

Morphometrical Study of Human Adult Dry Hip Bones in Gujarat Region

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Abstract

Background: To study morphometry of human adult dry hip bone in Gujarat region in order to obtain and compare different parameters of male and female hip bones. **Material and Method:** Study material consists of total 88 hip bones (52 male and 36 female). Non metric parameter i.e. weight of hip bones was measured by using digital weighing machine and metric parameter i.e. length and width were measured by osteometric board & metallic scale. Coxal index was calculated. **Results:** The mean weight of male hip bone was 135.91 gram and in female it was 92.21 gram. The mean length of male and female hip bone was 19.65 cm and 18.39 cm respectively. The mean width of male and female hip bone was 14.19 cm and 14.18 cm respectively. Coxal index of male and female hip bones were 72.53 and 77.26 respectively. **Conclusion:** The mean weight and length of male hip bones were higher than female hip bones. The mean width of male and female hip bones was near to similar. The coxal index was more in female than male hip bone. This study will help anatomist, anthropologist, and forensic expert for identification of individual from skeletal remains.

Key words: Hip bone, Morphometry, Coxal index

Introduction

The hip bone is large, irregular, constricted centrally and expanded above and below¹. Stature, age, sex and ethnic background are four main features for biological identity of individual. Numbers of bone of human skeleton shows age, sex and race related differences; the distinctive morphology of human hip bone is subject of interest for anatomist, anthropologist and forensic expert. Thus by using visual measures, metric techniques and discriminant function analysis, we can estimate the age, sex and race of an individual². It is possible to determine the sex by visual examination of the hip bone³. Non metric method for determination of sex is not so relevant. But metric methods used for sex determination of human hip bone have shown highest level of correctness¹. If the sex of unknown skeleton is accessed correctly, then further investigations are likely to be more accurate and separate male and female standards may be then used for estimation of age³.

The aim of the present study was to study morphometry of human adult dry hip bone in Gujarat region in order to obtain and compare different parameters of male and female hip bones.

The knowledge of different metric and nonmetric parameters of hip bone is useful for the determination of age, sex, and race. Not much work has been done in Gujarat region and there is paucity of such studies here. Therefore, the present study was carried out which provides various parameters like weight, length and width of hip bone in Gujarat region which would help the anatomists, anthropologists and forensic expert.

Material & Method

The present study is a descriptive type. In this study total 88 (44 right and 44 left) adult human dry hip bones of unknown sex were studied. The study bones were collected from various medical colleges of Gujarat state. The study duration was from June 2021 to September 2021. The total length of the study was 4 months. The sex of the hip bones were decided by the various visual morphological features like subpubic angle, ischial spine, shape of obturator foramen, ischiopubic ramus, pre-auricular sulcus and acetabular diameter. After sex determination it was founded out that out of total 88 adult human dry hip bones 52 were of male sex and 36 were of female sex.

Inclusion criteria- Adult, Dry, Complete, Not Broken

Exclusion criteria- Pediatric, Malformed, Broken with Skeletal Disorders

We measured

1. Non metric parameter i.e. weight of hip bones in gram by a digital weighing machine (Image-1)
2. Metric parameters i.e. length and width of hip bone with the help of osteometric board & metallic scale. All values were recorded in centimeters.
3. Based on data of width and length of hip bones coxal index were calculated.

The following metric and non metric parameters of the hip bones were studied.

- Weight: Hip bones are weighed by digital weighing machine. (Image-1)
- Length: Maximum distance between highest point on iliac crest and inferior surface of ischium.
- Width: Maximum distance between anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) of iliac crest.
- Coxal Index (CI):

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

All the raw data were entered and analysed by the Microsoft office excel 2010. Then various statistical data of male and female hip bones and right and left hip bones were determined and compared.



Figure 1. Measurement of weight of the hip bone**Results**

The mean weight with SD of male hip bone was 135.91 ± 16.57 grams and in female it was 92.21 ± 24.16 grams. The mean length with SD of male and female hip bone was 19.65 ± 1.25 cm and 18.39 ± 1.03 cm respectively. The mean width with SD of male and female hip bone was 14.19 ± 0.98 cm and 14.18 ± 0.72 cm respectively. The mean length and width of all hip bones were 19.14 ± 1.32 cm and 14.19 ± 0.88 cm respectively. The mean coxal index with SD in right hip bones was 74.06 ± 6.02 and in left hip bones was 74.88 ± 7.47 . The mean Coxal index with SD in male and female hip bones was 72.53 ± 7.41 and 77.26 ± 4.45 respectively.

Table 1: Weight of Hip Bones (gram)

Sex	Side	Range	Mean \pm SD
Male (n=52)	Right(n=26)	104.9 to 158.1	135.5 ± 16.85
	Left(n=26)	105.5 to 157.7	136.33 ± 16.60
Female (n=36)	Right(n=18)	58.6 to 138.3	92.31 ± 25.91
	Left(n=18)	59.9 to 131.1	92.07 ± 23.03

Table 2: Length of Hip Bones (centimeter)

Sex	Side	Range	Mean \pm SD
Male (n=52)	Right(n=26)	17.4 to 21.5	19.63 ± 1.15
	Left(n=26)	17.1 to 22.5	19.68 ± 1.36
Female (n=36)	Right(n=18)	17.0 to 19.0	18.51 ± 1.02
	Left(n=18)	16.2 to 19.5	18.27 ± 1.06

Table 3: Width of Hip Bones (centimeter)

Sex	Side	Range	Mean \pm SD
Male (n=52)	Right(n=26)	12.6 to 16.0	14.17 ± 1.00
	Left(n=26)	12.6 to 16.4	14.21 ± 0.99
Female (n=36)	Right(n=18)	12.4 to 15.3	14.12 ± 0.72
	Left(n=18)	12.9 to 15.4	14.25 ± 0.74

Table 4: Coxal Index of Hip Bones

Sex	Side	Range	Mean \pm SD
Male (n=52)	Right(n=26)	59.43 to 91.95	72.49 ± 7.28
	Left(n=26)	59.15 to 95.91	72.57 ± 7.69
Female (n=36)	Right(n=18)	72.08 to 79.77	76.33 ± 2.11
	Left(n=18)	68.56 to 95.06	78.20 ± 5.86

Discussion

In general, male bones are heavier and more massive than female bones. In the present study also the mean weight of male hip bone (135.91 ± 16.57 gram) was more than female hip bone which was 92.21 ± 24.16 gram. Singh S, Raju PB⁴, Dhindsa G S *et al.*², Gupta C *et al.*⁵ Kausar Z *et al.*⁶ reported that mean weight of hip bone were 134.94, 130.77, 136.2, 125.83 grams respectively. Khushale KD *et al.*⁷ and Purohit K *et al.*⁸ reported that average weight of male hip bone of right and left side were 147.22 & 133.91, 138.5 & 142 respectively. The average weight of female hip bone of right and left side measured by these authors was 91.34 & 99.15, 110 & 138 respectively. In present study mean weight of male hip bone of right and left side were 135.5 ± 16.85 & 136.33 ± 16.60 gram and mean weight of female hip bone of right and left side was 92.31 ± 25.91 & 92.07 ± 23.03 gram.

The mean length of all hip bones in present study was 19.14 ± 1.32 cm which was much similar to data obtained by Dhindsa G S *et al.*² and lower than Kausar Z *et al.*⁶ The mean length of male and female hip bone of both side was very close to Singh S, Raju PB⁴ and Khushale KD *et al.*⁷ Verneau⁹ reported value

of mean length were 22.0 cm for males and 19.7 cm for females. Maruyama *et al.*¹⁰ observed that the length of hip bone in males was 22.0 cm and in females was 20.0 cm. Lander¹¹ reported length were 21.4 cm and 21.2 cm for right and left sides respectively. Verneau⁹, Maruyama *et al.*¹⁰, Lander¹¹ reported higher values than the present study. Garson JG¹² observed the length of female hip bone in European population was 20.17 cm, in Australian population was 18.44 cm and in Andamanese population was 16.70 cm. Rosenberg K¹³ noted the average length of the hip bone on the right side was 13.78 cm.

In present study mean width of all hip bones was 14.19±0.88 cm which was much similar to Dhindsa G S *et al.*² and Kausar Z *et al.*⁶ Maruyama *et al.*¹⁰ reported that in males the width of the hip bone was 13.6 cm and in females it was 13.1 cm, which are lower than the present study. Verneau⁹ observed mean width was 16.4 cm in males and 15.6 cm in females higher than the present study. Griffith¹⁴ observed the values on the left side were more than on the right side (width of hip bone on right side was 14.48 cm and on left side it was 15.24 cm), whereas in the present study the values were similar on both side. Average width of male and female hip bone of both side was very close to study of Singh S, Raju PB⁴, Purohit K *et al.*⁸ and lower in Khushale KD *et al.*⁷

The coxal index in right hip bones was 74.06±6.02 and in left hip bones was 74.88±7.47. These values were higher than the study done by Siddapur KR *et al.*¹⁵ which was 69 on right side and 68.9 on left side. Dhindsa G S *et al.*², Gupta C *et al.*⁵, Purohit K *et al.*⁸ reported lower coxal index than present study. The coxal index of left hip bone was higher than right hip bone in Gupta C *et al.*⁵ and the present study. The coxal index of right hip bone was higher than left hip bone in Purohit K *et al.*⁸ Kausar Z *et al.*⁶. Coxal index of male and female hip bones were 72.53±7.41 and 77.26±4.45 respectively. Siddapur KR *et al.*¹⁵ reported the coxal index was 67.7 in male and 70.8 in female lower than the present study.

Table 5: Comparison of different parameters of hip bone with other authors

Author	Sex	Weight (gram)		Length (cm)		Width (cm)		Coxal index	
		Mean ±SD		Mean ±SD		Mean ±SD		Mean ±SD	
		Right	Left	Right	Left	Right	Left	Right	Left
Singh S, Raju PB ⁴ , 1977	Male	134.94		19.75	19.72	14.32	14.35	—	
	Female			18.13	18.21	13.78	13.78	—	
Dhindsa G S <i>et al.</i> ² (n=50), 2013	Male & Female	136.71 ±25.04	124.82 ±27.25	19.77 ±1.11	19.60 ±1.27	14.14 ±0.88	13.86 ±0.68	71.56 ±3.95	70.85 ±3.31
		130.77±26.15		19.69±1.19		14±0.78		71.21±3.63	
Gupta C <i>et al.</i> ⁵ (n= 53), 2015	Male & Female	136.2	131.8	19.01	19.7	13.54	13.9	70.9	72.1
Khushale K D <i>et al.</i> ⁷ , 2016	Male	147.22	133.91	18.60	18.72	13.66	13.62	—	
	Female	91.34	99.15	18.13	19.23	12.95	13.61	—	
Purohit K <i>et al.</i> ⁸ (n= 57), 2018	Male	138.5	142	19.45	20	14.15	14.5	71.90	70.33
	Female	110	138	19.15	20.8	13.6	14.6		
Kausar Z <i>et al.</i> ⁶ (n= 60), 2018	Male & Female	131.61 ±21.30	119.66 ±22.59	20.80 ±1.15	19.59 ±1.26	15.53 ±1.16	14.38 ±1.18	74.59 ±2.88	73.32 ±2.98
		125.83±22.57		20.21±1.34		14.98±1.30		73.98±2.97	
Present study (n=88)	Male	135.5 ±16.85	136.33 ±16.60	19.63 ±1.15	19.68 ±1.36	14.17 ±1.00	14.21 ±0.99	72.49 ±7.28	72.57 ±7.69
	Female	92.31 ±25.91	92.07±23.03	18.51 ±1.02	18.27 ±1.06	14.12 ±0.72	14.25 ±0.74	76.33 ±2.11	78.20 ±5.86

Conclusion

The mean weight and length of male hip bone of right & left side were higher than female hip bones of both side. The mean width of male and female hip bone of both side were near to similar. The coxal

index was more in female than male hip bone. The coxal index of right and left side was near similar. As we had not done study on hip bones from all medical colleges of Gujarat, so it is worthwhile to do more studies consist hip bones from every part of Gujarat region. This study will help anatomist, anthropologist and forensic expert for identification of individual from skeletal remains.

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