Research Article

# Determination of sex using os coxae in relation to ischial tuberosity – A morphometric study

**M. Shruthi, Karthik Ganesh Mohanraj***

**ABSTRACT**

**Introduction:** Sex determination of an unidentified individual is one of the main objectives when human skeletal remains are found, both in forensic investigation and archaeological studies. The distinctive morphology of the human hip bone and its clear sexual dimorphism build it of interest from anatomical, social science, and rhetorical points of analysis. Determination of biological sex is one of the most important determinations to be made from undocumented human remains which this study is aimed for. **Materials and Methods:** In the present study, a total of 30 dry human pelvic bones of unknown sex and without any gross abnormality will be collected from the Department of Anatomy, Saveetha Dental College, Chennai, for evaluation. With the help of Vernier caliper and ruler, the measurements such as minimum iliac breadth (MIB), maximum auricular length (MAL), and maximum ischiopubic length (MIPL) are measured. The results obtained were analyzed, tabulated, and represented graphically. **Results:** The average of MIB in male was found to be 57.61 ± 2.11 mm and in female was found to be 53.45 ± 3.14 mm. The MAL in male was 53.71 ± 1.67 mm and 49.16 ± 2.82 mm in females. The MIPL in male and female was 113.23 ± 4.89 mm and 107.2 ± 7.63 mm, respectively. **Conclusion:** The chances of attaining high levels of accuracy and reliability regarding sex identification are related to the skeletal components analyzed and the ability of techniques utilized to analyze shape and size differences among the sexes. The current opinion regards the os coxae or hip bone as the most reliable sex indicator because it is the most dimorphic bone, particularly in adult individuals.

**KEY WORDS:** Archaeology, Forensic investigation, Ischial tuberosity, Os coxae, Pelvic bone, Sex determination

## INTRODUCTION

Determination of sex of an anonymous individual is one of the main objectives when human skeletal remains are found, both in forensic investigation and archaeological studies. The distinctive morphology of the human hip bone (os coxae) and its clear sexual dimorphism build it of interest from anatomical, social science, and rhetorical points of analysis. Determination of biological sex is one of the most important determinations to be made from undocumented human remains and is an essential first step in the development of the biological profile in forensics and bioarchaeology.

The ischium is comprised three parts – the body, the superior ramus, and the inferior ramus. The body contains a noticeable spine, which fills in as the root for the superior gemellus muscle. The space inferior to the spine is the lesser sciatic notch. Proceeding down the back side, the ischial tuberosity is a thick, unpleasant surfaced noticeable quality underneath the lesser sciatic indent. This is the bit that underpins weight while sitting (particularly recognizable on a hard surface) and can be felt basically by sitting on the fingers. It fills in as the cause for the inferior gemellus muscle and the hamstrings.[1] The superior ramus is an incomplete beginning for the internal obturator and the external obturator muscles. The inferior ramus serves halfway as root for part of the adductor magnus muscle and the gracilis muscle. The ischial ramus joins the inferior ramus of the pubis anteriorly and is the most grounded of the hip (coxal) bones.[2]

The ischial tuberosity otherwise called tuber ischiadicum or tuberosity of the ischium or sitz bones is a huge swelling present on the superior ramus of the ischium and it additionally denotes the parallel limit of the pelvic outlet. At the point when an individual is in a sitting position, at that point, the greatest load of that

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individual is set on the ischial tuberosities. The ischial tuberosity is secured by the gluteus maximus muscle when an individual is in an upstanding stance; in any case, the ischial tuberosity is free in a situated position and regularly bears a large portion of the heaviness of the body when sitting.[3]

The ischial tuberosity is separated into two regions: The lower part of ischial tuberosity is rough and to some degree triangular shaped. It is additionally subdivided by an unmistakable longitudinal edge, which heads out from base to apex, into two further segments: The external part and internal part. The external part gives connection to the adductor magnus. The internal part gives connection to the sacrotuberous tendon.[4] The upper bit of ischial tuberosity is quadrilateral fit as a fiddle and is smooth. It is additionally subdivided into two sections by a ridge, which descends outward in a slanting position. The semimembranosus emerges from its external and upper zone. The semitendinosus and the long head of the biceps femoris emerge from its internal and lower parts. The ischial tuberosity has the attachment of following muscles, ligaments and bones: Gluteus maximus, hamstrings, adductor magnus, and sacrotuberous ligament. Ischial tuberosity is the site for pudendal anesthesia which is a local anesthesia and is utilized administered during labor period to lessen the seriousness of torment in the course of parturition.[5]

Recognizable proof of the sex of the skeletal remains is a vital advance in organic profiling of the skeletal remains or a severely damaged body in building up the personality of the person in measurable medication. Aside from sex, stature, age, and race can likewise be dictated by the anthropometric investigation of bones. Hip bone is considered as a progressively reasonable bone in the body for distinguishing proof of sex due to its checked sexual dimorphism which is an after effect of childbearing and motion in females and males.[7] Assurance of sex from hip bone by the morphological and morphometrical technique is extremely useful. Discriminant examination utilizing morphometrical parameters of hip bone serves to be more accurate than other basic techniques on sex determination. Different specialists have assessed diverse parameters for the estimation of sex in hip bone.[8]

Parameters in front outskirt of the hip bone for sex assurance were examined by Jain and Choudhary. It was seen that minor yet measurably huge contrasts exist between discriminant estimations of hip bones in guys and females in various population.[9] Skeletal parameters of hip bone such as back width of more noteworthy sciatic step distance across of hip bone socket, all out stature of hip bone, iliac expansiveness, and pubic length were contemplated by Isaac B in human hip bones of the Southern Indian population. The point of the present examination was to assess the adequacy of foremost outskirt parameters of the hip bone for sex assurance utilizing discriminant work investigation in Southern Indian population.[10,11]

## MATERIALS AND METHODS

A total of 30 dry human pelvic bones of unknown sex and without any gross abnormality were collected from the Department of Anatomy, Saveetha Dental College, Chennai, for evaluation. With the help of Vernier caliper and ruler, the measurements such as minimum iliac breadth (MIB), maximum auricular length (MAL), and maximum ischiopubic length (MIPL) are measured. The results obtained were analyzed, tabulated, and represented graphically.

Measurements of various parameters are as follows:

MIB: The distance from the point where the arch of the greater sciatic notch meets the posterosuperior margin of the acetabulum, to the point where anterior border of the ilium meets the anterosuperior margin of the acetabulum.

MAL: The maximum vertical distance between superior and inferior borders of the auricular surface of the ilium.

MIPL: The distance between the pubic crest and the most projecting point on femoral surface of the ischial tuberosity.

All these measurements on os coxae are shown in Figure 1, to make easy representation of various morphometric variables.

## RESULTS

Numerical data obtained by the measurement of iliac bone are represented in Table 1. The average of MIB in male was found to be 57.61 ± 2.11 mm and the

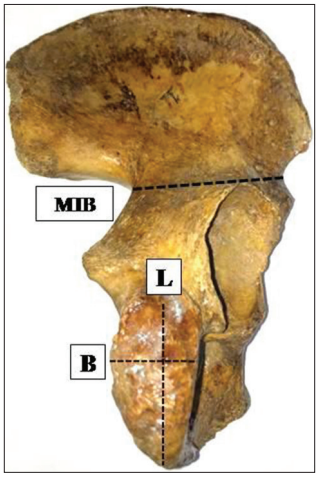


**Figure 1:** Os coxae showing various morphometric measurements such as minimum iliac breadth, length of ischial tuberosity (L), and breadth of ischial tuberosity (B)

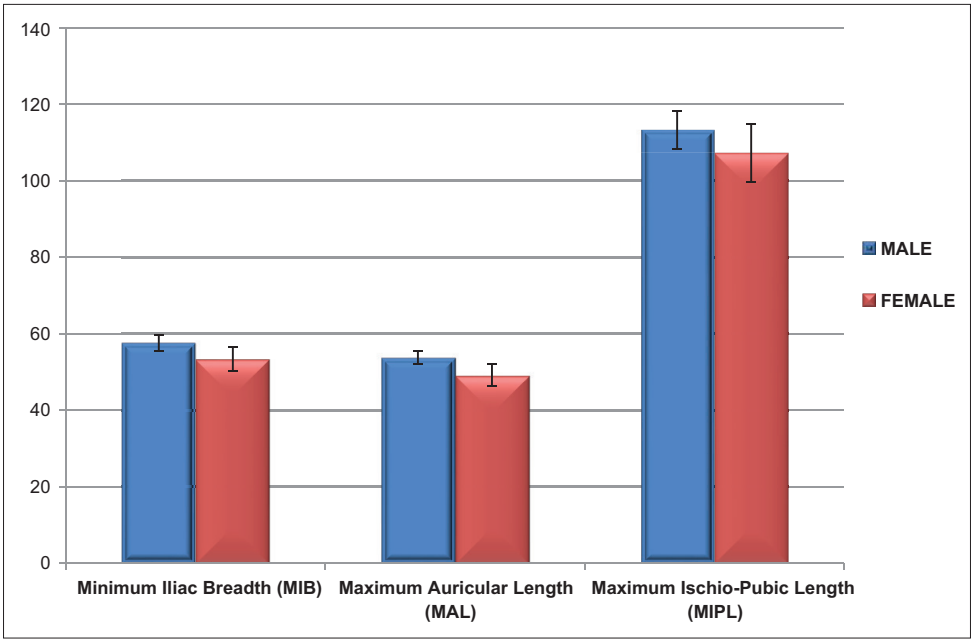


**Figure 2:** The determination of sex using various parameters of os coxae

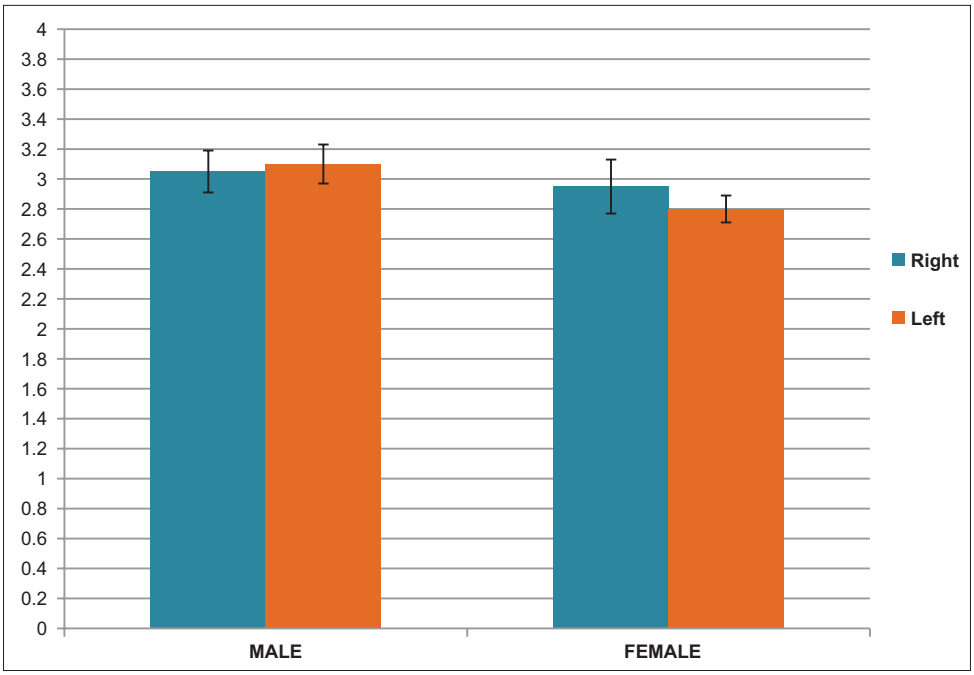


**Figure 3:** The diameter of ischial tuberosity of the right side and left side in male and female pelvic bone

**Table 1: Numerical data obtained by the measurement of os coxae**

| Parameters (mm) | Male (Mean±SD) | Female (Mean±SD) |
|---|---|---|
| Minimum iliac breadth | 57.61±2.11 | 53.45±3.14 |
| Maximum auricular length | 53.71±1.67 | 49.16±2.82 |
| Maximum ischiopubic length | 113.23±4.89 | 107.2±7.63 |

average of MIB in female was found to be 53.45 ± 3.14 mm. The MAL in male was 53.71 ± 1.67 mm and 49.16 ± 2.82 mm in females. The MIPL in male and female was 113.23 ± 4.89 mm and 107.2 ± 7.63 mm, respectively. Determination of sex using various parameters of os coxae is shown in Figure 2. Diameter of ischial tuberosity of the right side and left side in male and female pelvic bone is depicted in Figure 3.

## DISCUSSION

Pelvic differences between the sexes are easily identified by the unaided eye and are particularly accentuated in the pubic region and in the shape of the sciatic notch.[12] Visual sex determination takes advantage of these broad morphological differences,

which are evaluated by eye independently of size variation. When it comes to measure the level of sexual dimorphism in different human populations, the focus shifts from the shape of these pelvic regions to individual measurements.

In recent decades, pelvic sexual dimorphism in human populations has been measured and compared by means of indices of size dimorphism, which compares the size of specific pelvic measurements between the sexes. Several studies show how some pelvic traits such as diameter of the false pelvis, hip bone length, and ischial length vary in accordance with sexual differences in body size, being larger in males than in females.[13-15]

## CONCLUSION

The chances of attaining high levels of accuracy and reliability regarding sex identification are related to the skeletal components analyzed and the ability of techniques utilized to analyze shape and size differences among the sexes. The current opinion regards the os coxae or hip bone as the most reliable sex indicator because it is the most dimorphic bone, particularly in adult individuals.

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