	- 0.31	0.769
144-155	6	148.6(3.6)	139 (9.18)	9(16.6)	-1.45	0.197
156-167	7	160(4.2)	150 (12.2)	10(15.3)	-1.5	0.324
168-178	6	171.6(4.6)	160.3(20.3)	11.3(18)	-1.53	0.186

*: P< 0.05 statistical significance

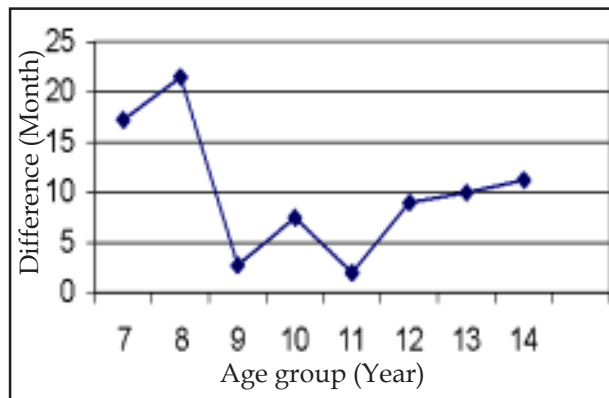


Fig-1: Mean differences in months for the deviation between chronological ages for boys.

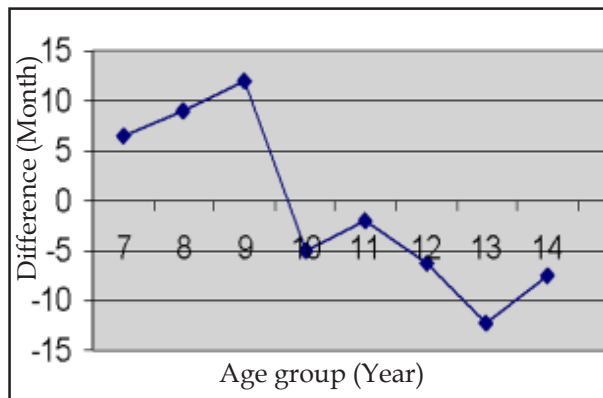


Fig-2: Mean differences in months for the deviation between chronological ages for girls.

radiologists were both 0.948. Mean chronological and bone ages of children according to age groups are given in Tables-I, II. Mean bone ages were delayed by 2 to 21.6 months when compared to the mean chronological ages in boys aged 7 to 14 years (Fig-1.). Mean bone ages were delayed by 6.6 to 11.9 months when compared to the mean chronological ages in girls aged 7 to 9 years and advanced by 2 to 12.2 months in girls aged 10 to 14 years (Fig-2).

DISCUSSION

Plain left-hand radiograph usually compare with finding in a normal population who are white upper-class North American children in the 1930s.² Groell et al showed that there were significant differences between chronological age and bone age. They concluded that the G&P Atlas must be used with reservation.⁴ Ontel et al stated that standards of Greulich and Pyle

skeletal age are applicable in white boys.⁵ Chiang KH et al offered that some modification of the GP Atlas was necessary to enhance ability with accuracy, reliability and consistency in determination of children's bone age in Taiwan.⁶ Our study showed a delay in bone age in boys 7 to 14 years which is consistent with study of Mora et al on prepubertal American children of European descent³ and Jimenez et al.⁷ but not with Koc et al who showed that mean skeletal ages were delayed in 7-13 years & advanced in 14-17 years ages in Turkish boys.⁸

In girls, our data suggest that Mean skeletal ages were delayed in 7 to 9 years and advanced in 10 to 14 (prepubertal) years. These results confirm findings of Buken et al⁹ and Chiang et al⁶ and Rikhasor et al¹⁰ that stated a retardation of bone age before puberty followed by an increase at puberty, resulting in advancement by the end of puberty but not with Groell et al⁴ and

Table-II: Mean Chronological and Bone Ages of Girls According to Age Group

	<i>chronological age (month)</i>	<i>skeletal age (month)</i>	<i>Difference (month)</i>	<i>P value t</i>	<i>Age groups (Month)</i>	
	<i>N</i>	<i>Mean (SD)</i>	<i>Mean (SD)</i>	<i>Mean (SD)</i>		
84-95	24	86.9(3.6)	80.3(9.2)	6.6(10.4)	-3	0.005*
96-107	14	102.9 (3.8)	93.7 (12.3)	9.2(11.2)	-3	0.009*
108-119	6	111.7(1.8)	99.8(14.8)	11.9(14)	-2	0.094
120-131	5	127.4(3.8)	132.4(11.8)	- 5 (14.67)	0.76	0.486
132-143	9	137.6 (3)	139.6(16.7)	- 2 (16)	0.38	0.713
144-155	12	151.5(3.5)	157.6(14.4)	-6.1 (15)	1.42	0.183
156-167	9	161.6(2.4)	173.8(9.8)	-12.2 (8.5)	4.35	0.002*
168-179	10	171.2(2.4)	178.6(11.6)	-7.4 (11.7)	2	0.077

*: P< 0.05 statistical significance

Ontell et al⁵ and Van Rijn et al¹¹ and Loder et al¹² who investigated the applicability of the Greulich and Pyle skeletal age standards. They concluded that those standards were not applicable to children greater than 7 months that is compatible to results of our study.

Limitations of the study: First, we couldn't have been investigating children under 7 years old, because our study was performed in primary and guidance school. Second, socioeconomic status hasn't been controlled in this study, because we did not have reliable data.

CONCLUSION

The results suggest that Kurdish children especially girls may have a different tempo of skeletal maturation during pubertal development from those American children from which GP standards were derived. There is a discrepancy of more than one year between the chronological age and the measured bone age in some age groups. We believe that some modification of the GP Atlas is necessary to enhance our ability to determine skeletal maturation with accuracy, reliability and consistency. Therefore, GP Atlas is not completely applicable to Kurdish children but can be used with some modification.

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