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Original Research Paper

Anatomy

# SEX DETERMINATION FROM HIP BONE FRAGMENT IN DHANBAD, JHARKHAND

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**ABSTRACT** The current study used discriminant function analysis to derive a model for determining sex from an adult hip bone fragment (distal ischio-pubic portion). The discriminant function obtained was DF = .76*SYL +1.60*SYW + 4.36. *DOF – 24.88.

The three predictors [maximum vertical length of symphyseal surface (SYL), maximum width of symphyseal surface of pubis (SYW), and maximum diameter of the obturator foramen (DOF)] accurately categorised 90.0 % of the cases. Cross-validated findings revealed 86.7% accurate categorization. This preliminary research's findings indicate that these three factors lead to gender discrimination in the study participants. Again, discriminant functions are population specific. Using the discriminant function on a sample from the population of Dhanbad, Jharkhand, the hipbone may be sexed quite accurately. This metric analysis may be utilised for the population's hipbone fragments.

**KEYWORDS :** Dhanbad population, Anatomy, Identification of Humans, Determination of Sex, Discriminant Function Analysis, Fragment, Hipbone, Human Identification.

## INTRODUCTION:

The human pelvis is very different in shape. The well-known and well documented topic of sex determination from the innominate bone is thoroughly researched and described. Sex determination is necessary to verify the identity of human remains. This has major anatomical and anthropological significance as well.

A number of techniques have been successfully used to identify the gender of skeletal remains in the past. Osteometry combined with discriminant function analysis has shown to be the most objective and accurate of these methods. Several previous studies have shown that there are osteometric variations between various demographic groups, as previously stated. [1, 2].

Bone measurements, which may be used to determine sex, are dependent on the population and thus cannot be used universally. an examination of the pelvis bones of South African whites and blacks found that, generally, the form of the pubic bone was the simplest to see. It was also the most consistent and accurate morphological predictor of sex across both sexes and demographic groupings.

They discovered that with an average accuracy of 88%, the most distinguishing characteristics among white people were shape of the pubic bone and the concavity of the pubic bone below the belly button. [3] In another research, a discriminant function analysis required the use of 122 adult human pubic hairs, 66 of which were male and 56 female. [4] In order to evaluate the variables (the distance from the symphyseal surface to the obturator and the thickness of the ischio-pubic ramus), the angle produced by the centre line of the superior ramus and inferior ramus of the pubis, sub pubic angle, was used. They were able to provide 100% correct results.

A previous study [5] of 100 human hipbons of Indian ancestry was performed on 12 measures and 5 indicators. The findings of the discriminatory function analysis demonstrated a satisfactory gender-discriminatory measurement of the acetabolic height (vertical diameter) and indicator (total pelvic height/acetabular height), (middle pubic width/acetabular height) and (public length/acetabular height).

Aim of the present study was to develop a model for the determination of sex from a fragment of adult hip bone (distal ischio-pubic portion) in a population specific sample using discriminant function analysis and a new combination of three variables, namely maximum vertical length of symphyseal surface (SYL), maximum width of symphyseal surface of pubis (SYW), and maximum diffraction of (DOF).

## MATERIALS AND METHODS:

Approximately 30 adult completely ossified innominate bones were used in the study, which came from the Department of Forensic Medicine. The bones with recorded sex belonged to members of the local community and were obtained via cadaver dissection for the purpose of regular classroom instruction. A calliper, technical quality divider, and a metallic (steel) graduated scale with readings up to one millimetre were used to obtain osteometric measures for this study.

The bone was kept in anatomical locations when measurements were made. In addition, 10 randomly chosen hipbons were assessed in the first week for intra-observer discrepancies and reproducibility of those measures and the values of the two groups examined. In both assessments of all three variables, no significant difference was observed.

**The following measurements (in cm) were taken. (Fig. 1)**

1. Maximum vertical length of symphyseal surface (SYL),
2. Maximum width of symphyseal surface of pubis (SYW)
3. Maximum diameter of the obturator foramen. (DOF).

**Fig.-1**

Means and standard deviations were used to summarise metric data. The one-sample Kolmogorov-Smirnov Test was performed to determine the distribution's normality. Discriminant function analysis was used to investigate the dimorphism in hipbone fragments and how the three variables might properly classify them as male or female. Statistical analysis was performed using SPSS software

version 17.0 for windows. A two-tailed P value of less than 0.05 was considered significant.

## RESULTS:

14 of the 30 bone samples were male, and 16 were female. All three factors were utilised in the research, and it was found that the hipbones were bigger in men**(Table-1)**. In the **(Table-2)** below, you can see the outcome of a test of whether the means of two groups are equal. Three factors were used as predictors in a direct discriminant function analysis to analyse sex. The settings for all the variables were input at the same time. Predictors included the greatest vertical length of the symphysis (SYL), the greatest width of the symphysis (SYW) and the greatest width of the obturator foramen (ODF) (DOF).

**Table 1: Descriptive Statistics**

| | SEX | N | Mean | Std. Deviation | 95% Confidence interval for Mean |
|---|---|---|---|---|---|
| SYL | Male | 14 | 3.8214 | .32148 | 3.63-4.00 |
| | Female | 16 | 3.5750 | .34545 | 1.55-1.73 |
| SYW | Male | 14 | 1.8214 | .17619 | 1.71-1.82 |
| | Female | 16 | 1.6438 | .17500 | 1.55-1.73 |
| DOF | Male | 14 | 4.6643 | .12774 | 4.59-4.73 |
| | Female | 16 | 4.2188 | .25091 | 4.08-4.35 |

**Table 2: Tests of Equality of Group Means**

| | Wilks' Lambda | F | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| SYL | .874 | 4.052 | 1 | 28 | .054 |
| SYW | .785 | 7.648 | 1 | 28 | .010 |
| DOF | .438 | 35.884 | 1 | 28 | .000 |

**Table 3: Results of Discriminant Function Analysis**

| Eigen value | % of Variance | Cumulative % | Canonical Correlation |
|---|---|---|---|
| 1.556 | 100.0 | 100.0 | .780 |
| Wilks' Lambda | Chi-square | Df | Sig. |
| .391 | 24.868 | 3 | .000 |

**Table 4: Functions at Group Centroids***

| Sex | Function |
|---|---|
| | 1 |
| Male | 1.288 |
| Female | -1.127 |

**Table 5: Classification Results**

| | | Sex | Predicated Group Membership | | |
|---|---|---|---|---|---|
| | | | Male | Female | Total |
| Original | Count | Male | 14 | 0 | 14 |
| | | Female | 3 | 13 | 16 |
| | % | Male | 100.0 | .0 | 100.0 |
| | | Female | 18.8 | 81.3 | 100.0 |
| Cross-validated | Count | Male | 14 | 0 | 14 |
| | | Female | 4 | 12 | 16 |
| | % | Male | 100.0 | .0 | 100.0 |
| | | Female | 25.0 | 75.0 | 100.0 |

The classification groups were male and female. One discriminant function was calculated with Wilks' Lambda equal to 0.391 chi square ([]2) equal to 24.86, degree of freedom 3 and P value of.000. Because P value was less than 05, we could say that the model was a good fit for the data **(Table 3)**. The following Discriminant Function (DF) was obtained: DF = 0.76*SYL +1.60*SYW + 4.36. *DOF – 24.88 According to the group centroid **(Table 4)**, the cut score was 0.080 [calculated by taking the arithmetic mean of the values from the data]. All of the bones that had a D F score of less than 0.080 were considered to be female. Males accounted for values of discriminant score greater than 0.080. In all, 90.0 percent of the sample was properly categorised into their respective groups using the model. Females were properly categorised in 81.3 percent of cases, whereas men were correctly classified in 100 percent of cases at the individual group level**. (See Table 5)**

Cross validation classifies each instance using functions obtained from all previous cases. Cross-validation findings indicated that this tri variate model accurately categorised 86.7 % of instances.

## DISCUSSION:

For previous research, osteometry has been proven to be an excellent method in determining sex from the human hipbone. a combination of [1, 2, 6, 7, 10] In the current sample, sex and age were not evenly distributed. In order to discover which continuous variables discriminate between two or more naturally occurring groups, discriminant function analysis is employed. Discriminant function analysis was performed in this research to see how a linear combination of those three variables (i.e. those three variables jointly being employed) may differentiate between male and female. As fragmented remains are frequently found in Anatomical examination as well as in Forensic practise, these three factors were examined for the distal piece of the hipbone.

The model accurately classified 90.0 percent of the original grouped instances. This finding is similar to a north Indian research [5] where accurate categorization was achievable using multiple predictors. The current series' 90.0 percent accuracy matches another study's findings on a different group. [3] The current findings are less accurate than a previous research [4] which utilised 122 bones and achieved 100% sex categorization accuracy. Despite several previous research [7, 8] stating the opposite, we believe that morphometry and sexual dimorphism in adult human hipbones are population and race specific.

Since these population-specific functions may be detected, this study is warranted. This is particularly helpful for corpses who have been maimed or dismembered and whose pelvic bones have been shattered. A sample of just thirty human hipbones was studied. Although we were using traditional measures, we could not afford digital equipment for osteometry, thus our data were linear.

Future studies can address these issues. Only three variables were recovered from the distal piece of the hipbone, and the current study performed using them. It is also important to take into consideration the age-related changes in the pubis while conducting future research. it is recommended that bigger research studies be conducted with a larger sample size and more quantifiable factors in order to discern between male and female hipbone fragment (distal part).

This preliminary research demonstrates that these three factors are associated with gender discrimination in the Dhanbad community, based on the findings of the preliminary study. It is feasible to identify the gender of an adult human hipbone, particularly the distal fragment, with acceptable accuracy by using the linear discriminant function on skeletal remains collected from the Dhanbad population.

It is also possible to use this technique to complement other ways [6] of determining the gender of adult skeletal remains based on the hipbone. Applied to anatomical research, this will be of practical significance when fragmented human skeletal remains are analysed in order to establish identification and build a biological profile of the individual.

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**Ethical Approval :**

No ethical approval was required as the study was based on cadaver in the department of Anatomy and Forensic Medicine, Shahid Nirmal Mahto Medical College, Dhanbad, Jharkhand 826005.

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