



Radiologic Study of Ischiopubic Index of Urhobos and Itsekiris of Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author GSO designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors KCA and CUG managed the literature searches, analyses of the study, performed the spectroscopy analysis and author EOR managed the experimental process. All authors read and approved the final manuscript.

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ABSTRACT

The study was designed to determine and compare the pubic length, ischial length and ischiopubic indices amongst Urhobos and Itsekiris. The parameters were measured from radiographs obtained from the Radiology department of Delta State University Teaching Hospital (DELSUTH), Oghara and Capitol Hill Clinic, Warri both in Delta State, Nigeria. Anteroposterior radiographs of 93 adult pelvis (age range, 18 years and above) were evaluated. 66 of the radiographs were those of Urhobos (36 males and 30 females), while 27 were those of Itsekiris (13 males and 14 females). The morphological measurements were the pubic length, ischial length and ischiopubic index. The mean values for pubic length, ischial length and ischiopubic index for Urhobo males were 78.51±12.4mm, 85.58±11.6mm and 91.66±5.86 respectively while those of their females were 92.39±7.08mm, 81.97±12.00mm and 114.93±18.14 respectively. The mean values for pubic length, ischial length and ischiopubic index for Itsekiri males were 82.20±10.62mm,

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83.84±10.82mm and 98.40±9.37 respectively while those of their females was 92.05±6.36mm, 85.03±14.59mm and 111.03±18.37 respectively. There were significant data for male and female pubic length and ischiopubic indices both in Urhobos and Itsekiris. The demarking point of ischiopubic index was more useful in sex determination assigning sex to 78.6% Itsekiri females ($p < 0, 05$). The accurate determination of sex and race are important tools to forensic scientists and physical and clinical anthropologists. Thus, this study is important as it has provided the necessary data for Nigerian population under investigation. The data is recommended to obstetricians, physical and clinical anthropologist and forensic scientists.

Keywords: Radiographs; pubic length; ischial length; ischiopubic index; morphology; anthropology; Urhobo; Itsekiri.

1. INTRODUCTION

Ischiopubic index is the ratio of pubic length to ischial length multiplied by 100. The pubis and ischium are parts of the pelvic bone.

The pelvic bone (innominate bone) consists of three parts which are the ilium, ischium and pubis. These bones are joined together to form the acetabulum which is directly lateral with the ilium lying superiorly.

The pelvic bones are develops endochondrally, where initially a cartilaginous anlage or template of the bone develops and is later infiltrated by bone tissue, creating centers of ossification [1]. Each of the three bones is formed from its own primary center of ossification, five secondary ossification centers develops later [2].

The anthropometric study of the hip bone and its sexual dimorphism is of interest in the field of anthropology, forensic science, anatomy and clinical sciences (gynecologist and obstetrics) [3]. The hip bone is an ideal bone for sex determination because, it not only reflects the general differences between the two sexes (male and female) but also the special adaptation of female hip bone for child bearing [4].

This measurement is also important for accurate identification of sex and race in human skeleton and is fixed on forensic and physical anthropology especially because of increased crime rates [5]. Reports have suggested that data on pelvic bone can be considered for forensic science [6].

Ischiopubic is important in forensic and physical anthropology in the identification of unknown sex as it can provide new, cheap and more accurate means of determining sex and race when the need arises [3].

No significant differences have been seen to exist between studies from skeletal remains and radiological pelvimetry [3]. This method has become the most popular technique in assessing obstetrics of skeletal remains.

However, the probable limitations could arise from using radiographs of young individuals. This is because, the secondary ossification of the ilium, ischium and pubis do not ossify until about 20-25 years. Therefore, adults of 20-25 years and above can be adequately used for sexed pelvis [7].

[7] studied the ischiopubic index amongst Kalabaris and Ikwerres of South-South Nigeria using 140 anteroposterior radiographs which were free of bone diseases with age ranging from 18-65 years. With their result they correctly assigned sex to 84% Kalabari males, 94.2% Kalabari females, 90% Ikwerre males and 98% Ikwerre females respectively. In addition, Rogers and Saunders, 1994 tested the accuracy and reliability in a set of 17 individual traits on a small sample of identified pelvic bones. Accuracy varied from 6.1-94.1% for each individual pelvic trait, and the greatest accuracy was obtained by combining the scoring of three traits. [8] described a combination of elements for sex determination using isolated fragments of hip bone. However his results have been inconsistent, as accuracy levels ranged from 59% to 96% [9]. Such inconsistency is due to the fact that sexual dimorphism of the whole hip bone should be considered, and observations should not be restricted to the pubis [10,11]. [12] however found no differences in ischial or pubic lengths. [13] found that ischial length was longer in boys, especially those above five years of age, indicating growth differences between the sexes. However, males and females were found to have similar length means until age 15-19. [8] reported a method using the pubis, specifically the ventral arc, subpubic concavity, and ischiopubic ramus

ridge. Each trait was scored as either present or absent. When a trait was present, this indicated a female, while absence of a trait indicated a male. [14] used a total of 150 X-ray films (A-P view) of the pelvis of adult (90 male and 60 female) Nigerians to measure the width, depth, posterior segment, total and posterior angles of the greater sciatic notch [15]. The mean ischio-pubic index of females was significantly greater than that of males ($p < 0.001$). The mean length of female pubis was significantly longer than for males ($p < 0.001$), and similarly the mean length of the ischium in males was significantly longer than that of females ($p < 0.001$). Using the x-ray films, sex could be accurately assigned to 87.8% of males and 100% of females while with the skeletal bones, sex could be assigned to 92.3% males and 100% females. [16] reported that the sub-pubic angle was significantly greater in the older age group (46-70 years) than in younger age group (21-45 years) of Nigerians ($p < 0.05$). This could also be the reason for the variation in the ischiopubic index.

This work was carried out amongst Urhobos and Itsekiris of Delta state in Nigeria. The aim was to produce a data base of ischiopubic index that could be of importance in Nigeria and in developing countries as tools in forensic science, clinical practice and anthropology.

2. MATERIALS AND METHODS

Materials used for this study are: 93 anteroposterior pelvic radiographs. 36 radiographs were those of Urhobo males, 30 were those of Urhobo females while 13 were those of Itsekiri males and 14 were those of Itsekiri females. The radiographs used were from Delta State University Teaching Hospital (DELSUTH), Oghara and Capitol Hill Clinic, Warri.

The radiographs were identified to be those of indigenous Urhobos and Itsekiris of Nigeria based on their names and the information gathered from the various Radiology departments. The radiographs were radiographs taken for other clinical conditions and appeared normal and showed no fracture of any kind.

Only radiographs with best alignment at the inferior margins of the pubic bones at the pubic symphysis were measured. This method is best used on x-ray films of adults (18 years and above) since the ventral arc and sub-pubic angles are not well developed until about 18 years of age [1]. The radiographs were placed on an x-ray view for clear visualization taken at a distance of 100cm in the anterior view (Fig. 1).

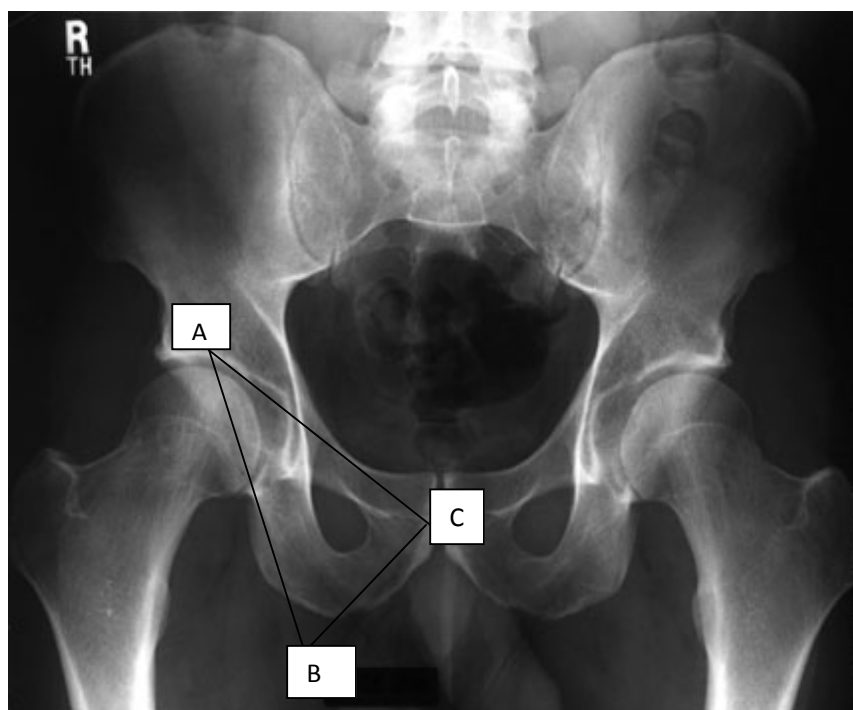


Fig. 1. Picture showing pelvic radiographs (anteroposterior view)

The selected bones used were the acetabulum, pubis and ischium. The shapes of the bones were marked by triangle from the cap of the acetabulum (A) to inferior part of the ischium (B) to meet at the pubis (C).

Ischial length: Is a straight line AB as shown on the radiograph.

Pubic length: Is a straight line AC as shown on the radiograph.

Measurement was carried out by choosing three (3) points on the radiograph: points A, B and C.

Point A= acetabular point (or hip socket) where the three pelvic bones meet

Point B= ischial tuberosity

Point C= pubic tubercle

A marker was used to mark these points for clear visualization and accurate measurement. The measurements were taken from the projected points of plane.

The distance between these points was measured with the aid of vernier calliper.

Distance:

AB= ischial length (from the acetabular point to the ischial tuberosity)

AC= pubic length (from the acetabular point to the pubic tubercle)

Note: Ischial length and pubic length are measured in mm.

Each distance was measured twice and the average recorded as the actual distance to ensure accuracy.

Ischiopubic index was calculated using Washburn's ischiopubic index formula as shown below:

$$IPI = AC/AB \times 100 \text{ (Washburn, 1948)}$$

Where

AB = ischial length

AC = pubic length

IPI = ischiopubic index

3. LIMITATIONS

1. Inadequate radiograph because of patient availability to radiographic study
2. Poor picture view of some radiograph

4. RESULTS

The results obtained for the measurement of pubic length, ischial length and the calculation of ischiopubic index were analyzed statistically and presented in Table 1 (Urhobos), Table 2 (Itsekiri) and 3 (Urhobos and Itsekiris). Results for ischiopubic index in the present study and other world populations previously study are presented in Table 4.

Ischial length was higher in male Urhobos while the pubic length and ischiopubic index showed higher value in females. The difference observed in the Ischial length of the male and female Urhobos was however, not significant ($P>0.05$).

Among Itsekiris, females showed higher values ($P<0.05$) for pubic length, ischial length and ischiopubic index. Female Urhobos similarly showed higher value for ischiopubic index ($P<0.05$).

Analysis using SPSS 17.0 version for t-test (Table 3) showed that only ischiopubic index among males demonstrated ethnic difference. No differences were observed in other parameters ($P>0.05$).

The results of comparison of ischiopubic index of Urhobos and Itsekiris with other populations (Table 4) showed that results were similar to other Nigerian populations in terms of sexual dimorphism and range of values in the present study.

5. DISCUSSION

In the present study, the ischial and pubic length could not identify reasonable percentage in both males and females. The ischiopubic index however was observed to be useful in sex differentiation. The mean values of this index were observed to be statistically significant ($p<0.05$). This study has also shown that the ischiopubic indices for males and females were in the range of 80.4-107.58 and 83.8-161.09 (for Urhobos) and 87.7-118.74 and 86.9-157.84 (for Itsekiris). The mean ischiopubic index of Itsekiri males had the highest value compared with the mean ischiopubic index of Cross Rivers people had the highest value for females with Urhobo and Itsekiri females with the next highest values (Table 4) while Australian aborigines had the lowest values for both males and females.

Table 1. Results of pubic length, ischial length, ischiopubic index and T-test of Urhobos

Parameters	Males (Mean±SD)	Females (Mean±SD)	T-values	P-values
Pubic length(mm)	78.5±12.4	92.3±7.1	6.779	0.000
Ischial length(mm)	85.5±11.6	81.9±12.0	0.509	0.614
Ischiopubic index	91.7±5.9	114.9±18.1	7.591	0.000
Sample size	36	30	C I = 95%	

Male: Pubic length (Max = 97.8mm Min = 55.6mm) Ischial length (Max = 99.4mm Min= 63.9mm) Ischiopubic index (Max =107.6 Min = 80.4)
Females: Pubic length (Max = 99.6mm Min = 75.3mm) Ischial length (Max=94.7mm Min= 55.3mm) Ischiopubic index (Max =161.1 Min =83.8)

Table 2. Results of pubic length, ischial length, ischiopubic index and T-test of Itsekiris

Parameters	Males (mean±SD)	Females (mean±SD)	t-values	p-values
Pubic length(mm)	82.2±10.6	92.0±6.4	2.697	0.019
Ischial length(mm)	83.8±10.8	85.0±14.6	0.052	0.959
Ischiopubic index	98.4±9.4	111.0±18.4	2.942	0.012
Sample size	13	14	C I = 95%	

Male: Pubic length (Max = 97.0mm Min 65.6mm), Ischial length (Max = 99.1mm Min 70.4mm), ischiopubic index (Max = 118.1 Min = 87.6).
Female: Pubic length (Max = 99.9mm Min = 80.9mm), Ischial length (Max = 99.6mm Min = 51.3mm), Ischiopubic index (Max = 157.8 Min = 86.9).

Table 3. Results of comparison of various parameters between Urhobos and Itsekiris

Parameters	t-values		p-values		Male	Female
	Male	Female	Male	Female		
Pubic length	1.025	0.160	0.05	0.05	Not significant	Not significant
Ischial length	0.486	0.684	0.05	0.05	Not significant	Not significant
Ischiopubic index	2.428	0.659	0.05	0.05	Significant	Not significant

Table 4. Comparative table of Ischiopubic index of some Nigerian populations and other populations of the world

Population	Sex	N	Mean ischiopubic index	P	Authors
Cross rivers people	M	114	94.20	<0.05	Ekanem et al. 2009 [4]
	F	100	117.30		
Middle belt Nigerians	M	20	83.10	<0.05	Oladijo et al. 2010 [7]
	F	20	101.7		
South- south Nigerians	M	30	81.40	<0.05	Oladijo et al. 2010 [7]
	F	40	104.20		
Urhobos	M	36	91.66	<0.05	Present study
	F	30	114.93		
Itsekiris	M	13	98.40	<0.05	Present study
	F	14	111.03		
Eskimos	M	129	93.90	<0.05	Hanna and Washburn, 1953 [17]
	F	99	99.80		
American whites	M	100	83.60	<0.05	Washburn, 1948
	F	100	99.50		
Bantus	M	82	82.50	<0.05	Washburn, 1949
	F	70	98.10		
Australian aborigines	M	89	76.00	<0.05	Hanna and Washburn, 1953 [17]
	F	72	92.70		

Note: M – male, F – female, P – probability level, N – sample size

Though the primary function of the pelvis in males and female is for locomotion, it is specially adapted for childbirth in the females [17]. This may explain the significantly higher sexual differences in ischiopubic observed in females in all races when compared with that of the males (Table 4). The pelvic bone is also important in protecting vital organs. [9] 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. Body size is known to be influenced by environmental, nutritional and genetic factors.

The relationship between the age and pelvimetry has also been given attention. [16] reported that the sub-pubic angle was significantly greater in the older age group (46-70 years) than in younger age group (21-45 years) of Nigerians ($p < 0.05$). This could also be the reason for the variation in the ischiopubic index.

6. CONCLUSION

In conclusion, the present study has established the presence of sexual dimorphism in the ischiopubic index of Urhobos and Itsekiris of Nigeria and also racial and regional variation. Thus, the value of ischiopubic index in Urhobo males and females overlaps with those of Itsekiri males and females respectively.

The high level of accuracy of this non-invasive method of determining the ischiopubic index cannot be over emphasized and it is thus recommended to obstetricians, physical and forensic anthropologist for sex and race determination in developing countries while more sophisticated methods are awaited.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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