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Original Research Article

Morphometry of the adult human dry hip bone in Kashmiri population

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ABSTRACT

Background: The distinctive morphology of the human hip bone makes it of interest from anatomical, anthropological and forensic point of view. Thus, by using visual criteria, metric techniques and discriminant function analysis we can estimate the age, sex and race of an individual. Objective was to do the morphometry of 60 dry human hip bones in Kashmiri population in order to evaluate the various parameters of the hip bone.
Methods: The study was done on 60 randomly collected Kashmiri adult unpaired hip bones of unknown sex to analyse and evaluate the weight, length, width and the Coxal index of hip bone. 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.
Results: The raw data obtained was statistically analysed. Range, mean, standard deviation and standard error of mean were determined for each parameter. All values were compared with series of other workers to draw the conclusions.
Conclusions: From this study, it was concluded that right hip bone has larger parameters and greater strength of skeletal elements. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations.

Keywords: Coxal index, Hip bone, Morphometry

INTRODUCTION

The hip bone is also called os-innominatum, due to its irregular shape. It is narrow in the centre and stretched out at its two ends. It is composed of three bones: ilium, ischium, and pubis which fuse with each other at acetabular cavity to form a single hip bone. The hip or the innominate bone is one of the most instructive bones in the skeleton because it is formed by three independent rudiments during the sub adult life and is directly involved with child birth.[1] The hip bone has the appearance of a propeller with a large blade (the ilium) directed upwards and a smaller blade (composed of the pubis antero-medially and the ischium posterolaterally) directed downwards. The two blades are almost at right angles to one another and meet at a narrow, thick hub, the acetabulum.[2] Morphometry of the hip bone is very important for the anatomist as well as for the anthropologist for population studies. It is of great importance for archaeologists and forensic experts for sex determination by using skeletal remains. The sexual dimorphism of hip bone is a special adjustment in the females for child bearing. Therefore, awareness of the average dimensions of the hip bone in both sexes will also help in early detection of disputed sex by forensic experts.[3-5]

It is possible to determine the sex by visual examination of the hip bone.[6] The metric and non-metric differences in skeletal component among populations are evident. By

taking into account several parameters of human hip bone, we are able to do sex determination, which is of utmost importance compared to other skeletal remains like sacrum, femur, clavicle, mandible etc.

Non metric method for determination of sex is not so relevant. But metric methods used for sex determination of human hipbone have shown highest level of correctness.[7] Superiority of objective assessment by metrical methods over simple morphological observations is well established.[8]

Morphometric measurements have indicated asymmetry between right and left side of hip bone.[9-11] Therefore, the study of sexual dimorphism of bones in human population is a matter of interest not only for Anatomists but also for the Anthropologists and Forensic experts.[12]

Racial differences in Thais, Chinese, Nigerians and other populations have been compared.[13,14] Various metrical parameters for hip bone have also been evolved.[15-17] Not much work has been done in Kashmiri population and there is paucity of such studies here. The present study will hence provide valuable parameters in the Kashmiri population which would help the forensic experts, anthropologists and orthopaedicians. The main objective of the present study was to perform morphometry of adult dry human hip bones to evaluate its various parameters in Kashmiri population.

METHODS

The study was conducted in post graduate department of Anatomy, Government Medical college Srinagar, Kashmir. A total of 60 Kashmiri adult unpaired right and left dry hip bones of unknown sex were studied. All the hip bones selected were dry, complete and showed normal anatomical features. Bones showing osteoarthritic changes, evidence of any previous trauma or skeletal disorders were excluded from the study.

All the measurements were taken with the help of Vernier's calliper and weighing machine. Three readings were taken for each parameter at different times and the average was recorded. Range, mean, standard deviation and standard error of mean were determined for each parameter. All values were compared with series of other workers to draw the conclusions.

Weight of hip bone

Each bone was measured separately using an electronic weighing machine and the weight was recorded in grams.

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, which was measured with the help of a Vernier's calliper and the measurements were recorded in centimetres. The most superior point of the iliac crest was placed in contact with the fixed end of the calliper and the inferior surface of the ischium was placed against the movable arm (Figure 1).

Figure 1: Measurement of length of hip bone with the help of Vernier's calipers.

Width of hip bone

It is described as the maximum distance between the anterior superior iliac spine and the posterior superior iliac spine. It was measured with the help of Vernier's calliper and the measurements were recorded in centimeters. The posterior superior spine was placed in contact with the fixed end of the calliper and the anterior superior spine was placed against the movable arm.

Coxal index

It is calculated from the observed values of length and width of the hip bones. The formula used for finding out the Coxal index is width of hip bone/length of hip bone x100.

RESULTS

A total of 60 hip bones of unknown sex were taken for study of different parameters, in which we had 31 right sided hip bones and 29 left sided hip bones, information of various parameters of hip bones was entered in Excel sheet. The comparison of weight, length, width and Coxal index of hip bones was done by various parameters, mean, standard deviation, standard error of mean as shown in Table 1.

The range of weight of hip bone varied from 90-160 gm on both sides with maximum n=8 right hip bones in the range of 140-149.9gm and maximum number of left hip bones in the range 100-109.9gms n=9 as shown in Table 2.

The range of length of hip bones varied from 18.4cm to 22.4cm on right side with maximum n=12 right hip bones having length in the range of 21-21.9 cm and maximum number of left hip bones in the range 19-19.9cm n=9 on left side with range of 17.2cm to 22cm, distribution of length is shown in Table 3.

Table 1: Comparison of weight, length, width and Coxal index of Hip bone.

Parameters	Side	Weight (gms)	Length (cms)	Width (cms)	Coxal index
Mean	R	131.61	20.80	15.53	74.59
	L	119.66	19.59	14.38	73.32
	T	125.83	20.21	14.98	73.98
SD	R	21.30	1.15	1.16	2.88
	L	22.59	1.26	1.18	2.98
	T	22.57	1.34	1.30	2.97
SEM	R	3.82	0.20	0.20	0.51
	L	4.19	0.23	0.22	0.55
	T	2.91	0.17	0.16	0.38
Range	R	90-160	18.4-22.4	13.1-17.5	69.6-79.6
	L	90-160	17.2-22.0	12.4-16.5	67.8-79.7
	T	90-160	17.2-22.4	12.4-17.5	67.8-79.7

SD: Standard deviation, SEM: Standard error of mean, R: Right, L: Left, T: Total

Table 2: Distribution of weight of hip bone.

Weight (gms)	Right sided hip bones (no.)	Left sided hip bones (no.)
90-99.9	1	2
100-109.9	4	9
110-119.9	3	4
120-129.9	3	4
130-139.9	4	2
140-149.9	8	2
150-159.9	2	3
160-169.9	6	3

Table 3: Distribution of length of hip bones.

Length (cms)	Right sided hip bones (no.)	Left sided hip bones (no.)
17-17.9	0	3
18-18.9	3	4
19-19.9	4	13
20-20.9	8	3
21-21.9	12	4
22-22.9	4	2

Table 4: Distribution of width of hip bones.

Width (cms)	Right sided hip bone (no.)	Left sided hip bone (no.)
12-12.9	0	2
13-13.9	3	11
14-14.9	6	6
15-15.9	8	5
16-16.9	11	5
17-17.9	3	0

The range of width of hip bones varied from 12.4cms - 16.5cms on left side; with maximum n= 11 left hip bones having width in the range of 13cms- 13.9cms (Table 4).

Table 5: Coxal index of hip bones.

Coxal index	Right sided hip bones (no.)	Left sided hip bones (no.)
65-69.9	2	2
70-74.9	13	18
75-79.9	16	9

DISCUSSION

Morphometric studies of hip bone are of importance not only to anatomist and anthropologists, but is of great value to osteologists, forensic medicine experts and orthopedicians. These studies are valuable to anthroplologists for racial and population studies. India being an abode to multiple and myriad ethnicities, population features vary in different demographic areas. Keeping in view paucity of studies on hip bone in Kashmiri population, this study was undertaken to generate data that would be useful to the orthopaedicians for geometric modelling, forensic experts for specimen identification and sex determination from skeleton remains.

The mean weight of hip bone as studied by Singh and Raju was 134.94gm and that in the present study is 125.83gms.[3] In the present study, mean weight of hip bone is more on right side 131.61 than on left side119.66gms, which also holds true for the previous study. Thus, the present values are consistent with the

previous values. The mean length of the hip bone in the present study is 20.80cm on the right side and 19.59cm on the left side. These values are again more consistent with those of Singh and Raju, which are 19.75cm and 19.72cm for right and left side respectively in males whereas in females these values are 18.13cm on the right side and 18.21cm on the left side.[3] The values noted by Verneau were 22.0cm for males and 19.7cm for females.[18]

According to Garson JG, the length of the hip bone in females of European population was 20.17cm, of Australian population was 18.44cm and of Andamanese population was 16.70cm.[19] The values noted by Lander, are 21.4cm and 21.2cm for right and left sides respectively.[20] Maruyama et al, noted that in males the length of hip bone in males was 22.0cm and that in females was 20.0cm.[21]

According to Rosenberg K, the average length of the hip bone on the right side was 13.78cm.[22] The studies done by Verneau, Lander, and Maruyama et al, showed mean length of hip bone, slightly more than present study.[18,20] This probably may be due to racial variations. In the present study mean width of hip bone is 14.14cm on right side and 13.86cm on left side. Singh and Raju, noted that in males the width of hip bone was 14.32cm on the right side and 14.35cm on the left side in males, whereas in females the values were 13.78cm on both the right and 1eft side.[3] The readings noted by Verneau, were 16.4cm in males and 15.6cm in females which are higher than the present study.[18] Maruyama et al, noted that in males the width of the hip bone was 13.6cm and in females it was 13.1cm, which are lower than the present study readings.[21]

According to Griffith, the readings on the left side were more than on the right side (width of hip bone was 14.48cm and on left side it was 15.24cm), whereas in the present study the values for the width of hip bone are more on the right side.[23] The Coxal index in present study is 71.56 on right side and 70.85 on left side. The values are consistent with values taken by Garson in Andamenese, Peruvian, New Caledonian and Savage Islander populations.[21] The values noted by Verneau and Broad are higher compared to present study values.[18,24]

CONCLUSION

From the above it can be concluded that right hip bone has larger parameters and there is overall greater strength of skeletal element. The difference seen between the values of present study and that of other workers could be explained on the basis of ethnic and racial variations. In this study the mean weight of right hip bone (131.61gm) is more than the mean weight of left hip bone (119.66 gm). The mean length and width of hip bone on right side is also more than left side. The values are similar to other Indian studies. The Coxal index in present study was 74.59 on right side and 73.32 on left side.

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