Journal of Anatomical Sciences

Email:anatomicaljournal@gmail.com

J Anat Sci 13 (1)

Comparative Anthropometric Evaluation of the Subpubic Angle and Ischiopubic Index in Adult Nigerians

[1]**Oyakhire MO and** [2]**Chukwuemeka Agi**
[1]Department of Anatomy, Faculty of Basic Medical Sciences,
University of Port Harcourt, Port Harcourt, Nigeria
[2]Department of Radiology, Faculty of Clinical Sciences,
University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria

Corresponding Author: Oyakhire MO
E-mail: ovbiadolor@gmail.com; +2348033419605

ABSTRACT
This study was done to determine the subpubic angle and ischiopubic index of indigenous Nigerians and compare their suitability for sexing. It involved 148 anteroposterior pelvic radiographs of adult Nigerians, within the age range of 20-65years. The x-ray films were obtained from the Radiology Department of University of Port Harcourt Teaching Hospital and Braithwaite Memorial Specialist Hospital. The measurement of subpubic angle was taken with a transparent goniometer. Pubic length and ischial length were measured from a common point at the acetabulum using the movable arms of the goniometer. Values ranged from $(71\text{-}81)^0$ with a mean of 93.11^0 Standard Deviation 12.5 and Standard Error 1.384 for males while for the females, the ranged from $(80\text{-}98)^0$ with the mean of 131.10^0 Standard Deviation of 15.30 and Standard Error of 1.51 the ischiopubic index ranged from $(71\text{-}80)^0$ with the mean of $(89.9)^0$, Standard Deviation of 7.5 and Standard Error of 1.10 for males while for the females the ranged from $(81\text{-}90)^0$ with the mean of 110.3^0, Standard Deviation of 9.8 and Standard Error of 0.98. Females had wider subpubic angle and ischiopubic index than males, ($P<0.05$). Adding the coefficient of variance, the subpubic angle gives higher variability of deviation from the mean than the ischiopubic index. Taking or using the demarking point method: 71.74% of Nigerians males and 83.33% of Nigerians females can be sexed with subpubic angle. With the ischiopubic index 63.0% of Nigerians males and 83.33% of Nigerians females can be sexed. The schiopubic index can therefore be considered a better parameter for sexing than the subpubic angle.

Keywords: subpubic angle, ischiopubic index, pelvic, pubic length, ischial length

INTRODUCTION
Determination of sex is perhaps the most important aspect in the identification of skeletal remains, especially when only a few fragments of bone are available because of its direct applications for matters commonly encountered in medico legal, clinical and forensic practice.

The bones of the pelvic girdle; ilium, ischium and pubis are formed from mesenchyme of the hip buds and endochondrial ossification begins at the 4th month of intrauterine life and ends at about 25th year of life [1].

The hipbone is ideal for sex determination because it reflects the general differences between males and females with regards to adaptation of specific components of the female hipbone for pregnancy and parturition This understanding has enabled a number of Authors to derive indices and parameters from linear and angular dimensions and relationships of the ilium, ischium and pubis such as sub pubic angle and ischiopubic index [2,3].

In obstetrics and gynecology, radiological techniques have replaced clinical pelvimetry in order to more accurately guide investigative protocol and decision making [1,4].

The subpubic angle can be measured from skeletal specimens or by radiological pelvimetry and studies have shown that there are no significant differences[5].

Subpubic Angle: This is the angle formed by the inferior borders of the ischiopubic rami of the two sides of the hipbone [1].

Experts have established that the subpubic angle varies according to sex, race and ethnic groups [6-10]. In the study by Igbigbi et al.,[6] the subpubic angle showed a significant difference between males (93.86^0) and female (116.11^0) Ugandans and Malawians males (99.16°) and females (129°) respectively, with which 63% Ugandans and 71% Malawians were assigned. Regional variability of the SPA in identification of sex was reported in the study by Oladpo et al.[8], using two hundred anteroposterior pelvic radiographs of Ijaws and Igbos aged 20-65 years, they observed that women had significantly wider angle than men ($p<0.05$). In that study, the range of SPA was 91º -123º and 74-111º for male Ijaws and Igbos respectively, and 100-146º and

90-140º for female Ijaws and Igbos respectively, with SD of 12.06 and 12.85 female Ijaws and Igbos respectively. They reported that 62.5% of Nigerians, 63% of Ugandan, and 71% of Malawians could be accurately assigned to the black race

Ischiopubic Index is defined as the length of the pubis divided by the length of the ischium measured from a common point in the acetabular ring and multiplying the outcome by 100. Many authors have also reported that the ischiopubic index varies according to sex and region [11,12].

The objective of the study by Samira Sale [11], was to determine ischiopubic index and subpubic angle in Egyptian males and females and compare data with other populations.

Antero -posterior radiographs of 120 adult males and females (aged from 18 to 70 years) were studied to document the pubic length, the ischial length and subpubic angle. Results reported with mean as estimator are as hereunder:

In Males, Pubic length, ischial length, ischiopubic index and subpubic angle were 72.4 mm, 80.6 mm, 86.3 and 102.4° respectively. In Females, Pubic length, ischial length, ischiopubic index and subpubic angle were 83.5 mm, 74.5 mm, 103.5 and 141.2° respectively.

Pubic length was significantly larger in females ($p<0.05$), opposite was observed for the mean ischial length being significantly higher in males ($p<0.05$). Ischiopubic index was significantly higher in females ($p<0.05$), while the subpubic angle in females was significantly higher than males

The aim of this study is to evaluate the subpubic angle and ischiopubic index and determine the suitability of these parameters for sexing using radiographs in Nigeria.

Nigeria is currently witnessing increasing cases of homicide where victims are children and adults of all ages. Death from road traffic accidents, armed robbers, terrorists and kidnappers has become an everyday experience. Findings from this work will be helpful to pathologists, radiologists, anatomists, and other health care providers who may be called upon to identify skeletal remains.

MATERIALS AND METHODS

Port Harcourt Nigeria is a large multi ethnic city with major resident ethnic groups consisting of the Ibos, Yorubas, Ijaws and Hausas. Other tribes predominant in the city include the Ikweres, Itsekiris, Urhobos, Ogonis Edos.

One hundred and forty eight (148) anteroposterior(AP) pelvic radiographs of subjects (102 females and 46 males) aged 20-65 years, from the radiology department of the University of Port Harcourt Teaching Hospital (UPTH) and Braithwaite Memorial Specialist Hospital (BMSH) Port Harcourt examined and screened for unwanted abnormalities were studied. Pelvic radiographs of individuals below 20years (due to the ischium, pubis and ilium not fusing well), adults above 70, broken or diseased pelvis, sharp and unobscured radiographs were excluded.

Each parameter was measured thrice and any discrepancy in the three readings was avoided by taking their average. The same radiograph was used for measuring subpubic angle, pubic length and ischial length, using the same instruments and by a single observer.

The following measurements were taken

Subpubic angle: This angle was measured by placing each radiograph on an x-ray viewing box. A tangential (or parallel) line was then drawn through the inferior borders of each ischiopubic ramus, to meet at a point in the interpubic disc (which appears transparent in the film). This point where they join or intersect makes it easier for measuring the angle. (fig 1)

Ischiopubic index: The ischiopubic index is calculated by dividing the pubic length by the ischial length and multiplying by 100. It is believed to play a major role in the pelvic inlet which is important to obstetricians and anatomical pathologists

Measurement was carried out by choosing 3 points on the radiographs: points A, B and C. Points A were the acetabular point where the three pelvic bones meet. Points B and C were the points on the ischial tuberosity and pubic tubercle respectively giving ischial length to be AC and pubic length to be AB. A marker was used to mark these points for clear visualization. The distance between these points were then measured with the aid of Vernier caliper. Fig 2

RESULTS

Overall Mean Angle = 103.96. From Table1-A, the mean subpubic angle in the males was given as 93.11, standard deviation of 12.50; the mean angle, for females was 131.10 and standard deviation of 15.30.
From Table 1-B, the mean ischiopubic index of the males was 89.5 and standard deviation of 7.5; The mean ischiopubic index for females was 110.3 and standard deviation of 9.8.

From Table II-A, the highest frequency was observed at 81-90 class limit for males, the females at 121-130.
From Table II-B, the highest frequency of ischiopubic index, occurred at the 81-90 class limit for males and for females at 101-110.

From table III, it is observed that the spread of subpubic angles of males and females about their respective means is greater than that of the ischiopubic index.

Demarking point is a statistical parameter. It is used to give a confidence relation and possible identification in percent (%) of a parameter which is significant in differences between two sets/groups of subjects (or in this case, males and females).

Demarking point = mean ± 2 S.D or mean ± 3 S.D. (as some prefer like the Indians)
For males: mean of females - 2. (S.D. of females) = <answer
For females: mean of males+ 2 (S. D of females) = > answer
From Table IV-A: Using the demarking point of <1005, 71.74% males can be identified in the same value while the demarking point of >118.11 show 83.33% of female identification.

From Table IV-B: The demarking point of male ischiopubic index in <90.7 and 63.0% of males where identified, while for females demarking point is > 104.8 and 83.53% of females were identified.

Table I: Descriptive Statistics of subpubic angle and ischiopubic index
A- Subpubic angle

Subjects -	N -	Range (^{0})	Mean (x) (^{0})	Standard Deviation (S.D) (^{0})	Standard Errors (S.E.) (^{0})
Male	46	71-81	93.11	12.50	1.84
Female	102	80-98	131.10	15.30	1.51

number of subjects (n), range, mean, standard deviation and standard error of the subpubic angle in Nigerian subjects.

B- Ischiopubic index

Subjects -	N -	Range (^{0})	Mean (x) (^{0})	Standard Deviation (S.D) (^{0})	Standard Errors (S.E.) (^{0})
Male	46	71-80	89.8	7.5	1.10
Female	102	81-90	110.3	9.8	0.98

number of subjects (n), range, mean, standard deviation and standard error of the ischiopubic index in Nigerian subjects.

Table II: Frequency distribution of the subpubic angle and ischiopubic index
A- Subpubic angle

CLASS LIMITS (^{0})	FREQUENCY			MEAN SUBPUBIC ANGLES (^{0})		
	Male	Female	Total	Male	Female	Total
71-80	8	0	8	75.5	0	75.5
81-90	13	1	14	85.5	83.0	168.5
91-100	12	3	15	95.5	95.0	190.5
101-110	8	6	14	105.5	107.2	212.7
111-120	5	10	15	115.5	117.0	232.5
121-130	0	28	28	0	126.6	126.6
131-140	0	27	27	0	135.7	13.5.7
141-150	0	20	20	0	146.9	146.9
151-160	0	5	5	0	155.6	155.6
161-170	0	2	2	0	164.0	164.0

Frequency distribution for the various class limits and their individual mean for the two parameters in both male and female Nigerians.

B- Ischiopubic index

CLASS LIMITS (^{0})	FREQUENCY			MEAN (^{0})		
	Male	Female	Total	Male	Female	Total
71-80	3	0	3	77.5	0	77.5
81-90	23	3	26	86.2	87.7	173.9
91-100	18	3	21	93.5	100.0	193.5
101-110	1	42	43	107.1	106.5	213.6
111-120	1	36	37	112.3	114.4	226.7
121-130	0	15	15	0	122.9	122.9
131-140	0	1	1	0	134.3	134.3
141-150	0	1	1	0	140.3	140.3

Frequency distribution for the various class limits and their individual mean for the two parameters in both male and female Nigerians.

Table III: Coefficient of variance (sd/mean × 100)

PARAMETER	SEX	MEAN	S.D	CV
Subpubic angle	M	93.11	12.50	13.42%
	F	131.10	15.30	11.67%
Ischiopubic Index	M	89.8	7.5	8.35%
	F	110.3	9.8	8.88%

Coefficient of variance (cv)= (sd/mean × 100)

Table IV-A: mean, demarking points and percentage of identification between sexes in the population groups

SUBPUBIC ANGLE	NIGERIANS		AMERICANS WHITE		UGANDAN	
Degrees (^{0})	Male (n=46)	Female (n = 102)	Male (n=50)	Female (n = 50)	Male (n=110)	Female (n = 93)
Range	72-120	83-165	-	-	50-140	75-155
Mean ± SD	93.11 ±12.50	131.10±15.30	63.7±7.8	88.4±8.5	93.86±21.12	116.11±17.79
Mean ± 2 SD	68.11 ± 118.11	100.5±161.7	48.1±79.3	71.1±105.4	51.62±136.1	80.53±151.69
Demarking point	<100.5	>118.11	<71.4	>79.3	<80.53	>136.10
Identification by sex (Z)	7174%	83.33%	-	-	31.82%	
P	<0.05		0.05		0.05	

Table IV-B: mean, demarking points and percentage of identification between sexes in population groups

ISCHIOPUBIC INDEX	NIGERIANS (using mean ± 3S.D and 2S.D)		AMERICANS WHITE(using mean 2S.D)	
Degrees (^{0})	Male	Female	Male	Female
Range	77.9-112.3	87.1-140.3	86.4-114	78.7-101
Mean ± SD	89.8±7.5	110.3±9.8	100±5.01	89±4.38
Mean ± 3 SD Mean ± 2 SD	67.3±112.3 74.8±104.8	80.9±139.7 90.7±129.0	84.97±115.03	75.85±102.14
Demarking point as applied for Indians	<80.9 <90.7	>112.3 >104.8	102.14	84.97
Identification by sex (Z)	8.6% 63.0%	33.33% 83.33%	27.27%	17.7%

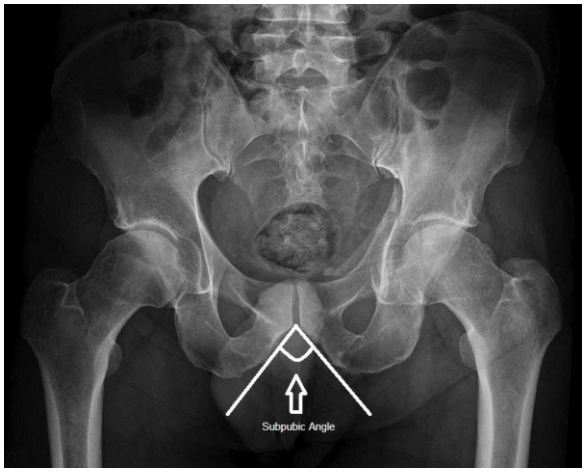

Figure 1: pelvic girdle showing the Subpubic Angle

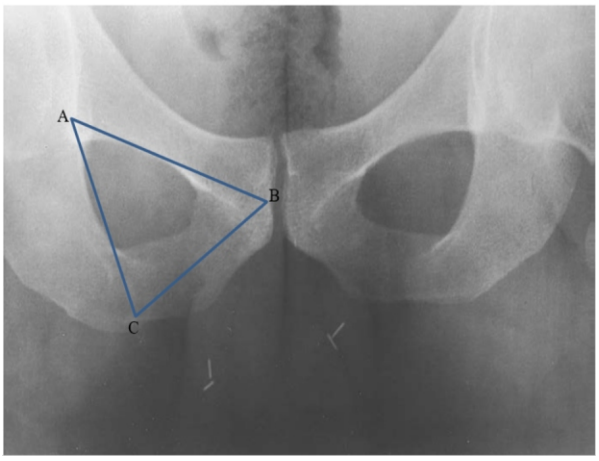

Figure 2: Pubic length - line AB, Ischial length - line AC

DISCUSSION

In females compared to males the superior ramus of the pubis is long accounting for the larger pubic ischial ratio, the increased pubic length and laterally displaced ischia result in wider pubic angle [13-17]. This is evident in this study (tables Ia and b).

From this study, it was seen that the ischiopubic index is a better estimator than subpubic angle (Table 3).

The differences found in the various populations compared, may be due to racial variability. The subpubic angles of Nigerian males and females are greater than those of white Americans. Nigerians have mean subpubic angle of 119.29^0 and white Americans 76.05^0, compared with mean subpubic angle of 104.99^0 for Ugandans. Mean ischiopubic index of female Nigerians is of higher than that of male Nigerians. Conversely, average values of ischiopubic index of male Indians are higher than those of their females. (Table IVa and b) observed that there is a difference in the mean subpubic angles and ischiopubic index between Nigerian indigenous subjects and other populated groups, ($p < 0.05$) except the Ugandan males.

Thus for research, planning and interventions, consideration should be given to population specific data. This study supports the argument that there is a relationship between sexual dimorphism in the subpubic angle and ischiopubic index. Racial differences could be as a result of genetic factors, as well as nutritional and environmental influences.

From the foregoing, dimensions of the hip bone are specific with regards to age sex race and ethnic groups[9] although some authors Pal et al[7] have queried the reliability of current methods used for Sexing of Hip Bones. Using 205 hip bones (143 males & 62 females), they evaluated the reliability of chilotic line index, ischio-pubic index and acetabulo-pubic index for demarking a male from a female hip bone
With the help of this method the parameter ischio-pubic index could identify only 35.6% males and 24% female hip bones.

Features and anatomical land marks exhibit wide variations with regards to age, sex, race, ethnicity, occupation, nutritional status, amongst others. Data derived from the measurements are equally subject to many variations, some temporal hence the need for more studies to compare with previous studies and document similarities and disagreements.

CONCLUSION

There are sex differences in the subpubic angle and ischiopubic index of Nigerians. This study shows that subpubic angle and ischiopubic index than are both larger in females. Concerning sexing using demarking points, the Ischiopubic index gives a higher accuracy than the subpubic angle.

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