

## A Study of the Ischiopubic Index: A Radiographic Analysis In Maiduguri, North Eastern Nigeria

Attah, M. O<sup>1</sup>, Suleiman, I. D<sup>2</sup>., Samaila M. C<sup>3</sup>., Amaza D. S<sup>4</sup>., Ishaya H. B<sup>5</sup>., Balogun S. U<sup>6</sup>., Okon K. A<sup>7</sup>., Dibal N. I<sup>8</sup>., Buba H. S<sup>9</sup>. Jacks T.W.

<sup>1,2,3,4,5,8,9</sup>(Department of Human Anatomy, College of Medical Sciences/ University of Maiduguri, Nigeria)

<sup>6</sup>(Department of Human Anatomy, Kogi State University, Anyigba, P.M.B. 1008, Anyigba, Kogi State, Nigeria)

<sup>7</sup>(Department of Human Anatomy, Faculty of Basic Medical Sciences University of Uyo Uyo, Nigeria)

**Abstract :** This study was carried out to determine the ischiopubic index and sexual dimorphism in ischiopubic index among adults in Maiduguri, North-Eastern Nigeria. Anteroposterior radiographs of adult pelvis (age range, 18-60 years) were evaluated. One hundred and twenty (120) radiographs (60 males and 60 females) were used for the study. The morphological measurements were pubic length, ischial length and ischiopubic index. The mean values of pubic length, ischial length and ischiopubic index of males in Maiduguri North Eastern Nigeria population were 81.0mm, 91.7mm and 88.5, respectively while those of their females counterparts were 92.7mm, 87.1mm and 106.8, respectively. The mean pubic length was significantly longer in females than males in the population ( $p < 0.05$ ). The mean ischial length was significantly higher in males than in females ( $p < 0.05$ ). The ischiopubic index of the females was significantly higher than that of the males ( $p < 0.05$ ). There was sexual dimorphism in the ischiopubic index of North Eastern Nigerian population in this study. When these results were compared with other populations there were slight differences. An ischiopubic index greater than ninety (90) will most probably be that of a female and less than ninety (90) will most probably be that of a male in North Eastern Nigeria population.

**Keywords:** ischial length, ischiopubic index, pubic length, radiographic analysis, sexual dimorphism

### I. INTRODUCTION

Ascertaining a biological profile from the skeleton is a vital component in both forensic and archaeological settings. When skeletal material is discovered, one of the prime attributes that an anthropologist seeks to identify is the individual's sex [1]. Sexual dimorphism, or size and or shape differences between the males and females of a species can be best observed primarily on the cranium and pelvis of humans. Reliable methods of sex determination for adult skeletal material have existed for decades; cranial features include the mandibular angles, orbital area, and mastoid processes, while pelvic features include the sciatic notch, sub-pubic angle, obturator foramen and ischiopubic index [2]; [3]; [4]; [5]; [6];[7]. The pelvis, the most sexually dimorphic area of the body, is essential for biological sex determination of the adult skeleton [8]. This is because one of the major biological differences between men and women, that of having babies, largely determines the shape of that part of the body. Even though several pelvic traits are sexually distinguishable throughout the developmental process, the skeletal remains of infants and children have been primarily excluded from sex determination analyses as researchers believed that sex determination does not occur until an individual has reached puberty [9], [10]; [11]. In an anthropometric study performed by [12], ischiopubic index was measured in adult Malawians using the x-ray films of pelvises of 225 adult subjects aged between 18 and 65 years. The results showed that mean ischiopubic index of females was significantly greater than that of males ( $p < 0.001$ ). The mean length of female pubis was significantly longer than that of males ( $p < 0.001$ ), and similarly the mean length of the ischium in males was significantly higher than that of females ( $p < 0.001$ ). [13] studied the radiographic determination of sex difference in ischiopubic index of a Nigerian population which was carried out by measuring the pubic and ischial lengths in 214 X-ray films of Cross-Rivers State (Nigeria) indigenes. The pubic length in females was observed to be higher than in males. These differences was observed to be statistically significant ( $p < 0.001$ ). The ischial length of males measured more than that of females. This differences was found to be statistically significant ( $p < 0.001$ ). The ischiopubic index of the females was higher than that of the males. In a research carried out by [14] the ischiopubic index of a Nigerian population residing in Rivers State was measured using anteroposterior radiographs of the adult pelvis. Six hundred and seventy four (674) radiographs were used for the study. The mean pubic length of males and females were  $91.99 \pm 17.76$ mm and  $103.12 \pm 13.11$ mm respectively. The mean pubic length in females was significantly higher than that of males ( $p < 0.05$ ). The mean ischial length of males and females were  $101.16 \pm 18.53$ mm and  $90.07 \pm 12.19$ mm respectively. The mean ischial length of males is significantly higher than that of females

( $p < 0.05$ ). The mean ischiopubic index in males and females were  $90.88 \pm 5.52$  and  $114.87 \pm 8.08$  respectively. Females had significantly higher ischiopubic index ( $p < 0.05$ ).

Despite the anthropological, clinical and forensic importance of the ischiopubic index, reports on Nigerians are scarce. The present study is therefore carried out to produce a comprehensive data on the Nigerian populations under investigation to solve the aforementioned problems. The objectives of the study are to determine the ischiopubic index and sexual dimorphism index among adults in Maiduguri, North-Eastern Nigeria.

## II. MATERIALS AND METHODS

### 2.1 Materials

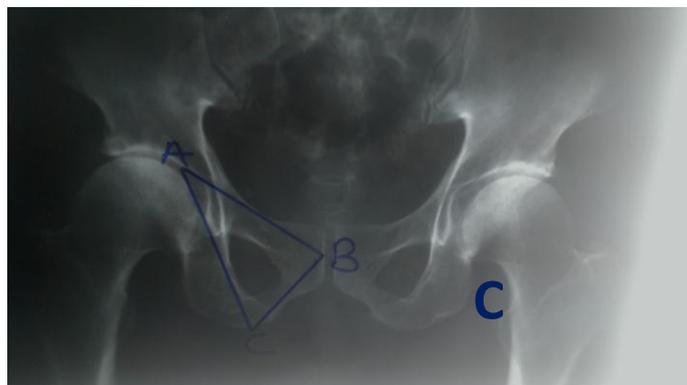
The materials used for the study includes a transparent meter rule, pelvic x-ray films, x-ray illuminator box, a pencil and notebook.

### 2.2 Method

A total of 120 radiographs of the anteroposterior view of the pelvis were used, which comprised of 60 males and 60 females. The subjects were aged between 18 and 60 years. All the radiographs were collected from the University of Maiduguri Teaching Hospital (UMTH), Borno State, Nigeria. The radiographs were normal, showed no underlying bone disease which could have affected the intact pelvic bone. Only radiographs with complete alignment at the inferior margins of the pubic bones at the pubic symphysis were measured because determination of misalignment is best made at the inferior margins [15]

### 2.3 Morphometric Analysis of the Pelvic Bone

Measurements were carried out by choosing 3 points on the radiographs: Points A, B and C. Point A is the acetabular point where the three pelvic bones meet. Points B and C are the pubic tubercle and ischial tuberosity respectively. A marker was used to mark these points for clear visualization. The parameters measured were: Pubic length and ischial length. The radiographs were placed on an X-ray illuminator and the pubic length and ischial length were measured using a transparent metre rule and recorded on a notebook. All measurements (in mm) were taken twice and the average recorded as the actual distance to ensure accuracy.



#### 2.3.1 Measurement of Ischial Length

A straight line AC was drawn on the radiographs from the center of triradiate cartilage to the maximum ischial tuberosity.

#### 2.3.2 Measurement of Pubic Length

A straight line AB was drawn on the radiograph from the center of the triradiate cartilage to the pubic symphysis.

#### 2.3.3 Determination of ischiopubic Index

Pubic length (AB) divided by ischial length (AC), and then multiplied by 100 ( $IP = AB/AC \times 100$ ).

### 2.4 Data Analysis

The data obtained were statistically analyzed using graph pad instant 300 values on Windows 7.

## III. Results

The mean values of pubic length, ischial length and ischiopubic index for males in North-Eastern were 81.0mm, 91.7mm and 88.5 respectively, while those of their females counterpart were 92.7mm, 87.1mm and 106.8 respectively. The pubic length in females was observed to be higher than in males. These differences were

observed to be statistically significant ( $p < 0.001$ ). The ischial length of males measured more than that of females. This difference was found to be statistically significant ( $p > 0.01$ ). The ischiopubic index of the females was higher than that of males. This index varied from 70.6-105.9 with the mean of  $88.5 \pm 7.1$  in the males. In the females, the index varied from 88.2-123.8 with a mean of  $106.8 \pm 7.0$ . This difference was statistically significant ( $p < 0.001$ ).

#### IV. FIGURES AND TABLES

**Table 4.1: Mean and standard deviation of pubic length, ischial length and ischiopubic index among adults in Maiduguri, North-Eastern Nigerian Population**

Subjects	N	Pubic Length±SD (mm)	Ischial Length±SD (mm)	Ischiopubic Index±SD
Males	60	81.0±7.6	91.7±7.3	88.5±7.1
Females	60	92.7±7.4	87.1±8.2	106.8±7.0

$p < 0.05$  (sexual dimorphic); SD: Standard Deviation; N: Sample size

**Table 4.2: Comparative analysis of pubic length, ischial length and ischiopubic index in different population**

Population (Source)	Pubic Length				Ischial Length				Ischiopubic Index			
	Male No.	Mean	Female No.	Mean	Male No.	Mean	Female No.	Mean	Male No.	Mean	Female No.	Mean
Cross River State, Nigeria (Ekanem <i>et al.</i> , 2008)	114	65.6	100	75.6	114	69.9	100	63.6	114	94.2	100	118.8
South-South Nigeria (Oladipo <i>et al.</i> , 2010)	30	70.0	40	84.0	30	85.8	40	81.1	30	81.4	40	104.2
Middle Belt, Nigeria (Oladipo <i>et al.</i> , 2010)	20	72.0	30	80.3	20	85.7	30	82.3	20	83.1	30	101.7
Kalabari (Oladipo <i>et al.</i> , 2012)	25	72.2	35	80.4	25	82.8	35	77.3	25	87.3	35	104.1
Ikwerre (Oladipo <i>et al.</i> , 2012)	30	64.2	50	71.1	30	74.3	50	68.8	30	86.1	50	101.1
South-South Nigeria (Okeseima and Udoaka, 2013)	259	74.99	259	84.48	259	85.03	259	79.52	259	88.65	259	106.45
Urhobos (Oladipo <i>et al.</i> , 2015)	36	78.5	30	92.3	36	85.5	30	81.9	36	91.7	30	114.9
Itsekiris (Oladipo <i>et al.</i> , 2015)	13	82.2	14	92.0	13	83.8	14	85.0	13	98.4	14	111.0
North-Eastern Nigeria (present study)	60	81.0	60	92.7	60	91.7	60	87.1	60	88.5	60	106.8

**Table 4.3: Male and Female Ischiopubic index in Maiduguri, North-Eastern Nigerian Population**

Subjects	N	Mean Ischiopubic Index±SD	SEM	Range	Median (50 <sup>th</sup> percentile)	95% Confidence Interval
Male	60	88.5±7.1	0.91	70.6-105.9	88.9	86.7-90.3
Female	60	106.8±7.0	0.89	88.2-123.8	107.3	105.0-108.6

N: Sample size; SEM: Standard Error of Mean

#### V. Discussion

In this present study, the mean values of ischiopubic index was higher in females and it was statistically significant ( $p < 0.05$ ). [13] working on this index identified 69% and 81% for Cross River State males and females, respectively. In a recent study, [12], measured the ischiopubic index in black Malawian and found that it was useful for gender determination using adult skeletons or radiographs. With the skeletal bones, sex could be assigned to 92% males and 100% females whereas using radiographs sex was accurately assigned to 87.8% males and 92.3% females, respectively. The pubic length, ischial length and ischiopubic index differ in different populations. A comparative data of these parameters in different populations are shown in Table 4.2. The Mean pubic length of Ikwerre people [16] had the lowest mean value of 64.2mm for males and 71.1mm for females. South-South Nigeria [17] had a mean value of 74.99mm for males and 84.48mm for females. In the present study the pubic length of Maiduguri people, North-Eastern Nigerian males was recorded as 81.0±7.6mm while that of females was 92.7±7.4mm and the mean pubic length for males and females in this study is the highest compared to other populations in females and second highest in males (as in Table 4.2). The mean ischial length in North-Eastern Nigerian females was recorded as 87.1±8.2mm and that of the males was

91.7±7.3mm. The value of males and females in this study when compared to those of other population in literature was higher (Table 4.2).

From this study, Maiduguri populations of North-Eastern Nigeria have an overall mean ischiopubic index of 97.6±11.5 as assigned to the black race. However, the mean ischiopubic index of North-Eastern Nigerians was significantly higher than that of black Malawians ( $p<0.05$ ). This is an indication of regional variation of the ischiopubic index. The relationship between age and pelvimetry has also been given attention. The population differences observed may either be due to environmental or hereditary factors or both [19];[20], observed that sexual dimorphism in body size is a critical factor in influencing pelvic dimorphism. They observed that the pubic length for both sexes particularly that of the females showed accelerated changes depending on the body size. [21] working on pubis growth study on sexual and age diagnostic confirmed that ischiopubic index is one of the good variables for sub-adult sex determination. [22], reported that the sub-pubic angles was significantly greater in the older age group (46-70years) than in younger age group (21-45years) of Nigerian ( $p<0.05$ ). Racial hereditary factor acts as primary factor within which functional activities operate as secondary factor.

## VI. Conclusion

The mean ischiopubic index was average in this present study in both males and females when compared to other populations. In North-Eastern Nigerian males and females, the mean ischiopubic index was 88.5±7.1 and 106.8±7.0, respectively. Though the primary function of the pelvis in males and females is for locomotion, it is specially adapted for childbirth in the females. This may explain the significantly higher sexual differences in ischiopubic index observed in the females in all the population when compared with that of their males counterparts.

## REFERENCES

- [1] Washburn, S.L. Sex differences in pubic bone. *American Journal of Physical Anthropology* 6; 1948, 199-207.
- [2] Stewart, T.D. Sex determination of the skeleton by guess and measurement. *American Journal of Physical Anthropology*.12; 1954, 385-392.
- [3] Thieme, F. and Schull, W. Sex determination from the skeleton. *Human Biology*. 29; 1957, 242-273.
- [4] Krogman, W.M. The Human Skeleton in Forensic Medicine. *International Journal of Anthropology*.3; 267-283.
- [5] Davivongs, V. The pelvic girdle of the Australian Aborigine: Sex differences and sex determination. *American Journal of Physical Anthropology*. 21(4); 1963, 443-455.
- [6] Coleman, W.H.. Sex Differences in the Growth of the Human Bony Pelvis. *American Journal of Physical Anthropology*. 31(2); 1969, 125-151.
- [7] Bruzek, J. A Method For Visual Determination Of Sex, Using The Human Hip Bone *American Journal of Physical Anthropology*.117; 2002, 157-168
- [8] Ferembach, D.; Schwidetzky, I. and Stloukal, M. (1980). Recommendation for Age and Sex Diagnoses of Skeleton. *Journal of Human Evolution*. 9;1980, 517-549.
- [9] Boucher, B.J. Sex Differences in the Foetal Sciatic Notch. *Journal of Forensic Sciences*.2;1955, 51-54.
- [10] Boucher, B.J. Sex Differences in the Foetal Pelvis. *American Journal of Physical Anthropology*. 15;1957, 581-600.
- [11] Rosing, F.W. Sexing Immature Human Skeletons. *Journal of Human Evolution*..12 1983; 149-155.
- [12] Igbigbi, P.S. and Msamati, B.C.. Ischio-Pubic Index in Adult Malawians. *East African Medical Journal*. 77(9);2 2000, 514-516.
- [13] Ekanem, T.; Udongwu, A. and Singh, S. Radiographic Determination of Sex Differences in Ischiopubic Index of a Nigerian Population. *The Internet Journal of Biological Anthropology*.3(2) 2009.
- [14] Oladipo, G.S. and Anugweje, K.C.. Ischiopubic Index of a Nigerian Population Residing in Rivers State. *Current Trends in Technology and Sciences*. Vol.3(2) 2014.; 80-85.
- [15] Lusted, L.B. and Keats, T.E. (1978). The Lower Extremity: Atlas of Reontgenographic measurements. In: Lusted L.B, Keats T.E. London, England: Yearbook Medical Published, pp: 265.
- [16] Oladipo, G.S.; Okoh, P.D. and Leko, B. Radiologic study of pubic length, ischial length and ischiopubic index of adult Kalabaris and Ikwerrres of Nigeria. *Journal of Medicine and Medicine Sciences*..3(2); 2012 99-102.
- [17] Okoseimiema, S.C. and Udoaka, A.I.. Radiological Determination of Ischiopubic Index in South-South Nigerian Population. *Asian Journal of Medical Sciences*. 5(5) 2013; Pp 96-100.
- [18] Hanna, R.E. and Washburn, S.L. Determination of Sex of Skeleton as illustrated by a study of Eskimo Pelvis. *Human. Biology* 25; 1953, 21-27
- [19] Krishan, K. (2007). Anthropometry in Forensic Medicine and Forensic Science-'Forensic Anthropometry'. *The Internet Journal of Forensic Science*. 2 (1)..
- [20] Maclanghlin, S.M. and Bruce, M.F. (1986). Population variation in sexual dimorphism in the human innominate bone. *Human Evolution*. 1; Pp 221-231.
- [21] Rissech, C. and Malgosa, A. . Pubis growth study: Applicability in sexual and diagnostic. *Forensic Science International*. 173(2); 2007 137-146.
- [22] Nwoha, P.U.. The Anterior Dimensions of the Pelvis in Sex Determination. *West African. Journal of Medicine Science*., 24(4); 1992 329-335.