

## Radiologic Determination of Ischiopubic Index in South-South Nigerian Population

S.C. Okoseimiema and A.I. Udoaka

Department of Human Anatomy, Faculty of Basic Medical Sciences, University of Port  
Harcourt, Nigeria

**Abstract:** For anthropological and medicolegal reasons, sex is usually identified from the human skeleton. The hip bone is normally used and the ischiopubic index is one of the best parameters used for determination of sex. This study was carried out to determine the pubic length, ischial length and ischiopubic index of the South-South people of Nigeria. Anteroposterior radiographs of adult pelvis (age range, 18-75 years) were evaluated. Five hundred and eighteen (518) radiographs (259 males and 259 females) were those of the south-South people of Nigeria. The morphological measurements were pubic length, ischial length and ischiopubic index. The mean values of pubic length, ischial length and ischiopubic index of male South-South Nigerians were 74.99 mm, 85.03mm and 88.65, respectively while those of their females were 84.48 mm, 79.52 mm and 106.45, 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. Using the formulae (Mean $\pm$ 3SD). But then, using the formulae (Mean $\pm$ 2SD), sex was assigned to 68.72% of South-South Nigerian males and 62.53% of South-South Nigerian females. When these results were compared with other races, there were racial differences. Thus, this study is important as it has provided the necessary data for the Nigerian population under investigation. An ischiopubic index greater than (90) will most probably be that of a female and less than (90) will most probably be that of a male in South-South Nigeria. The data is recommended to obstetricians, physical anthropologists and forensic scientists.

**Keywords:** Anthropologists, ischial length, ischiopubic index, forensic scientists, Nigerians, pubic length

### INTRODUCTION

Forensic Experts are often called upon to identify skeletal remains which often involve diagnosis of sex. The best indicators of sex in the skeleton are to be found in the pelvis. The hip bone is the most reliable skeleton in sexual dimorphism (Ferembach *et al.*, 1980). 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. Medical studies of various indices have been carried out. Such indices include ischiopubic index (Singh and Potturi, 1978), indices of the greater sciatic notch (Segebarth-Orban, 1980) and chilotic index (Derry, 1924). These indices have been measured in different races and ethnic groups.

Udoaka *et al.* (2009) used Standard Anterior-Posterior (AP) pelvic radiographs of 100 normal adults comprising 54 females and 46 males to determine ischio-pubic index of Nigerians. It was observed that the pubic bone was longer in females but the Ischium was longer in males. They stated that Ischio-pubic index greater than 90 will most probably be that of a female and less than 90 will most probably be that of a male Nigerian in Port Harcourt. Sexual dimorphism has

been previously reported in ischiopubic index of White and Black Americans (Tague, 1989), Caucasians (Caldwell and Moloy, 1933), Malawians (Igbigbi and Msamati, 2000), France (Washburn, 1948) Portuguese (Phenice, 1969), eastern Nigerians (Oladipo *et al.*, 2010) and the people of Calabar in Nigeria (Ekanem *et al.*, 2009). Ekanem *et al.* (2009) measured the pubic and ischial lengths in 214 x-ray films (114 males and 100 females) of Cross River State indigenes in order to determine Sex differences In Ischiopubic Index of a Nigerian Population. The demarking point was worked out and it assigned sex to 69% males and 81% females.

In spite of the relevance of ischiopubic index in forensic studies, anthropological, obstetrics and gynaecology; there is lack of literatures in South-South Nigerian Population. The aim of this study therefore was to determine the ischiopubic index of South-South Nigerians and to establish a baseline data for the population.

### MATERIALS AND METHODS

Five hundred and eighteen normal, Standard pelvic anteroposterior radiographs (259 male and 259 female) aged between 18 and 75 years were used from

Table 1: Showing mean and standard deviation of measurement in South-South Nigerian population

Subjects	N	Pubic Length ±SD (mm)	Ischial Length±SD (mm)	Ischiopubic index±SD
South-south males	259	74.99±5.51	85.03±7.53	88.65±8.06
South -south females	259	84.48±6.73	79.52±5.64	106.45±7.65

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

their biometric data. This study was conducted in South-South of Nigeria between March, 2011 to November 2011. The following hospitals within South-South Nigerian States were used: University of Port-Harcourt Teaching Hospital, Rivers State, Braithwaite memorial Specialist Hospital, Port Harcourt, Rivers State; Federal Medical Centre, Yenagoa, Bayelsa State, University of Benin Teaching Hospital, Ugbowo, Benin city; Edo State and Rehoboth specialist hospital, D-Line, Rivers State.

The routine distance from which these radiographs were taken was 100 cm. All the radiographs were of anteroposterior view. All the radiographs were free from pathological changes and belonged to adults from the ages of eighteen to seventy five years. In taking these measurements the radiographs were placed on the horizontal surface of an illuminator and the following measurement were taken with the help of a vernier calliper. A marker was used to mark these points for clear visualization.

**Ischial length:** A straight line AC was drawn on the radiograph from the center of triradiate cartilage to the maximum ischial tuberosity.

**Pubic length:** A straight line AB was drawn on the radiograph from the center of the triradiate cartilage to the pubic symphysis:

$$\text{Ischiopubic index} = \text{Pubic length (AB)} \times \frac{100}{\text{Ischial length (AC)}}$$

Data on the measured parameters were analyzed using the z-test to determine the sex differences and (p<0.05) was taken as being statistically significant. The actual ranges for the male and female sexes were found out. The highest and lowest values of this range were used in gender determination. The identification point is the low or high value got from the actual range of the values measured from male and female pelvis. The demarking point is the low or high values deduced from the calculated range which is got by using the formula mean±3Standard Deviation (Jit and Singh, 1966).

## RESULTS

The mean and standard deviation of the three measurements are shown in Table 1. The mean pubic



Fig. 1: A radiograph of pelvis showing the measurements of the ischial length AC and pubic length AB



Fig. 2: A radiograph of pelvis showing the measurements of the pubic length AB on one of the female subjects



Fig. 3: A radiograph of pelvis showing the measurements of the ischial length AC on one of the female subjects

Table 2: Showing mean pubic length, mean ischial length of males and females of different races and present study

Racial group source	Male pubic length (mm)		Female pubic length (mm)		Male ischial length (mm)		Female ischial length (mm)		Source
	No	Mean	No	Mean	No	Mean	No	Mean	
Eskimos	129	74.10	95	80.10	129	88.40	95	81.00	Hanna and Washburn (1953)
American whites	100	73.80	100	77.90	100	88.40	100	78.30	Davivong (1963)
American negro	50	69.20	50	73.50	50	86.60	50	77.50	Washburn (1948)
Bantu	82	66.20	70	73.20	82	80.30	70	74.80	Ekanem <i>et al.</i> (2009)
Australian aborigines	89	63.30	72	69.20	89	81.20	72	74.70	Davivong (1963)
Nigerians (calabar)	114	65.80	100	75.60	114	70.10	100	64.50	Ekanem <i>et al.</i> (2009)
South-south nigerians	259	74.99	259	84.48	259	85.03	259	79.52	Present study

Table 3: Showing male and female ischiopubic index of South-South Nigerians

Measurements and calculations	Female ischiopubic index	Male ischiopubic index
N	259	259
Mean	106.45	88.65
Standard deviation	±7.65	±8.060
Actual range	89.36-128.38	73.107-107.59
Identification point	>107.59	<89.36
Percentage identified	52.12%	59.84%
Calculated range(mean ±3SD)	83.50-129.40	64.47-112.83
Demarking point	>112.83	<83.5
Percentage identified by demarking point	31.66%	32.43%
Mean ±2SD	91.15-121.75	72.53-104.77
Demarking point	>104.77	<91.15
Percentage identified by demarking point	62.53%	68.72%

length of South-South Nigerian males and females were 74.99±5.51 mm and 84.48±6.73 mm, respectively. The pubic length (AB) which was described in Fig.1 and 2 was sexually dimorphic. The females mean pubic length was significantly higher than that of the males (p<0.05). The mean ischial length of South-South Nigerian males and females were 85.03±7.53 mm and 79.52±5.64 mm, respectively. The ischial length which was described in Fig. 3 was also sexually dimorphic. The males mean ischial length was significantly higher than that of the females (p<0.05). The mean ischiopubic indices in South-South Nigerian males and females were 88.65±8.06 and 106.45±7.65, respectively. There was a significant difference in the ischiopubic index (p<0.05). The South-South females showed higher mean ischiopubic index (106.45±7.65). The mean ischial length and pubic length of South-South Nigerian males and females were compared with previous studies in Table 2. There was sexual dimorphism and racial differences. The range, mean and demarking points of ischiopubic index of the studied populations are shown in Table 3. Sex was accurately assigned to 32.43% of South-South males, 31.66% of South-South Nigerian females, when the formulae (mean±3SD) was used (Jit and Singh, 1966). When the formula (Mean±2SD) (Rao, 1962) was used, the percentage identified by demarking point was 68.72% for males and 62.53% for females. The mean ischiopubic indices of various populations previously studied and the present study were shown in Table 4. Like in other populations previously studied, sexual dimorphism was observed.

## DISCUSSION

The ischiopubic index however was observed to be useful in sex differentiation. In this present study, the identification point for female was >107.59 while that of male was <89.36. The percentage identified by identification point for female was 52.12% and that of male was 59.84%. The mean values of this index were observed to be statistically significant (p<0.05) and the percentage identified by demarking point was 32.43% for males and 31.66% for females when using the formula Mean±3SD (Jit and Singh, 1966). When the formula Mean±2SD (Rao, 1962) was used, the percentage identified by demarking point was 68.72% for males and 62.53% for females. Washburn (1948) working on this index identified 80% and 100% for American males and females, respectively. In a recent study, Igbigbi and Msamati (2000), 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 races. A comparative data of these parameters in different races are shown in Table 2. The Mean pubic length of Australian Aborigines had the lowest mean value of 63.3 mm for males and 69.2 mm for females. The Eskimos (Hanna and Washburn, 1953) had a mean value of 74.1 mm for

Table 4: Showing mean Ischiopubic indices of various populations

Population	Sex	Mean $\pm$ SD	N	P	Authors
Black Malawians	Male	85.0 $\pm$ 15.7	120	<0.05	Igbigbi and Msamati (2000)
	Female	104.6 $\pm$ 15.7	135		
France	Male	82.0 $\pm$ 7.2	93	<0.05	Washburn (1948)
	Female	94.5 $\pm$ 3.1	61		
Portuguese	Male	78.2 $\pm$ 6.2		<0.05	Phenice (1969)
	Female	71.3 $\pm$ 3.1			
Americans	Male	67.4 $\pm$ 8.1	253	<0.05	Tague (1989)
	Female	93.1 $\pm$ 10.4	212		
White American	Male	63.7 $\pm$ 7.8	50	<0.05	Tague (1989)
	Female	88.4 $\pm$ 8.5	50		
Black Americans	Male	65.8 $\pm$ 8.7	50	<0.05	Tague (1989)
	Female	85.2 $\pm$ 8.5	49		
Caucasians	Male	<60	-	<0.05	Caldwell and Moloy (1933)
	Female	<90	-		
South-South Nigerians	Male	81.4 $\pm$ 6.4	30	<0.05	Oladipo <i>et al.</i> (2009)
	Female	104.2 $\pm$ 11.1	40		
Middle Belt Nigerians	Male	83.1 $\pm$ 5.8	20	<0.05	Oladipo <i>et al.</i> (2009)
	Female	101.7 $\pm$ 11.3	30		
Eastern Nigeria	Male	84.0 $\pm$ 10.4	100	<0.05	Oladipo <i>et al.</i> (2010)
	Female	102.6 $\pm$ 11.7	100		
Port Harcourt, Nigeria	Male	81.0 $\pm$ 5.70	46	<0.05	Udoaka <i>et al.</i> (2009)
	Female	102.7 $\pm$ 9.20	54		
A Nigerian population	Male	94.2 $\pm$ 9.9	114	<0.001	Ekanem <i>et al.</i> (2009)
	Female	118.8 $\pm$ 12.8	100		
South-South Nigerians	Male	88.658 $\pm$ 8.06	259	<0.05	Present study
	Female	106.45 $\pm$ 7.65	259		

males and 80.1mm for females. In the present study the pubic length of South- South Nigerian males was recorded as 74.99 $\pm$ 5.51 (mm) while that of females was 84.48 $\pm$ 6.73 (mm) and the mean pubic length for males and females in this study is the highest.

The mean ischial length in South-South Nigerian females was recorded as 79.52 $\pm$ 5.64 mm and that of the males was 85.03 $\pm$ 7.54 mm. That of the female value in this study is lower than the Eskimos but then when compared to those of other races in literature it was higher in Table 2. For the males, the American whites and the Eskimos had the higher values of 88.4 mm while for the females the Eskimos had the higher ischial length of 81.0 mm. The values for the American whites 78.3 mm; Bantus 80.3 mm and the Australians 81.2 mm are lower than ours for the males.

The mean ischiopubic index was highest in this present study in both males and females when compared to other races apart from the study carried out on Nigerians in Calabar by Ekanem *et al.* (2009). In Nigerian males and females the mean ischiopubic index were 88.65 $\pm$ 8.06 and 106.45 $\pm$ 7.65, respectively. Though the primary function of the pelvis in males and females is for locomotion, it is specially adapted for childbirth in the females (Hanna and Washburn, 1953). This may explain the significantly higher sexual differences in ischiopubic index observed in the females in all the races when compared with that of the males (Table 4).

From this study, South-South Nigerians have an overall mean ischio-pubic index of 97.55 $\pm$ 11.87 as assigned to the black race. However, the mean ischio-

pubic index of South-South Nigerians was significantly higher than that of black Malawians (p<0.05). This is an indication of regional variation of the ischio-pubic index. The relationship between age and pelvimetry has also been given attention.

The racial differences observed may either be due to environmental or hereditary factors or both (Krishan, 2007). Maclaghlin and Bruce (1986), 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. Rissech and Malgosa (2007) 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. Nwoha (1992), 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.

## CONCLUSION

The relevance of the use of ischiopubic index in identification of sex can should not be over emphasized. It should be given more attention. Further studies should be carried out to compare the pubic length, ischial length and ischiopubic index in other parts of Nigeria. It is therefore recommended to obstetrics, physical and forensic anthropologists for sex

and race determination in developing countries while more sophisticated methods are awaited.

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