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Original Research Article

MORPHOMETRY OF THE ADULT HUMAN DRY HIP BONE IN SOUTH INDIAN POPULATION

Bollavaram Pullanna [1], Bindhu S [*2], Ramakrishna Avadhani [3], Meera Jacob [4].

[1] Tutor, Yenepoya Medical College, Yenepoya (Deemed to be) University, Deralakatte, Mangalore, Karnataka, India.

[*2] Associate Professor, Yenepoya Medical College, Yenepoya (Deemed to be) University, Deralakatte, Mangalore, Karnataka, India.

[3,] Professor, Yenepoya Medical College, Yenepoya (Deemed to be) University, Deralakatte, Mangalore, Karnataka, India.

[4,] Assistant Professor, Yenepoya Medical College, Yenepoya (Deemed to be) University, Deralakatte, Mangalore, Karnataka, India.

ABSTRACT

Introduction: Sex determination of the unknown hip bone either of whole skeleton or any part of it, is always a field of research not only for anatomist but also for forensic expert, anthropologist and archaeologist. Hip bone was considered as ideal bone for sex determination after skull. The morphometry of 100 dry human hip bones, in south Indian population was done in order to evaluate the various parameters of the hip bone. Body proportions and absolute dimensions vary widely in respect to age, sex and racial groups.

Materials and Methods: This study was conducted in the Department of Anatomy,YenepoyaMedical College, Yenepoya University, Mangalore. 100 hip bones of both sexes were used. The Osteometric parameters such as Length, Width, were measured using osteometric board, Weight electronic weighing machine. And Coxalindex of hip bone, were used formula, Length of hip bone ÷ Width of hip bone ×100. The data were analyzed statistically using SPSS software. In this study we included only healthy bones, deformed and eroded bones were excluded from the study.

Results: The data obtained was statistically analyzed. Mean, Standard deviation and standard error of mean, t-value and p- value, were determined for each parameter. Length of hip bone: (Mean for Female –18.31 cm, Male -20.29cm). Weight of hip bone: (Mean for Female –86.48gm, Male-121.72gm). Width of hip bone: (Mean for Female-13.50cm, male-14.38cm.). Coxal index: (Mean for Female-73.73, male-70.87.)

All parameters show statistically highly significant (P- value <0.0001). All values were compared with series of other workers.

Conclusion: In this study all the parameters were larger in males as compared to females and were found to be statistically highly significant. Difference were present in gross morphometric parameters, hence these measurements of the hip bone can be used for sex determination of unknown skeletons remains and in the forensic science for medico legal cases.

KEY WORDS: Total hipbone height, hipbone width, hipbone weight, Sexual dimorphisam.

Address for Correspondence: Dr. Bindhu. S, Associate Professor, Yenepoya Medical College, YenepoyaUniversity, Deralakatte, Mangalore, karnataka, India. **E-Mail:** nairbindhu@yahoo.com

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INTRODUCTION

The hip bone is an irregular bone made up of three components, the ilium, pubis and ischium, which are united to each other at the acetabulum. The bones of the pelvis consist of the right and left pelvic (hip) bones, the sacrum, and the coccyx. The sacrum articulates superiorly with vertebra L 5 at the lumbosacral joint. The pelvic bones articulate posteriorly with the sacrum at the sacro-iliac joint and with each other anteriorly at the pubic symphysis. [1]

MATERIALS AND METHODS

A total of 100 Indian adult dry hip bones of known sex were studied from teaching collection of the Anatomy Department, Yenepoya Medical College,Yenepoya University, Mangalore.Out of the total of 100 hip bones, 49 was male and 51 was female, All the hip bones selected were dry, complete and showed normal anatomical features. Specimens showing osteoarthritic changes, evidence of any previous trauma or skeletal disorders was excluded from the study. All the measurements were taken with the help of osteometric board and weighing machine. Two readings were taken for each parameter at different times and the average was recorded. Mean, Standard deviation and Standard error of mean and t-value, p-value, were determined for each parameter. All values were compared with series of other workers to draw the conclusions.

1. Weight of Hip Bone: Each bone was measured separately using an electronic weighing machine and the weight was recorded in grams.[fig:1]

2. Length of Hip Bone: It is the maximum distance from the most superior point on the iliac crest to a plane drawn along the inferior surface of the ischium. It was measured with the help of an osteometric board and the measurements were recorded in cm.[fig:2]

3. Width of Hip Bone: It is the each bone distance between the anterior superior iliac spine and the posterior superior iliac spine. It was measured with the help of an osteometric board and the measurements were recorded in centimeters. The posterior superior spine was placed in contact with the fixed end of the board and the anterior superior spine was placed against the movable arm .[fig:3]

4. Coxal Index: It was calculated from the observed values of length and width of the hip bones. The formula used for finding out the coxal index is width Divide by length of hip bone x 100

$$\text{Coxal index} = \frac{\text{Width of hip bone}}{\text{Length of hip bone}} \times 100$$

Sex Determination: All 100 hip bones were separated in to males and females depending on seven visual criteria of human hip bones. Bones those fulfil all these criteria were selected for the study. These criteria were:

1. Preauricular sulcus [2]**:** Preauricular sulcus was seen or felt as a depression just inferior to auricular part of sacropelvic surface of ilium. This was deeper in female and absent or shallower in male.

2. Greater sciatic notch [2]**:**The greater sciatic notch i present posteriorly, bounded above by the ilium,below by the ilium and ischium. It is formed by turning of the posterior border of hip bone horizontally forwards for about 3cm and then turning down and back to join the posterior ischial border. The width and posterior angle of the notch was observed in the entire bones. Greater sciatic notch is wider in female and narrower in male.

3. Obturator foramen [2]**:**The shape of obturator foramen present below and slightly anterior to the acetabulum was noted in both the sexes. The shape of obturator foramen was oval in male and triangular in female.

4. Iliac fossa [2]**:**The depth of iliac fossa i.e. the internal cavity of ilium forming the wall of greater pelvis was compared in both the sexes. Iliac fossa was deep in male and shallow in female.

5. Ischiopubic ramus eversion [2]**:** Presence or absence of eversion of ischiopubic ramus was looked for in both the sexes. Ischiopubic ramus was everted in male because of attachement of crus of penis. This was not everted in female.

6. Subpubic concavity [2] **:**This was seen from the dorsal aspect as a small curve of the ischiopubic ramus, a short distance below the lower margin of pubic symphysis. Subpubic concavity

was present in female and absent in male.

7. Comparison between diameter of acetabulum and the distance of its anterior rim from pubic symphysis[2]**:**This was done to assess the size of acetabulum in both the sexes. Acetabular diameter was more than distance of its anterior rim from pubic symphysis in male as compared to female.

RESULTS

In the present study the mean length of hip bone is 20.29cm in male, whereas in females it is 18.31cm, S D in male is 1.02, in female was 0.93, t-value is 10.13, p- value is < 0.001. The mean weight of hip bone in male is 121.72gms, whereas in female it is 86.48gms. S D in male is 31.30, in female 22.15. t- value 6.51. p- value is Â0.001. The mean width of hip bone in males was 14.38cm, whereas in female was 13.50cm.SD in male was 0.73, female it is 0.75. t-value is 5.84.p-value is Â0.001.The coxal index in male was 70.87 and female it is 73.73.

Table 1: Showing Statistical calculations of hip bone.

Parameter	Gender	Number	Mean	SD	t-value	P -value
Length	male	49	20.29	1.02	10.13	<0.001
	female	51	18.31	0.93		
Width	male	49	14.38	0.73	5.84	<0.001
	female	51	13.5	0.75		
Weight	male	49	121.72	31.3	6.51	<0.001
	female	51	86.48	22.15		
Coxal index	male	49	70.87	3.65	3.56	<0.001
	female	51	73.73	4.23		

Fig. 1: Showing Length measurement of hip bone.

Fig. 2: Showing width measurement of hip bone.

Fig. 3: showing weaning weight of hip bone.

DISCUSSION

The overall goal of this study was to generate data that would be useful for geometric modeling. The study would also help the forensic experts in specimen identification and sex determination from skeleton remains. It would also be valuable for the anthropologists in their racial and population studies.

A general rule is male bone are heavier and more massive than female bones. The crests, ridges, tuberosities and lines of muscles and ligament attachments are more strongly marked in males .However the quantitative traits are receiving more and more attention in determination of sex [3]

Length of hip bone: In the present study, the mean length of hip bone in male is 20.29cm whereas in females was 18.31cm. According to

other studies by Gursharan singh dhindsa, poonam singh[4] Unow sex mean length was 19.77cm.and the values noted by Sudarshan Gupta kiran arora[5] mean length of hip bone is males 19.38cm, whereas in females was 17.94cm. According to Kalpana Purohit, Ankita Purohit [6] mean length in males right side is 19.45cm and left was 20cm, whereas females right side is 19.15cm and left was 20.8cm. In our present study these values it is almost similar to the length of hip bone.

According to Verneau.et al [7] the mean length in males was 22.0cm whereas females it was19.7cm. Maruyama et al [8] the mean length in males was 22.0cm whereas females 20.0cm.In these studies, the mean length is more when compared to present study.

Width of hip bone: In the present study, the mean width of hip bone in male is 14.38cm, whereas in female it is 13.50cm, (P- value <0.0001). which is comparable to other studies by Gursharan singh dhinds,poonam singh et al [4] were mean width was 14.14cm. The values noted by Sudarshan Gupta kiran arora [5] mean width of hip bone is males 13.73cm, whereas in females it is 13.32cm. According to Kalpana purohit, Ankita purohit [6] mean width in males on right side was 14.15cm and left was 14.14cm, whereas in female right side was13.6cm and left was 14.6cm. In our present study these values are almost similar to the width of hip bone.

According to Kishor Dattatray Khushale, et.al the mean width of male right hip bone was 15.11cm, left was 16.59cm. According to Verneau.et al [7] the mean length in males was 22.0cm whereas in females was 19.7cm. Maruyama, et.al,[8] the mean length males was 22.0cm whereas in females 20.0cm. In these studies, the mean width is more when compared to present study.

Weight of hip bone: In the present study, the mean weight of hip bone in male was 121.72g, whereas in female it was 86.48g, (P- value <0.0001). According to Gursharan singh dhinds,poonam singh[4] the mean weight was[unknown sex] 136g. According to kalpana purohit, Ankita purohit et al, [6] mean weight in males right hipbone was 138.5g and left it was 142g, whereas females right hip bone was110g and left was138g.These values are more[high] when compared to present study.

Coxal Index of hip bone: In the present study, the mean coxal index in male was 70.87 whereas in female was 73.73. (P- value <0.0001). According to Sudarshan Gupta Kiran Arora et.al [5] male was 70.83, whereas in females it has 74.24. In our present study is almost similar to the coxal index values.

According to Kishor Dattatray Khushale,Yuvaraj Jayaprakash Bhosal, K. [9] the mean coxal index in male Right was 73.66,and Left was 70.52,whereas in female Right was 86.45, and Left was 76.81. According to Sudarshan Gupta Kiran Arora et.al [5] mean coxal index in male was 70.83, whereas in female was 74.24. These values more when compared to present study.

Table 2: Showing comparison with other studies.

Parameters	Sex	Length[cm]	Width[cm]	Weight [gm]	Coxal Index
Gursharan singh et. al [2013] [4]	Unknown sex	R-19.77 L-19.60	R-14.14 L-13.86	130.77	R-71.56 L-70.85
Sudarshan Gupta et.al [2013] [5]	male female	19.38 17.94	13.73 13.32		70.84 74.24
Singh and raju et.al [1977] [10]	male	R-19.75 L-19.72	R-14.32 L-14.35	134.94	-
	female	R-18.13 L-18.21	R-13.78 L-13.78	-	-
Kishor Dattatray Khushale et. al.[2016] [9]	male	R-18.60 L-18.72	R-15.11 L-16.59	R-147.1 L-133.91	R-73.66 L-70.52
	female	R-18.13 L-19.23	R-12.95 L-13.61	R-91.34 L-99.15	R-86.45 L-76.81
Kalpana Purohit et. al.[2017] [6]	male	R-19.45 L-20.0	R-14.15 L-14.15	R-138.5 L-142	-
	female	R-19.15 L-20.8	R-13.6 L-14.6	R-110 L-138	-
Verneau. 1875 [7]	male	22	16.4		
	female	19.7	15.6		
Maruyama et al. 2001 [8]	male	22	13.6		
	female	20	13.1		
Present study	Male	**20.29**	**14.38**	**121.72**	**70.98**
	Female	**18.31**	**13.5**	**86.48**	**73.73**

CONCLUSION

In this study all the parameters in male bones are statistically highly significant, than the female ones [p <0.001]. Difference were present in gross morphometric parameters, hence these measurements of the hip bone can be used for sex determination of unknown skeletons remains and in the forensic science for medico legal cases.

Morphological study on adult hip bone is useful for anatomists, anthropologists, experts in forensic medicine, and orthopaedics for performing surgical procedures in this area. The purpose of this work is to contribute to the scientific literature, providing anatomical data on the similarities and variations. This information may be helpful during hip arthroplasty treatment of joint fracture and in diagnosing congenital hip dysplasia.

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Conflicts of Interests: None

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