

Sexual Dimorphism in Adult Human Dry Sacra Comparing Sacral Index and Curvature Index

Greeshma V Biju¹

¹Tutor, Department of Anatomy, M.S. Ramaiah Medical College, Bangalore

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ABSTRACT

Human sacral bone is one of the most important bones used for identification of gender. Sex determination is one of the most vital steps necessary to establish identity from skeletal remains. Sexual dimorphism of skeletal structure develops during childhood and becomes pronounced at adolescence in human. Some bones are better indicators than others but no skeletal feature can be definitive for sexual differentiation. The pelvis is said to be the best marked and reliable characteristics for distinguishing sex in 90-95% subjects in the determination of personal individuality from adult human skeletal remains. This study is to compare the indices in identifying the dimorphism of adult human dry sacra.

Objective: - To compare the accuracy of identifying the sexual dimorphism of adult human dry sacra using sacral index and curvature index.

Methods: - The specimen (50 dry human adult sacra- 31 male and 19 female) for the study was taken, measured the parameters and calculated the indices in each sacrum. Calculated the mean, standard deviation, calculated range and demarcating point and the percentage of bone identified by demarcating point.

Results: - In the present study the mean sacral index for male was 97.30 and for female it was 116.64. The statistical study showed that it is highly significant in sex determination of sacrum. The mean value of curvature index is more in male (89.5) than females (87.9) only with a slight variation. Only 2 male sacra were identified as male by using the demarcating point of midventral curved length of sacrum. 15 sacra were identified as male by using the demarcating point of maximum breadth of sacrum. Only 1 male sacrum were identified as male by using the demarcating point of midventral curved length of sacrum. 17 sacra were identified as female by using the demarcating point of maximum height of sacrum.

Conclusion: - Sacral index was less (110) when compared to that of females (129) and but is the best index for the identification of sex of sacrum than curvature index.

Keywords: Breadth of sacrum, Height of Sacrum, Sacral Index, Curvature Index

INTRODUCTION

The sacrum is triangular bone, forms the posterosuperior wall of pelvic cavity by the fusion of five sacral vertebrae wedged between two innominate bones, and the adult bone retains many vertebral features. Sex determination is easy when a complete skeleton is available for examination, but skeletal remains are rarely complete and undamaged. Integration of evidence from every piece of skeleton is important for

personal identification. This reduces the degree of error rates in identification and adds to the degree to certainty and strengthens the overall identification process. This study aims the identification of sex of adult human dry sacra and to compare the accuracy between the sacral index and curvature index.

MATERIALS AND METHODS

50 dry human adult sacra (31 male and 19 female) were used for the study

Exclusion criteria

Sacrum with: -

1. Bone resorption
2. Lumbarization
3. Coccygeal segments
4. Incomplete sacralization
5. Fractures were excluded from the study

The metrical data was recorded from each sacrum according to the method demonstrated in Wilder's manual of Anthropometry Vernier Caliper and standardized flexible ribbon tape were used to measure the parameters. ⁽¹⁾.

Parameters measured were: -

1. Maximum breadth of sacrum.

The maximum distance was noted in millimeters with the Vernier Caliper by taking two points between the lateral most part of ala of sacrum.

2. Maximum height of sacrum.

The maximum height of sacrum was measured in millimeters by using Vernier Caliper as the straight distance from middle of anterosuperior margin of sacral promontory to the middle of anteroinferior margin of last sacral vertebra.

3. Midventral curved length

It was measured in millimeters by flexible measuring tape as the distance from anterosuperior margin of sacral promontory to middle of anteroinferior margin of last sacral vertebra.

Using the above measurements, the following indices were calculated.

1. Sacral Index

$$\frac{\text{Maximum breadth of sacrum}}{\text{Maximum height of sacrum}} \times 100$$

2. Curvature Index

$$\frac{\text{Maximum height of sacrum}}{\text{Midventral curved length}} \times 100$$

From the obtained values, demarcating points were calculated on the lines of Jit and Singh (1966) and the percentage of bones, thus identified were found in relation to each parameter.

The mean of maximum breadth of sacrum in male was 10.29cms. To this value 3 times the standard deviation is added and subtracted and this gives the calculated range ($3 \times S.D \pm \text{mean} = C.R$). Thus, for maximum breadth of sacrum in males the calculated range comes to 9.90 to 10.69.

Similar calculations are made for the maximum breadth of sacrum in females, calculated range comes to 10.32 to 11.31.

Thus, the demarcating point of sacrum for maximum breadth of sacrum for males comes to <10.32 and of females comes to >10.69 . Similarly, all the parameters were subjected to arrive at the demarcating points and percentage of identified bones were recorded.

Statistical Analysis

Students t test (two tailed and independent) has been used to determine the significance of each parameter in the determination of sex of sacrum.

RESULT

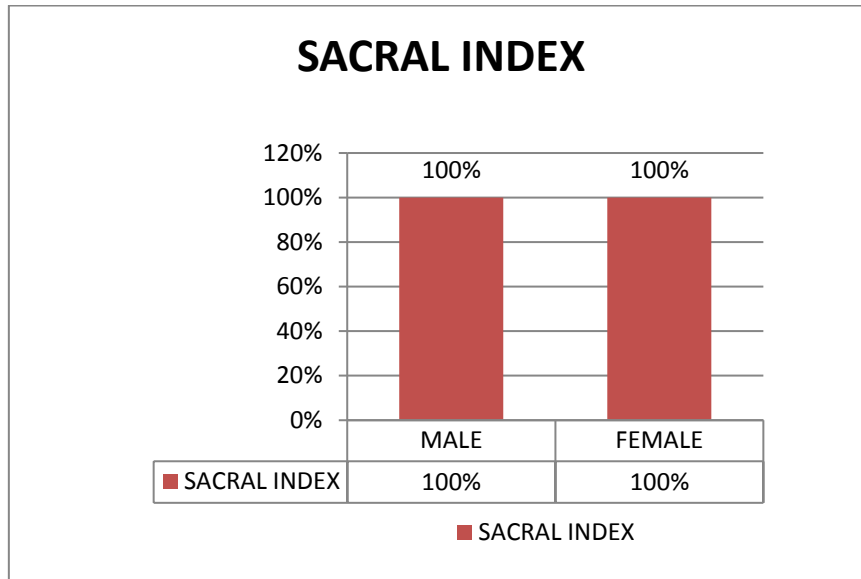
1. SACRAL INDEX

Table 1: Percentage of bone identified by demarcating point

Range (cms)	Sex	Mean (cms)	Standard deviation	Calculated range	P value	Demarcating point (D.P)	% of bone identified by D.P
8.81 – 110	M	97.3078	1.462	92.9218 – 101.6938	<0.001	<112.4904	100%
108 – 129.30	F	116.6484	1.386	112.4904 – 120.8064	-	>101.6938	100%

Table 1 shows the calculation of mean, demarcating point and the percentage of bone identified by demarcating point.

The mean value of sacral index of males and females showed that it is significantly higher in females as the female sacra are shorter and wider.



Graph 1: Percentage of bones identified by demarcating point of sacral index

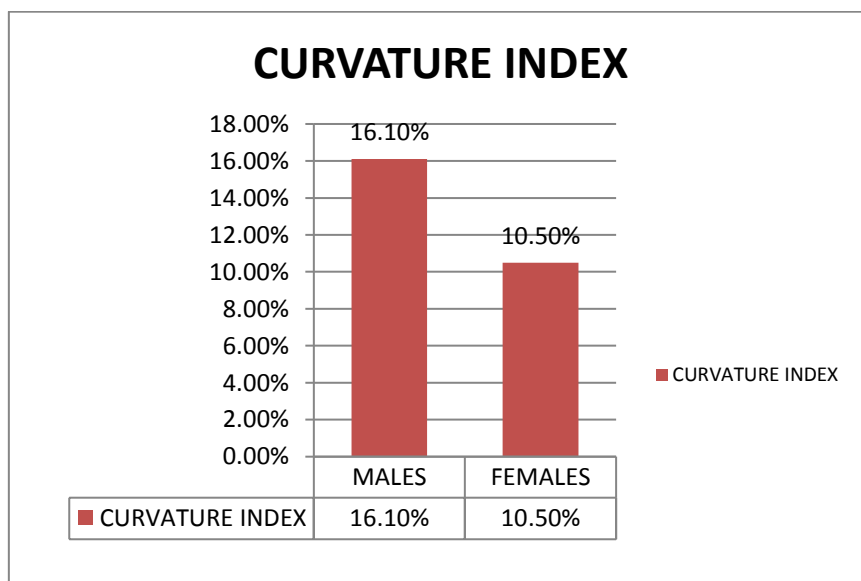
2. CURVATURE INDEX

Table 2: Percentage of bone identified by demarcating point

Range (cms)	Sex	Mean(cms)	Standard deviation	Calculated range	P value	Demarcating point (D.P)	% of bone identified by D.P
80- 108.42	M	89.500	1.077	86.269 – 92.731	.135	<83.776	16.1%
78.64 – 95.19	F	87.037	1.087	83.776 – 90.298		>92.731	10.5%

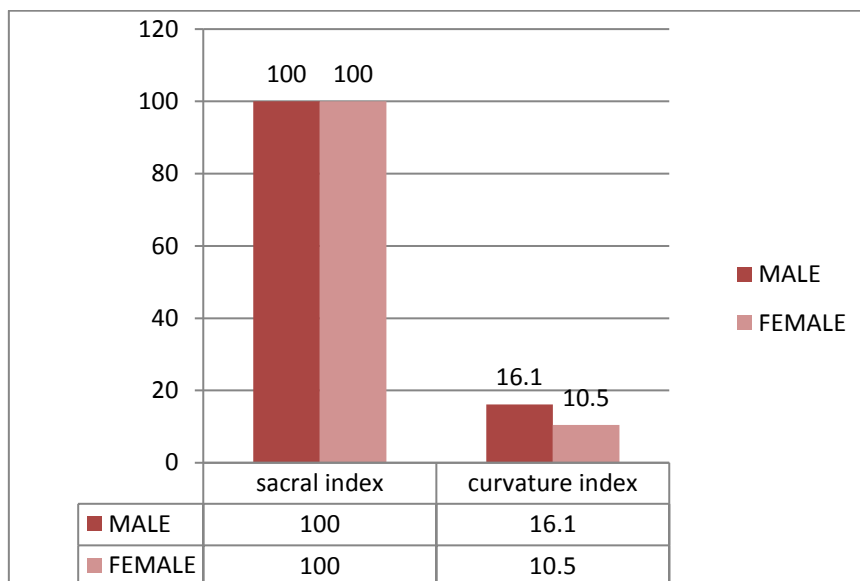
Table 2 shows the calculation of mean, demarcating point and the percentage of bone identified by demarcating point.

Curvature index is more in males than females and there is no marked difference between male and female.



Graph 2: Percentage of bones identified by demarcating point of curvature index

COMPARISON OF SACRAL INDEX AND CURVATURE INDEX



Graph 3

DISCUSSION

1. MAXIMUM BREADTH OF SACRUM

Davivongs (1963) studied the pelvic girdle of Australian origin (50 males and 50 females) and observed that the maximum breadth of sacrum was more in females (10.12) than in males (9.99) ⁽²⁾. Kanika Sachdeva (2011) noted that the average breadth of sacra in males were found to be significantly higher than females ⁽³⁾. In the present study the maximum breadth of sacrum was more in males (11.6) than females (11.5) only with slight variation.

2. MAXIMUM HEIGHT OF SACRUM

Ravichandran (2013) study on sacral index in Tamil Nadu and Andhra Pradesh population (63 males and 60 females) and observed that the maximum height of sacrum was more in males (97.8mm) than females (90.6mm) ⁽⁴⁾. In the present study the mean value for males are (106.29mm) and for females are (92.89mm).

3. SACRAL INDEX

Flander (1978) reported that the average sacral index in white males was (106.49) and (108.69) in white females. In blacks he reported that the average sacral index was (106.17) in males and (112.35) in

females ⁽⁵⁾. 97.30 was the mean sacral index for male in the present study and for female it was 116.64. The statistical study showed that it is highly significant in sex determination of sacrum.

4. CURVATURE INDEX

Davivongs (1963) observed in his study that the mean value for curvature index was higher in males (92.46) than female (90.80) ⁽²⁾. In the present study the mean value of curvature index is more in male (89.5) than females (87.9) only with a slight variation.

CONCLUSION

The following observations were assessed and noted.

- Sacral index was less (110) when compared to that of females (129) and but is the best index for the identification of sex of sacrum.
- Curvature index were more in males (108.42) and shows that 16.1% of males and 10.5% of female bones were identified using curvature index.

Continuance of such studies will definitely help in establishing the anthropometric standards. A single parameter may not be of much use in sexing

the sacra. Hence it can be concluded that for the determination of sex of sacrum, maximum number of parameters should be taken to attain 100% accuracy.

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Conflict of Interest: None

Ethical Approval: Approved

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