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Sex determination using ischiopubic index in Gwalior region of Madhya Pradesh, India (anthropometric analysis)

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Abstract
This study was carried out to determine the Ischiopubic Index of Madhya Pradesh (India) particularly those living in Gwalior region.
Material and Method: A total of 100 Human (50 males 50 females) dry Hip bones was obtained from the Department of Anatomy, G.R. Medical College, Gwalior M.P. Digital Vernier calipers had been used for taking measurements. A divider with fixing device was also used for taking the measurements. All the observations were tabulated and analyzed statistically and compared with the previous studies.
Results: Ischiopubic Index came out to be 121.059±8.013 (Range 105.97 – 137.34) in males and 138.41± 9.936 (Range 117.89 - 153.99) in females, the difference between the means of the two sexes being statistically significant (p-value < 0.001).
Conclusion: The mean value of Ischiopubic Index was greater in females as compared to males. The percentage of estimating the sex accurately is 76 %.

Keywords: Ischopubic Index, Sexual Dimorphism, Forensic investigation

Introduction
Sex determination of skeletal remains has great importance in the field of forensic medicine. Ischiopubic index of the is a good alternative in the determination of sex in an unknown specimen if the skull bone is not available. [6] When the pelvis is used with the skull it can produce an accuracy of sex determination of 98 – 100%.[7] The hip bone is not used for sexing on young individuals because the ischium, ilium and pubis do not usually ossify until the individual is about 20 years of age. Therefore, only adults, 20 years and above can be adequately sexed using the pelvis [5]. The bony pelvis transmits weight in standing position from the vertebral column to the lower extremities through the sacro-iliac and hip joints [11]. it also provides attachments for powerful muscles [9]. The innominate or hip bone is made up by three bones ilium superiorly, pubis anteroinferiorly, and the ischium posteroinferiorly. These three parts are joined to each other in a Y-shaped epiphysis involving the acetabulum [5]. Ischiopubic index is also pivotal role in forensic medicine and physical anthropology in the identification of unknown sex as it can provide new, cheap, and probably more accurate means of determining sex and race when the need arises [6].
The female pelvis makes room for accommodation of the foetal. head and guides the act of parturition through the birth canal so the hip bone bear the greatest degree of sexual dimorphism and play a highly valuable role in identification of sex. Ischiopubic Index measurements are significantly authentic tool in determination of gender in adults with fully ossified bones. Properly determining skeletal sex is a key element in any anthropological or forensic examination [1]. Hip bone is considered as an ideal bone for sex determination as it provides the highest accuracy levels for sex determination because enlargement in the pelvic ring of the female for the successful passage of newborn and it is a result of natural selection Sex differences in the pelvis may be an integral part of the general secondary sex differentiation, affecting bodily structures among primates, and this is widely different in different species. Hence the hip bone is considered as the most reliable sex indicator in the human skeleton [4]. Many workers have studied various metric parameters for sexing the hip bone. The present study was done to identify the important measurements of the ischiopubic index which significantly differentiates the sex of human hip bone which will be useful in

anatomical, anthropological, archaeological and forensic studies. Therefore the study of sexual dimorphism of bones in human population is a matter of interest not only for the anatomist but also for the anthropologists and forensic experts [2]. Ischiopubic Index can provide identification of sex in mass disasters, trauma or fire has rendered the face unrecognizable.

Materials and Methods

A total of 100 human (50 males 50 females) dry Hip bones was obtained from the Department of Anatomy, G.R. Medical College, and Gwalior M.P. Digital Vernier calipers had been used for taking measurements. A divider with fixing device was also used for taking the measurements. All the bones were fully ossified adult bones without any pathological or congenital defect.

Instrument: The measurements of Hip bone were taken on an anatomically sound basis. All measurements were taken using a digital vernier caliper, taking into account the error if any, in the instrument. A divider with fixing device was also used for taking the measurements.

Photo - Digital Vernier calipers

Measurement Procedure: The various parameters of the hip bone were measured by using a sliding digital vernier calipers

1. Length of pubic bone i.e. length from the superior most aspect of the public symphysis to the nearest rim of the acetabulum, is measured in millimeters by using sliding vernier caliper.

Fig 1: Measuring the length of Body of Pubic bone.

2. Length of ischial bone i.e. the vertical distance from the anterior aspect of the ischial tuberosity to the nearest rim of the acetabulum, is measured in millimeters by using sliding vernier caliper.

Fig 2: Measuring the length of Body of Ischium.

3. Ischio-pubic index: It is obtained by using following formula.

$$\frac{\text{Length of pubic bone}}{\text{Length of Ischial bone}} \times 100$$

Statistical analysis was performed using SPSS 16.0

Observations & result

Table 1: Statistical significance of mean Ischiopubic index in males and females.

Sex	I.P Index Range	Mean	S.D.	P. Value	Significance
Male	105.97 – 137.34	121.059	8.013	<0.001	**Highly Significant**
Female	117.89 - 153.99	138.41	9.936		

Ischiopubic Index came out to be 121.059±8.013 (Range 105.97 – 137.34) in males and 138.41± 9.936 (Range 117.89 - 153.99) in females, the difference between the means of the two sexes being statistically significant (p-value < 0.001).

The descriptive statistics and the degree of sexual dimorphism for ischiopubic index depicted in Table 1. The mean value of ischiopubic index was greater in females compared to males. These study showed practically and significant difference between the sexes. Ischiopubic index was higher in females compared to males. The percentage of estimating the sex accurately was 76 %.these study shows marked and significant difference in people belonging to different state and different country.

Discussion

The study was conducted on 100 subjects, out of which 50 were males and 50 were females. The study established the existence of a definite statistically significant sexual dimorphism. Variation in ischiopubic index between the different populations being characteristic of genetic factor, environmental factors, sex, heredity, race, secular changes and bilateral asymmetry.

Table 2: Comparison of Ischiopubic Index in different populations.

Population	Author	Ischio-pubic Index	
		Male	Female
Indore (India)	Pal *et al* [12]	100	89
Maharashtra (India)	Nirmale *et al* [13]	116.87	128.14
punjab(India)	Kanika *et al* [15]	98.27	117.97
Mumbai (India)	Kushale *et al* [14]	86.58	108.55
Gwalior (India)	Presnt study	121.059	138.41

Present study close to Nirmale *et al.* [13] (2016) who studied the people of Maharashtra which is near state of Madhya Pradesh India. These study shows more than 76% cases accuratly what is the sex of perticular person or bone or if

we include chilotic line index and acetobulopubic index the percentage of accuracy will be more. Washburn (1948) [16] claimed 84% male and 100% female sorting of hip bones with ischio-pubic index only. The importance of ischiopubic index in obstetrics cannot be over emphasized. It has been observed that the size of the ischiopubic index determines the size of the birth canal, which is an important criterion in vaginal delivery [8]. Study of ischiopubic index bears significant observations in obstetrics, radiology, forensic and anthropological sciences.

Conclusion

To conclude ischiopubic index can be used as an aid for sex determination. Thereby, they can aid in identifying a person from hip bones. The mean values ischiopubic index less for males than for females and the differences were statistically significant. The present study has provided a detailed study of the ischiopubic index statistically significant, sexually dimorphic parameters which might serve in sex determination even when fragmentary remains of hip bone are available to comment upon the sex of the dead & decomposed skeletons.

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