

STUDY OF SACRAL INDEX: COMPARISON BETWEEN DIFFERENT REGIONAL POPULATIONS OF INDIA AND ABROAD

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ABSTRACT

Identification of sex by human skeletal remains is a critical problem and is very important in anthropological and medico legal works. Bones often survive the process of decay and therefore provide the major evidence of human age and sex after death. Over the years different authors had carried various types of measurements on human sacra of different races and regions. The present study carried out 81 sacra of unknown sex contains 45 male and 36 female sacra identified by physical characteristics. They were collected from Telangana and Andhra Pradesh region. India may be divided into four regions like North part, South part, West part, and East part for different study purpose on local population. In the present study mean sacral index in males is 104.08 and females are 115.72. The male mean sacral index value of present study is more than the values of Eastern part, north part, other worker of Southern part of India and western part except in Western part in Western Rajasthan population. The female mean sacral index value of present study is higher than the observation of Eastern part, other workers of Southern part of India, Varanasi and Jammu of north part of India and Saurashtra region of western region of India. Observations of the workers from remaining areas of Western part of India and Agra region of North India is higher than the present study. The studies on Indian population suggest that mean sacral index in females is higher than that of males.

KEYWORDS: Sacrum, Sacral index, Regions of India

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INTRODUCTION

Sex, age, stature and ethnic background are the four main features of biological identity. It is indicating that "almost all elements of human skeleton show some degree of sexual dimorphism, but results can be obtained from only a few bones, sacrum being one of these few".

Sacrum is a major bone of pelvis forms the postero

-superior wall of the pelvic cavity is formed by fusion of five vertebrae. It lies between the two innominate bones which supports the spine and provides the strength and stability of the bony pelvis.

Morphological features over the bones also depend on the nutritional, geographic and occupational factors [1].

India is a sub continent with confluence of different races and pure ethnic groups are often difficult to get in it. However, Chand et al. suggested that India may be divided into four regions like North, South, West, and East for different study purpose on local population. Though, studies on the sacral anthropometry are available from different regions of the country are data from the eastern part by Jana et al in the Burdwan region of West Bengal, Sibani Mazumdar et al in the Kolkata region, data from western region of india by Sushma K Kathari in rajasthan region, Dr. Antarpreet kaur aurora et al in Amritsar, pujab region , data from southern part of india by Ravichandran et al in Andhrapradesh and Tamilnadu, Shailaja C. Math et al in Gulbarga, Karnataka and data from North India by Mishra et al in Agra region, Singh et al in Jammu, Raju et al in Varanasi. Mean value may be significantly different in bones from different zones. Therefore, the present work was conducted on the sacra of Telangana region to observe the sexual and regional differences of the local population and compare the findings with similar observations across India [2, 3].

The accurate method for identification of female or male type sacrum has often been the sacral index method as explained in the Hrdlicka's practical Anthropometry.

The formula for Sacral Index is:

$$\frac{\text{Maximum width} \times 100}{\text{Maximum straight length}}$$

The present study was aimed to identify the sex of sacrum by using sacral index and comparison of present study with other works on Indian population and works of other countries.

MATERIALS AND METHODS

The material for the present study consists of 81 adult intact human sacra of unknown sex. They were collected from the Department of Anatomy, MNR medical college, Sangareddy, Medak, Telangana and SVIMS University, Tirupati. Measurements were taken by using Stainless steel sliding calliper. The measuring was done on intact parts of normal bones. Bones showing wear and tear, fracture or any pathology were not considered. Each linear recording was taken to the nearest millimetre.

Following parameters were recorded on each sacrum for the identification of sacral index:

1. Maximum length of sacrum: (anterior straight length-SL)

It measures the straight distance from sacral promontory in the mid saggital plane to the corresponding lowest point on the anterior margin of the sacrum.

Instrument used- sliding caliper.

Fig 1: Showing measuring the maximum length of sacrum.



2. Maximum breadth (width) of sacrum:

By taking two points at the lateral most part of the ala of sacrum.

Instrument used-sliding caliper.

Fig. 2: Showing measuring the maximum width of sacrum.



with the use of Formula for the identification of sacral index Mean±S.D is given for quantitative variables, frequencies and percentage is given for qualitative variables. Two independent sample 't' test was applied to check group mean differences. A p-value of <0.05 was considered as statistically significant.

RESULTS

In the present a total of 81 sacra of unknown sex were subjected to sexing by observing morphological parameters according to which they were classified in to 45 male and 36 female sacra. The specimens were subjected to 13 Morphometric parameters and the results were analyzed as described below (Table No. 1)

1. The mean Maximum length of sacrum in male was 9.85 ± 1.14 and in females it was 10.01 ± 1.22 . P-value is 0.5538 by conventional criteria this difference is considered to be statistically not significant.
2. The mean Maximum breadth (width) of sacrum in males was 10.11 ± 0.48 and in females it was 10.52 ± 0.51 . P-value is 0.0001 by conventional criteria this difference is considered to be statistically significant.
3. The mean sacral index in males was 104.08 ± 11.5 and in females it was 115.72 ± 16.50 . P-value is 0.0004 by conventional criteria this difference is considered to be statistically significant.

Table No. 1: Showing the values of present study.

S.No	Parameters	Sex	Range	Mean	SD	T value	P value
1	Length of Sacrum (mm)	Male	34-55	9.85	1.14	0.5947	0.5538
		Female	75-129	10.01	1.22		
2	Width of Sacrum (mm)	Male	91-116	10.11	0.48	6.9222	*0.0001
		Female	95-115	10.82	0.43		
3	Sacral index	Male	81-136	104.08	16.5	3.731	*0.0004
		Female	85-146	115.72	13.64		

DISCUSSION

Comparison of values of sacral index with the studies of other workers in India:

The present study was conducted in Andhra Pradesh and Telangana regions related to southern part of India and values of sacral index in males is 104.08 and females is 115.72.

The mean sacral index in male sacra of Eastern part of India observed by Jana et al is 91.27 and Sibani Mazumdar et al is 94.9 was lower when compared with the present study i.e. 104.8. The mean sacral index in female sacra of Eastern part of India observed by Jana et al 103.89 and Sibani Mazumdar et al is 109.8 was lower when compared with the present study i.e. 115.72. [3, 4] (Table No. 2)

The mean sacral index in male sacra of Western part of India observed by Sushma K Kataria is 104.11 is slightly higher, by M.M Patel et al is 96.25 and by Dr. Anterpreet Kaur Aurora et al is 93.685 is lower than the present study. The mean sacral index in female sacra of Western part of India observed by Sushma K. Kataria is 120.01, by Dr. Anterpreet Kaur Aurora et al is 125.35 is higher and by M.M Patel et al is 110.05 is lower than the present study [5, 6, 7]. (Table No. 2)

The mean sacral index in male sacra of Southern part of India observed by Ravichandran et al is 96.32 and by Shilaja C. Math is 94.2. The value is lower when compared with the present study.

Table No. 2: Comparative study of sacral index between male and female sexes in present study with studies of Indian population.

SI. No.	Investigators	Male				Female				S.S.D.
		No	mean	Range	S.D.	No	mean	Range	S.D.	
1	Jana et al (1987)	-	91.27	83.3-112.5	-	-	103.89	89.61-115.7	-	-
2	Singh et al (1988)	26	94.32	76.3-110.94	-	12	104.81	95.77-113.85	-	-
3	S.S.Dapate (1997)	117	94.58	77.27-118.42	6.96	83	104.27	85.0-136.36	10.675	0.05
4	Mishra et al (2003)	74	98.21	90- 108	4.89	42	117.84	103- 131.25	7	<0.001
5	Patel et al (2005)	32	96.25	90.5 – 106	4.6	32	113.25	104.8- 131	5.74	<0.001
6	Shilaja C. Math (2006)	190	94.24	53.57- 152	11.78	64	113.19	91.89- 146.15	10.26	<0.001
7	Dr. Anterpreet Kaur et al(2010)	20	93.685	58.9-128.38	11.57	20	125.35	90.94- 159.76	11.47	<0.0001
8	Sibani mazumdar et al (2012)	127	94.9	80.5- 109.3	4.8	123	109.8	87.9- 131.7	7.3	<0.0001
9	Ravichandran et al (2013)	63	96.32	80.7 – 106.4	5.4	60	102.29	93.1 – 108.8	4	<0.0001
10	Sushma K Kataria (2014)	42	104.11	5.86	-	32	120.01	-	8.75	-
11	Present study	81	104.08	81-136	16.5	64	115.72	85-146	13.64	<0.0004

Table No. 3: Comparative study of sacral index between male and female sexes in present study with studies of other countries:

Sl. No.	Investigators		Male				Female				S.S.D.
			No	mean	Range	S.D.	No	mean	Range	S.D.	P
1	Martin (1928)		-	112.14	-	-	-	-	-	-	-
2	Grays Anatomy (1954)		-	105	86.9-123.2	8.93	50	115.49	96.2-140	10.39	<0.001
3	Davivong (1963)		50	104.16	86.9-123.2	8.93	50	115.49	96.2-140	10.39	<0.001
4	Charnalia (1967)		60	105.1	-	-	30	112	-	-	-
5	Flander	-1978									
	White		50	106.49	-	10.4	50	108.69	-	13.59	N.S.
	Black		50	106.17	-	10.36	50	112.35	-	11.03	<0.01
6	Sahana	-1980	-	-	<90	-	-	-	>90	-	-
7	Raju et al (1980)		33	100.85	74.72-126.9	8.71	11	111.39	88.38-134.4	7.67	<0.001
8	Bagde (1981)		65	94.75	80.2-114	7.15	30	112.05	90.8-133.3	10.9	<0.001
9	Vindo Kumar et al (1984)		-	91.27	-	-	-	103.89	-	-	-
10	British (cited by Vinod Kumar)		-	112	-	-	-	116	-	-	-

The mean sacral index in female sacra of Southern part of India observed by Ravichandran et al is 102.29 and by Shilaja C. Math is 113.19. The value is lower when compared with the present study. [8] (Table No. 2).

The mean sacral index in male sacra of North India observed by Mishra et al is 98.21, Singh et al is 94.32 and Raju et al is 100.85 was lower than the values of present study. The mean sacral index in female sacra of North India observed by Mishra et al is 117.84 was higher than the present study, by Singh et al is 104.81 and by Raju et al is 111.39 was lower with the values of present study. [9, 10, 11] (Table No. 2).

The male mean sacral index value of present study i.e. 104.08 is more than the values of Eastern part, north part, other worker of Southern part of India and western part except in Western part in Western Rajasthan population. The female mean sacral index value of present study i.e. 115.72 is higher than the observation of Eastern part, other workers of Southern part of India, Varanasi and Jammu of north part of India and Saurashtra region of western region of India.

Table No. 4: In present study sacra can be classified as follows according to their sacral index in the table.

Classification	Range	Male	Female
Dolichohierisch (narrow)	<99.9	17	7
Hyplatyhierisch (medium)	100-105.9	10	3
Platyhierisch (broad)	>106	18	26

Observations of the workers from remaining areas of Western part of India and Agra region of North India is higher than the present study.

According to the works which are conducted in Indian population up on sacral index confirms that the mean sacral index in females is higher than the male sacral index.

The mean sacral index in male sacra observed by Davivongs in Australian aborigines is 104.16, by Martin is 112.40, by Grays Anatomy is 105, by Charnalia is 105.1, by Flander in British whites is 106.49 and in British blacks is 106.17, by Bagde is 94.75, by Vindo Kumar et al is 91.27, by British (cited by Vinod Kumar) is 112, by S.S.Dapate is 94.58. whereas in the present study it is 104.08 which is higher than that of values recorded by Bagde, Vinod Kumar et al, S.S.Dhapate and minutely lower than that of Australian aborigines and lower than Grays Anatomy, Charnalia, Flander in British whites and in British blacks, British cited by Vinod Kumar [12, 13, 14, 15, 16, 17 18]. (Table No. 3)

The mean sacral index in female sacra by Davivongs in Australian aborigine is 115.49, by Gray's Anatomy is 115.49, by Charnalia is 112, by Flander in British whites is 108.69 and in British blacks is 112.35, by Raju et al is 113.39, by Bagde is 112.05, by Vinod Kumar et al is 103.89, by British (cited by Vinod Kumar) is 116, by S.S.Dhapate is 104.27. Whereas in the present study it is 115.72 (Table no 3) that were higher than that reported in the Australian aborigines (Davivong), and remaining other workers. This is in conformity with the observations by Singh

and that by Martin [12, 13, 14, 15, 16, 17 18].

Sacra with sacral index <100 are considered to be grouped as Dolichohierisch group and if >100 they belong to platyhieric group. When compared to observations of Jana et al and Singh et al, the sacra in the present study are considered to belong to sub-platyhieric variety as the index is above 100. Even the sacra in studies by Davivongs and Raju et al belonged to sub platyhieric group [19].

Female sacra in the present study belong to platyhieric group. Martin reported that in the European sacrum, both male and female, mean values fall into the platyhieric group. The male sacra show a mean sacral index of 104.08 that is low when compared to female sacra that show a mean sacral index of 115.72 in the present study. Even in the present study the difference between male and female values is very significant ($p < 0.04$) (Table no 4).

CONCLUSION

The present study was conducted in Andhra Pradesh and Telangana regions related to southern part of India and values of sacral index in males is 104.08 and females is 115.72. In this study the mean of female sacral index is higher than the mean of male sacral index.

The male mean sacral index value of present study is more than the values of Eastern part, north part, other worker of Southern part of India and western part except in Western part in Western Rajasthan population. The female mean sacral index value of present study is higher than the observation of Eastern part, other workers of Southern part of India, Varanasi and Jammu of north part of India and Saurashtra region of western region of India. Observations of the workers from remaining areas of Western part of India and Agra region of North India is higher than the present study.

According to the works which are conducted in Indian population up on sacral index confirms that the mean sacral index in females is higher than the male sacral index.

Conflicts of Interests: None

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