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ORIGINAL ARTICLE

Age estimation from iliac crest epiphyseal fusion by conventional radiographic techniques.

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ABSTRACT… Objective: To determine the correlation between radiological age estimation from iliac crest fusion and actual chronological age. **Study Design:** Cross sectional study. **Setting:** Forensic Medicine & Toxicology Department, King Edward Medical University, Lahore and Radiology Department, Mayo Hospital, Lahore. **Period:** 01-08-2023 to 31-01-2024. **Methods:** Data collection & analysis: Digital X-rays of the pelvis of 80 individuals showing iliac crest in antero-posterior view were taken. The radiographic age was estimated. Then actual age of patients was noted from national identity card, form B, birth certificate of the municipal committee or hospital, school certificate and driving license. Demographic data (name, gender, ethnicity, occupation) was also recorded. Data was entered and analyzed in SPSS Version 20. **Results:** There were 51(63.7%) males and 29(36.25%) females. The mean estimated age on X-ray was 20.10+2.19 years. The correlation coefficient (r) value of estimated age (years) on X-ray was 0.964 which indicates very strong positive correlation with actual age and was significant ($p<0.0001$). Males showed stronger positive correlation($r=0.976$, $p<0.0001$) with estimated age (years) on x-ray as compared to females. **Conclusion:** It can be concluded from the study that mean age observed on X-ray was almost same as actual age, among all the individuals. There is strong correlation coefficient (r) of estimated age (years) on X-ray with actual age, and p value was significant.

Key words: Actual Age, Correlation, Ethnicity, Estimated Age, Iliac Crest Fusion, Occupation, X-ray.

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INTRODUCTION

Identification is required both in the living and the dead. Of the various parameters for establishment of personal identity, age determination is of paramount importance. The reliability of various regions of the skeleton to determine age differs at different age groups such as fetus, children, adolescence, adult, and elderly. Hence, expertise of forensic expert is required to determine the age in such cases.[1-3]

Besides physical examination, radiography of various bones and joints is used for determination of age. Lot of work has been done in this field and many studies have been conducted on estimation of age from examination of human bones by anatomists and anthropologists. Almost every bone has been used for this purpose.[4-8] The epiphyseal union at different sites in body occurs at different ages, thus allowing wide range of age estimation. Estimation of age from examination of almost every part of human skeleton to establish identity of the deceased has been done.[4-8]

In previous studies, age is estimated from iliac bone by using X-Rays, ultrasonography, computed tomography and magnetic resonance imaging. However, these studies have been conducted using various methods but there is no standard method yet documented. Among these age determinant methods, radiography of the bony skeleton focusing on appearance and union of ossification centers is regarded as having greater accuracy and reliability by the legal and medical authorities as the epiphyseal union of every bone takes place at a specific age.[9-11]

Since iliac crest ossifies relatively late, it is of use to estimate age after attaining age of majority. Estimation of age from radiological examination of iliac crest can be of use in medicolegal cases such as establishment of identity, age of majority, valid age of marriage for both sexes, criminal responsibility, right to cast vote in elections, eligibility for contesting elections, consent for participation in sports with risk to life.[11]

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A study reported that on radiological examination of pelvic bone, the correlation between estimated age and actual age was r=0.964 (R^2 =0.9688) while another study showed a positive significant correlation between age and iliac crest ossification (males: right side, r= 0.719; P=0.0001, left side r-0.716; P=0.0001, girls: right side, 0.724, left side, r=0.700; P=0.0001).[12,13]

Use of pelvic bone for assessment of age of an individual for medicolegal purpose can be highly reliable due to very strong positive correlation observed. However, local evidence is lacking in our region so this study is conducted.

METHODS

This Cross sectional study was conducted at Forensic Medicine & Toxicology Department, King Edward Medical University, Lahore and Radiology Department, Mayo Hospital, Lahore for Six months from 01-08-2023 to 31-01-2024. The sample size of 80 cases is calculated with 5% type I error, 10% type II error and value of correlation coefficient between chronological age and estimated age on X-ray i.e. r=0.964.[12] Sampling technique was Non Probability, Consecutive sampling.

Inclusion Criteria

Healthy alive candidates of age 17-25 years, both genders were included presenting to Forensic medicine department for medicolegal purposes.

Exclusion Criteria

Patients with fracture or surgery of hip joint (on medical record), patients with tuberculosis, carcinoma or metastasis (on medical record), osteomalacia, muscular or skeletal dystrophy, cerebral palsy, Down's syndrome, rheumatoid arthritis.

Eighty healthy alive candidates of both genders between 17-25 years of age were enrolled in the study. They were referred to Radiology Department, Mayo hospital Lahore after taking written informed consent. Demographic data (name, gender, ethnicity, occupation) was noted. Then patient underwent X-ray by a single radiologist having 4 years experience in radiology. Digital X-rays (antero-posterior view) of the pelvis showing iliac crest was taken. Stage of epiphyseal union of iliac crest was noted on the X-ray film. The radiographic age was estimated. Then actual age of patients was noted from national identity card, form B, birth certificate of the municipal committee or hospital, school certificate, driving license. All the data was noted on a specially designed proforma.

Data entry and analysis was done through SPSS version 20. Quantitative data like estimated age on radiograph and actual age was presented as mean and SD. Frequency and percentage were calculated for gender, ethnicity and occupation. Pearson's correlation coefficient was calculated to measure correlation between estimated age on radiograph and actual age. p-value ≤0.05 was taken as significant. Data was stratified for gender, ethnicity and occupation. Post-stratification, Pearson's correlation coefficient was calculated to measure correlation between estimated age on radiograph and actual age for each stratum. p-value ≤0.05 was taken as significant.

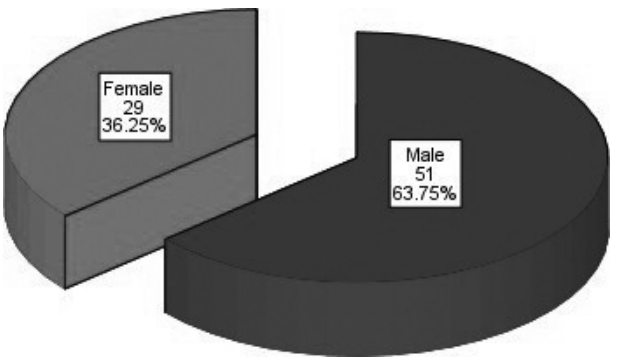
Ethical approval was obtained from institutional review board vide letter ref. no. 489/2023 dated 13-07-2023.

RESULTS

Of the 80 individuals, there were 51(63.7%) males and 29(36.25%) females. Figure-1

FIGURE-1

Gender distribution

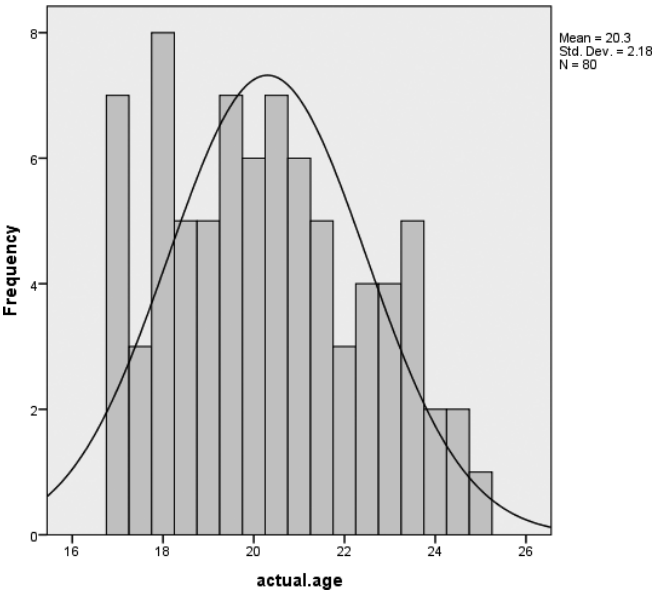


The mean age estimated on X-ray was 20.10±2.19 years with minimum and maximum value 17.0 and 24.0 while the mean actual age was 20.30 ± 2.18

years with minimum and maximum value 17.0 and 25.0. (Figure-2)

FIGURE-2

Descriptive Analysis of Estimated Age on X-ray and Actual age



The correlation coefficient (r) value of estimated age (years) on x-ray was 0.964 which indicates a strong positive significant correlation between them (p<0.0001).Table-I, Figure-3

TABLE-I

Correlation between estimated age (years) on X-ray with actual age

		Age (years)
EAO_X-Ray	Pearson Correlation	0.964
	Sig.(2-tailed)	0.000
	N	80

According to gender, male had strong positive correlation (r=0.976, P<0.0001) with estimated age (years) on x-ray as compared to female showing moderate positive correlation (r=0.932, P<0.0001). Table-II

As in occupation, for prediction of employee age, strong positive correlation was observed i.e. r = 0.950 (p<0.0001). In laborers and nursing students, correlation was highest i.e. r>0.999, (P <0.0001) whereas moderate positive significant correlation was seen in students (r=0.960, P< 0.01) and workers (r=0.971, P<0.01) respectively. (Table-III)

FIGURE-3

Descriptive Analysis of Estimated Age on X-ray and Actual age

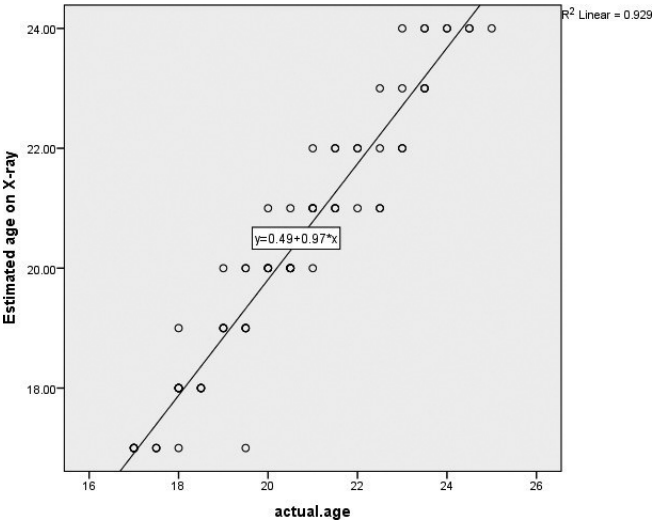


TABLE-II

Correlation between estimated age on X-ray with gender

Gender			Age(years)
Male	EAO_X-Ray	Pearson Correlation	0.976
		Sig.(2-tailed)	0.000
		N	51
Female	EAO_X-ray	Pearson Correlation	0.932
		Sig.(2-tailed)	0.000
		N	29

On the variable of ethnicity, strong positive correlation was observed in Punjabis (r=0.976, p<0.01) followed by Pathans and Urdu speaking (r=0.963 & 0.951, p<0.01) with estimated age on X-ray respectively. (Table-IV)

The relation between actual age and iliac crest fusion in males showed that complete fusion of iliac crest (stage V) occurred at 21.91 ±1.64 years. (Table-V)

The relation between actual age and iliac crest fusion in females revealed that complete fusion (stage V) occurred at 20.98 ±1.52 years. (Table-VI)

TABLE-III

Correlation of estimated age on X-ray with occupation

Occupation	Estimated age on X-ray	Actual Age
Auto mechanic	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Butcher	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Chef	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Car business	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Doctor	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Employee	Pearson Correlation	.950**
	Sig.(2-tailed)	.000
	N	17
Laborer	Pearson Correlation	1.000**
	Sig.(2-tailed)	.000
	N	5
Maid	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Medical student	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Nursing student	Pearson Correlation	1.000**
	Sig.(2-tailed)	.000
	N	3
Property dealer	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Student	Pearson Correlation	.960**
	Sig.(2-tailed)	.000
	N	39
Sweeper	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Worker	Pearson Correlation	.971**
	Sig.(2-tailed)	.001
	N	6

TABLE-IV

Correlation of estimated age on X-ray with ethnicity

Ethnicity	Estimated age on X-ray	Actual Age
Hindkoh	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Pathan	Pearson Correlation	.963**
	Sig.(2-tailed)	.008
	N	5
Punjabi	Pearson Correlation	.976**
	Sig.(2-tailed)	.000
	N	39
Saraiki	Pearson Correlation	a
	Sig.(2-tailed)	.
	N	1
Urdu speaking	Pearson Correlation	.951**
	Sig.(2-tailed)	.000
	N	34

TABLE-V

Frequency of stage of fusion of iliac crest among males

Male		Iliac Crest Stage on X-ray				Total
		II	III	IV	V	
Actual age	17.0	7	0	0	0	7
	17.5	2	0	0	0	2
	18.0	0	4	1	0	5
	18.5	0	4	0	0	4
	19.0	0	0	2	1	3
	19.5	0	0	1	1	2
	20.0	0	0	0	2	2
	20.5	0	0	0	5	5
	21.0	0	0	1	3	4
	21.5	0	0	0	3	3
	22.0	0	0	0	2	2
	22.5	0	0	0	2	2
	23.0	0	0	0	2	2
	23.5	0	0	0	4	4
	24.0	0	0	0	1	1
	24.5	0	0	0	2	2
	25.0	0	0	0	1	1
Total		9	8	5	29	51
Mean		17.11	18.25	19.30	21.91	20.24
Median		17.00	18.25	19.00	21.50	20.25
SD		0.22	0.27	1.10	1.64	2.39

TABLE-VI

Frequency of stage of fusion of iliac crest among females

Female		Iliac crest stage on X-ray				Total
		II	III	IV	V	
Actual age	17.5	0	1	0	0	1
	18.0	0	1	2	0	3
	18.5	0	0	1	0	1
	19.0	0	0	0	2	2
	19.5	0	1	0	4	5
	20.0	0	0	0	4	4
	20.5	0	0	0	2	2
	21.0	0	0	0	2	2
	21.5	0	0	0	2	2
	22.0	0	0	0	1	1
	22.5	0	0	0	2	2
	23.0	0	0	0	2	2
	23.5	0	0	0	1	1
	24.0	0	0	0	1	1
Total		0	3	3	23	29
Mean		NA	18.33	18.17	20.98	20.41
Median		NA	18.00	18.00	20.50	20.00
SD		NA	1.04	0.29	1.52	1.78

DISCUSSION

Expert opinion of forensic experts is many times needed in situations having significant implications for the individuals targeted by the decision. The cases of age estimation of individuals to determine whether the estimated age is actually the age claimed by him/her is undoubtedly one of these scenarios.

Of the various parameters of identification, age is of fundamental importance as it is a primary characteristic of biometric profiling. According to Maples (1989), age estimation is an art rather than science. According to Osborne et al (2004), it is the greatest challenge faced by the forensic experts.[14] However, the need to conduct studies to determine age in the living have caught attention of the forensic experts only recently because of its increasing medicolegal importance in both civil and criminal cases. Forensic age assessment is, therefore, of great significance because of the serious implications of inaccurate age estimation, particularly in cases of unaccompanied minors considered as adults when applying for asylum. Another important situation chiefly encountered in developing countries like Pakistan is lack of maintenance of birth records especially in rural areas due to illiteracy.[1] According to United Nations Children's Fund (UNICEF), only 50% of births are registered in developing countries.[15]

Different bones are used to determine age at various age groups. Age ranging from 14 to 22 years is critical in judicial and non-judicial proceedings in many countries.[15] Forensic experts are summoned to determine age in such cases. Amongst all the parameters of age determination, radiological examination to assess the extent of epiphyseal union has been found to be reliable by medicolegal experts.

In this study, among 80 individuals, the mean estimated age on X-ray was 20.10±2.19 years. The mean actual age was 20.3±2.18 years. Maqsood et al.[16] conducted a similar study including 200 individuals of both gender of age group 17- 25 years at Shalamar Hospital, Lahore. In his study, the mean actual age was 20.41± 2.55 years which is in agreement with our study.

According to the present study, the correlation coefficient (r) value of estimated age (years) on X-ray was 0.964 indicating a strong positive correlation between them (P<0.0001). In a prospective study by Pandey et al.[17] age was determined by radiological methods (X-ray and ultrasonography) of 240 individuals of ages between 12-21 years. A strong positive correlation was observed between the estimated mean age and the actual age on X-ray (p=0.0001) among all the individuals of both genders.[17] This is in accordance with our findings.

Males had strong positive correlation (r=0.976, P<0.0001) with estimated age (years) on X-ray as compared to females showing moderate positive correlation (r=0.932, P<0.0001). Our finding is in agreement with that of Hosmoni et al.[18] who reported a greater degree of correlation between the estimated age and chronological age in males than in females.[18]

As in occupation, for prediction of employee age, strong positive correlation was observed i.e. r=0.950 (p<0.0001). In laborer and nursing students, correlation was highest i.e. r>0.999,

(P<0.0001) whereas moderate positive significant correlation was seen in students (r=0.960, P< 0.01) and workers (r=0.971, P<0.01). The correlation of occupation with the prediction of age was studied, based on the assumption that strenuous physical activity leading to higher metabolic rate in heavy weight lifters may affect the rate of skeletal maturity. Our study was supported by study of Theintz[19] who evaluated the impact of intensive physical training in adolescent female swimmers and gymnastics. He observed delay in fusion of epiphysis relative to the adult height and chronological age in gymnastics. The underlying mechanism was thought to be exercise, in association with or due to metabolic effects of dieting. Saini[20] also studied relationship between estimated skeletal age and sports and exercise. He found estimated age was more than the chronological age. This is congruent with our study. However, occupation did not have significant impact on the age of union of iliac crest as the p value was not significant (0.123) in study by Maqsood et al.[16]

In the present study, on the variable of ethnicity, Punjabis had a strong positive correlation (r=0.976, P<0.01). Pathans and Urdu speaking (r=0.963 & 0.951, P <0.01) also showed strong positive correlation with estimated age on x-ray. Cole at al.(2015)[21] studied the role of ethnicity and gender in skeletal maturation in 607 boys and girls of black and white ethnic groups between ages 9 and 20 years in South Africa. Girls, both black and white, attained skeletal maturation 1.9 years before boys. However, black boys, showed a delay of 7 months as compared to white boys. These findings indicated that skeletal maturation varied differentially by sex and ethnicity.[21] This is in line with our findings. The delayed maturity of black boys, but not black girls, indicates that boys are affected more from environmental stressors than girls. However, Maqsood et al.[16] reported that there is no significant role of ethnicity on ossification of the iliac crest (p value > 0.751) in his study.[16] This is contrary to our findings.

In our study, stage V of the complete union of the iliac crest on radiographic examination was found to be 21.91 years in males and 20.98 years in females. One hundred and fifty seven pelvic radiographs were studied to assess age from ossification stage of iliac crest by Chowdhuri et al.[22] who found 20.85 years in males and 20.43 years in females as age of complete union of iliac crest respectively. This is in agreement with our study. In study by Bhise[23], epiphyseal union of iliac crest was seen at 21 - 22 years in males and 20-21 years in females also supporting our findings. Maqsood et al.[16] reported complete union among 93 (70.45%) males in the age group of 21-25 years as compared to 40 (58.83%) females between 20-25 years of age which is comparable with our findings.[16] The findings of our study are also in agreement with the study done by Coqueugniot and Weaver[24] on 137 Portuguese skeletal remains of ages 7–29 years. They observed that complete fusion of the iliac crest occurred at 20 years of age in males and 22 years in females. However, Memon[25] in a study on heterogeneous population of Hyderabad city and vicinity in Pakistan observed complete union of iliac crest at earlier age i.e.17 years and 10 months in females and 18 years and 10 months in males. This may be because rate of skeletal maturity varies in response to various factors like dietary habits, socioeconomic status, health, gender, ethnicity etc.

In our study females showed ossification of iliac crest approximately one year earlier than males which has also been reported in literature.[16,23,25]

CONCLUSION

It can be concluded from the study that mean age observed on X-ray was almost same as actual age, among all the individuals. There is strong correlation coefficient (r) of estimated age (years) on X-ray with actual age, and p value was significant.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Karargyris A, Kashyap S, Wu JT, Sharma A, Moradi M, Syeda-Mahmood T, editors. **Age prediction using a large chest X-ray dataset.** Medical Imaging 2019: Computer-Aided Diagnosis; 2019. SPIE.

2. Monum T, Makino Y, Prasitwattanaseree S, Yajima D, Chiba F, Torimitsu S, et al. **Age estimation from ossification of sternum and true ribs using 3D post-mortem CT images in a Japanese population.** Legal Medicine. 2020; 43:101663.
3. Ravikanth R, Varghese P. **Radiological age estimation from sternum in living individuals.** Prof RK Sharma. 2017; 11(1):173-7.
4. Herath LH, Senanayake G, Jeyasugiththan J. **Radiological age estimation from fusion at xiphi-sternal joint of living persons through CT images of thoracic region.** Sri Lanka Journal of Forensic Medicine, Science & Law. 2019 Dec 5; 10(2):25-32.
5. Schmeling A, Dettmeyer R, Rudolf E, Vieth V, Geserick G. **Forensic age estimation: methods, certainty, and the law.** Deutsches Ärzteblatt International. 2016; 113(4):44.
6. Singh J, Pathak R. **Sex and age related non-metric variation of the human sternum in a Northwest Indian postmortem sample: A pilot study.** Forensic Science International. 2013; 228(1–3):181.e1-e12.
7. Weaver AA, Schoell SL, Nguyen CM, Lynch SK, Stitzel JD. **Morphometric analysis of variation in the sternum with sex and age.** Journal of Morphology. 2014; 275(11):1284-99.
8. Jaiswal R. **Sternum as an index for determination of sex.** International Journal of Anatomy Research. 2019; 7(4.2):7070-9.
9. Lottering N, Alston-Knox CL, MacGregor DM, Izatt MT, Grant CA, Adam CJ, et al. **Apophyseal ossification of the iliac crest in forensic age estimation: Computed tomography standards for modern Australian subadults.** Journal of Forensic Sciences. 2017; 62(2):292–307.
10. Ekizoglu O, Inci E, Erdil I, Hocaoglu E, Bilgili MG, Kazimoglu C, et al. **Computed tomography evaluation of the iliac crest apophysis: age estimation in living individuals.** International Journal of Legal Medicine. 2016; 130:1101-7.
11. Maqsood M, Butt MK. E**piphyseal fusion of ischial tuberosity in adolescents—an age estimation criterion.** Journal of Fatima Jinnah Medical University. 2016; 10(2):7-14.
12. Liu H, Zhang Y, Rang M, Li Q, Jiang Z, Xia J, et al. **Avulsion fractures of the ischial tuberosity: progress of injury, mechanism, clinical manifestations, imaging examination, diagnosis and differential diagnosis and treatment.** Medical Science Monitor: International Medical Journal of Experimental and Clinical Research. 2018; 24:9406.
13. Norouzi M, Hanafi MQ, Gharibvand MM. **Computed tomography-based age estimation of iliac crests calcification in 10–29-year-old individuals.** Journal of Family Medicine and Primary Care. 2019; 8(6):1947-52.
14. Sullivan S, Flavel A, Franklin D. **Age estimation in a sub-adult Western Australian population based on the analysis of the pelvic girdle and proximal femur.** Forensic Science International. 2017; 281:185.e1.
15. Mansour H. **Age estimation of living individuals and identification of unknown deceased by means of forensic odontological investigations [doctoral dissertation].** Hamburg: Staats-und Universitätsbibliothek Hamburg Carl von Ossietzky. 2019.
16. Maqsood M, Bashir MZ, Butt MK, Maqsood MF. **Epiphyseal fusion of iliac crests in male and female adolescents: an age estimation criterion.** Journal of Fatima Jinnah Medical University. 2021; 2(1):11-21.
17. Panday K, Khan I, Prakash V, Mishra PP. **Assessment of chronological age of individuals using radiological and ultrasonological means.** International Journal of Contemporary Medical Research. 2017; 4(4):818-21.
18. Hosmani A, Pathak H, Khartade H, Jadav D, Shedge R, Pawar M, et al. **Age estimation in sportspersons from the epiphyseal fusion around wrist, elbow, and pelvic joints.** Cureus. 2023; 15(1):e33282.
19. Theintz GE, Howald H, Weiss U, Sizonenko PC. **Evidence of reduction of growth potential in adolescent female gymnasts.** Journal of Pediatrics. 1993; 122(2):306-13.
20. Saini PC, Punia RK, Simatwal NK. **An observational study of radiological age and documented age in 16–20 years of age group in Jaipur.** Prof (Dr) RK Sharma. 2019; 19(2):134-42.
21. Cole TJ, Rousham EK, Hawley NL, Cameron N, Norris SA, Pettifor JM. **Ethnic and sex differences in skeletal maturation among the Birth to Twenty cohort in South Africa.** Archives of Disease in Childhood. 2015; 100:138-43.
22. Chowdhuri S, Bhattacharjee R, Das S, Ghosh R. **A study to estimate forensic age by Kreitner and Kellinghaus main stages method from epiphyseal ossification of the iliac crest by digital radiography.** Saudi Journal of Forensic Medical Sciences. 2018; 1:51-4.
23. Bhise S, Nanandkar S. **Age determination from pelvis: a radiological study in Mumbai region.** Journal of Indian Academy of Forensic Medicine. 2012; 34(2):104-7.
24. Coqueugniot H, Weaver TD. **Brief communication: Infracranial maturation in the skeletal collection from Coimbra, Portugal—new aging standards for epiphyseal union.** American Journal of Physical Anthropology. 2007; 134:424-37.
25. Memon N, Memon MU, Memon K, Junejo H, Memon J. **Radiological indicators for determination of age of consent and criminal responsibility.** Journal of Liaquat University of Medical and Health Sciences (JLUMHS). 2012; 11(2):64.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Mariam Arif:** Data collection, compilation, manuscript writing.
2	**Syed Rayyan Hamad:** Data collection.
3	**Syed Hamad Rasool:** Data entry, analysis.