

Comparative Study of the Sub-Pubic Angles of Adult Ikwerres and Kalabaris

G.S. Oladipo, P.D. Okoh and J.S. Hart

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

Abstract: The aim of this study is to document the sub-pubic angles of adult Ikwerres and Kalabaris and to provide a comprehensive data for use by anthropologists and medical practitioners. Six hundred (600) anteroposterior pelvic radiographs of adult indigenous Ikwerres and Kalabaris aged 20-70 years were studied to determine their sub-pubic angle. The angles ranged from 75-126° and 86-128° for male Ikwerres and Kalabaris respectively, while for female Ikwerres and Kalabaris ranged from 96-142° and 95-151° respectively. The standard deviation of 3.00 and 3.17 were for female Ikwerres and Kalabaris respectively. Women had significantly wider angle than men ($p < 0.05$) due to childbearing factor as indeed, has previously been shown in other population group studied. The value of the sub-pubic angle in adult Ikwerres and Kalabaris can be said to be obtuse in females, but overlap between acute and obtuse in males. Using the watershed sub-pubic angle derived from mean of previously documented studies and present study, 62.5% of Nigerians, 63% of Ugandan, and 71% of Malawians could be accurately assigned to the black race. The study has demonstrated not only sexual but also regional variability of this angle among Ikwerres and Kalabaris and among different population groups. This study is important and is therefore recommended to obstetricians, physical and forensic anthropologists especially in developing countries.

Key words: Anthropology, ethnic group, racial, regional variation, sexual, sub-pubic angle

INTRODUCTION

The sub-pubic angle is the angle that exists between the inferior rami and below the pubic symphysis in an articulated bony pelvis. It is also referred to as pubic arch (Moore and Dalley, 1999). It has been observed that the size of the sub-pubic angles determines the size of birth canal, which is an important criterion in vaginal delivery. The sub-pubic angle is more angular in male being 50-60°C, and in female more rounded, usually 80-85°C.

When the vagina admits 3 fingers side by side, the sub-pubic angle is said to be sufficient to permits passage of foetal head after it has passed through the pelvic outlet (Moore and Dalley, 1999). When the need arises to determine the identity of an unknown skeleton, the skulls were often, the first bone of the choice and an accuracy of about 80-90% has been reported (Igbigbi *et al.*, 2003). However the skull is not always available, but because it had been suggested that the shape of the pelvic may correlate with that of same extension (Schultz, 2003).

Attempts to sex an unknown pelvis using one criterion alone for example, could determine sex in 70% of the cases while several criteria could give 90-95% accuracy (Phenice, 1969). The ischio-pubic index for instance, produced values of 83.7-100% for adult white Americans and when correlated with dimensions of the sciatic notch, sex of 98% of the pelvis could be deduced (Phenice, 1969).

In a recent study of indices of Malawian subjects, sex could be accurately assigned to 87.8% for males and 100% females using X-ray films and 92.3% males and 100% female using skeletal bones (Igbigbi and Msamati, 2000). When the pelvis is used with the skull, it produces an accuracy of sex determination of 98-100% (Phenice, 1969).

Nevertheless, assessment of sex isolated and often-incomplete human remains cannot always be certain. No significant differences have been seen to exist between the studies from skeletal remains. Radiological pelvimetry has become the most popular redefined technique in assessing obstetrics and forensic problems such as sexing and identification of skeletal remain which are usually mostly established from the pelvis.

Despite the anthropological and forensic importance of the sub-pubic angle, only a few studies exist in sub-Saharan African population (Inuwa, 1992; Nwoha, 1992). Report on sub-pubic angle of Nigerians show a mean sub-pubic angle of 91.87° and 115.49° for male and female Nigerians respectively (Oladipo, 2006). Previous report by Oladipo *et al.* (2009) has show that sub-pubic angle is affected by ethnicity hence the need for data for each ethnic group. Thus the aim of the present study was to determine the values of sub-pubic angle for the Nigerian ethnic groups under investigation, which could be used to solve the aforementioned problems.

MATERIALS AND METHODS

The present study was carried out between May 2009 and January 2010. In the measurement of the sub-pubic angle the following material were used: A goniometer, a marker, an X-ray view box and anteroposterior radiographs. X-ray of 386 females and 214 males both of Ikwerre and Kalabari ethnic groups aged 20-70 years were examined from the archives of the Braithwaite Memorial Hospital, Port Harcourt and University of Port Harcourt Teaching Hospital-Nigeria. Only radiograph with the best alignment at the inferior margin of the pubic bones at the pubic symphysis were measured. This is because misalignment is best determined at the lower margin (Lusted, 1978). These radiographs were taken at a distance of 100cm in the anterior posterior view.

The angle was measured by placing each radiograph on an X-ray view box for clear visualization. A point was chosen at the inferior midline of inter-pubic disc and two tangential lines drawn at the inferior border of the pubic rami intersecting at an angle of the chosen point. A goniometer was placed over the intersection of these two lines and the angle measured.

The sex and age of the subjects shown in the radiograph jacket together with the angle were recorded. The results were compared with previous studies on Caucasian, Amerindians, Malawians and Ugandans analyzed with discrete statistics. Sex was determined by using the demarking point method. This method involves calculating the maximum and minimum limit of range of the sub-pubic angle by using the formula, mean±2 Standard Deviation (SD).

RESULTS AND DISCUSSION

Table 1 shows the range; mean, standard deviation (SD), standard error (SE) of the sub-pubic angle of adult Ikwerres and Kalabaris. Table 2 show the frequency distribution for the various class limits and their individual mean angles for both male and female Nigerians. Table 3 comparison of the subpubic angles between the Kalabari (Female and Male) and Ikwerre (Female and Male) using z-test. Table 4 shows the mean subpubic angle between sexes in various population groups. From the results the, the subpubic angle of Ikwerre and Kalabari males were 100.25° and 105.63° respectively while those of females were 119.38 and 125.00° respectively (Table 1). Kalabaris had higher values than Ikwerres (p<0.05) in both sexes. Sexual dimorphism was equally observed in the two ethnic groups (Table 3). Comparison with other ethnic groups or tribes showed distinct angle in the two ethnic groups compared to other groups previously studied suggesting ethnic differences (Table 4).

Races were assigned from the overall mean for each racial group. From this mean, using the watershed pubic angle of 76.05, 80.25, and 98.1° races were assigned as follows. Sub-pubic angles of more than 76.05° to less than 80.25° indicated white Americans. Sub-pubic angles of more than 80.25° to less than 90.21° indicated Americans. Sub-pubic angle more than 98.21° indicated Africans (Table 4).

The result from this study confirms the existence of sexual and regional variations in the sub-pubic angle amongst the Ikwerres and Kalabaris.

Table 1: The number of cases (n), range, mean, standard deviation and standard error of the subpubic angle of the Kalabaris and Ikwerres

	n		Range (°)		Mean (°)		SD		SE	
	Ikwerre	Kalabari	Ikwerre	Kalabari	Ikwerre	Kalabari	Ikwerre	Kalabari	Ikwerre	Kalabari
Subjects										
Male	85	129	75-126	86-128	100.25	105.63	7.80	3.88	0.85	0.34
Female	173	213	96-142	95-151	119.38	125.00	3.00	3.17	0.23	0.22

SD = Standard Deviation, SE = Standard Error, Ikwerre = Ikwerre, Kal = Kalabari, n = Sample size, Overall mean angle: 112.57°

Table 2: The frequency distribution for the various class limits and their individual mean for both male and female Kalabaris and Ikwerres

Class intervals	Female (n = 213)		Male (n = 129)		Female (n = 173)		Male (n = 85)		Kalabari		Ikwerre	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
71-80	0	0	0	0	6	0	0	0	0	0	77.17	77.17
81-90	0	3	0	0	6	0	0	86.67	0	0	85.00	85.00
91-100	8	19	6	13	91.75	96.58	91.17	96.58	91.17	97.31	97.31	97.31
101-110	12	45	39	24	105.00	105.40	106.18	105.40	106.18	104.26	104.26	104.26
111-120	36	43	35	26	116.81	116.11	116.5	116.11	116.5	115.27	115.27	115.27
121-130	61	19	59	10	125.68	123.40	125.37	123.40	125.37	122.5	122.5	122.5
131-140	72	0	30	0	135.35	0	134.9	0	134.9	0	0	0
141-150	22	0	4	0	143.41	0	141.5	0	141.5	0	0	0
151-160	2	0	0	0	151.00	0	0	0	0	0	0	0

Table 3: Comparison of the subpubic angles between the Kalabari (female and male) and ikwerre (female and male)

Contrast	Z-values (critical)	Z-Values (calculated)	p-value	Significance
Kalabari female Vs Ikwerre female	1.96	17.78	<0.05	S
Kalabari male Vs Ikwerre male	1.96	5.89	<0.05	S
Kalabari female Vs Ikwerre male	1.96	28.35	<0.05	S
Ikwerre female Vs Kalabari male	1.96	33.54	<0.05	S

Table 4: The mean subpubic angle between sexes in various population groups

Population group	Sex	Mean±SD (°)	Overall mean angles (°)	Demarkin point (p)	Author(s)
Amerindians	Female	67.4±8.1	80.25	<0.05	Tague, 1989
	Male	93.1±10.4			
Nigerians	Female	91.87±10.6	103.80	<0.05	Oladipo 2006
	Male	115.49±11.58			
Igbos	Female	111.44±12.58	103.36	<0.05	Oladipo 2009
	Male	95.29± 10.58			
Ijaws	Female	119.48±12.06	114.43	<0.05	Oladipo 2009
	Male	109.38±10.0			
Black ugandans	Female	93.86±21.12	104.98		Igbigbi,2003
	Male	116.11±17.79			
Kalabaris	Female	125.0±3.17	115.31	<0.05	Present study
	Male	105.63±3.88			
Ikwerres	Female	119.38±3.0	109.82	<0.05	Present study
	Male	100.25±7.8			

Significant differences were also found to exist in the sub-pubic angle between Ikwerres and Kalabaris and other races in both sexes ($p < 0.05$). This study has shown that the sub-pubic angle as described by Harold (1974) with males being an acute angle of about 60° and females being a right angle of slightly greater than 90° is actually true and applicable to the Europeans not Africans and precisely not Nigerians as, thus confirming racial variability.

From the study, the Ikwerres and Kalabaris had an overall mean of greater than 98.21° as assigned to Africans and thus can be assigned to the black race (Igbigbi, 2003).

The presence of sexual, racial and regional variability of the sub-pubic angle could possibly be explained on genetic, dietary and environmental factors. Although, samples demonstrated significant differences between sexes, racial and regional variations, there would always be individual variation in pelvic structure within a given population which could explain why the subject did not show 100% accuracy in sexual and racial variability of the sub-pubic angle.

The relationship between age and pelvimetry has also been given attention. Report shows that the sub-pubic angle was significantly greater in older age group (46-70 years) Nwoha, 1992 than in younger age group (21-45 years) of Nigerians (Oladipo, 2006) ($p < 0.05$). In clinical practice however, individual measurement of a female patients are more significant than the estimated mean, since an obstetrician is more concerned with comparison between the mother's dimension and foetal head. The proper dimensions are those of the gynaecoid pelvis, which meant to be the normal phenotype in women, although it may vary.

CONCLUSION

This study has established the presence of sexual dimorphism in the sub-pubic angle of Ikwerre and Kalabari ethnic groups of Nigeria and also racial and

regional variations. Thus, the value of the sub-pubic angle among Ikwerres and Kalabaris can be said to be obtuse in females but overlap between acute and obtuse in males.

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

REFERENCES

- Harold, E., 1974. Clinical Anatomy: A Revision and Applied Anatomy for Clinical Students. 5th Edn., Blackwell Scientific Publications Ltd., pp: 119-124.
- Igbigbi, P.S. and A.M. Igbigbi-Nanono, 2003. Determination of sex and race from the sub-pubic angle in Ugandans. Am. J. Forensic Med. Path., 24(2): 168-171.
- Igbigbi, P.S. and B.C. Msamati, 2000. Ischio-pubic index in adult black Malawis. East Afr. Med. J., 77(9): 514-516.
- Inuwa, I., 1992. A study of the shaft of the neck of femur and sub-pubic angle in Hausa tribe of Nigeria. West Afr. J. Anat., 1(2): 64.
- Lusted, L.B. and T.E. Keat, 1978. The Lower Extremities: Atlas of Roentgenographic Measurement. Yearbook Med. Publisher, England, London, pp: 165.
- Moore, K. and A. Dalley, 1999. Clinically Oriented Anatomy. 4th Edn., Lippincott Williams and Wilkins, pp: 332-331, 506.
- Nwoha, P.V., 1992. The anterior dimensions of the pelvis in sex determination. West Afr. J. Med. Res., 24(4): 329-335.
- Oladipo, G.S., 2006. The sub-pubic angle in Adult indigenous Nigerians. Trop. J. Med. Res., 10(1): 15-18.
- Oladipo, G.S., H.A.A. Ugboma and Y.A. Suleiman, 2009. Comparative study of sub-pubic angles in adult Ijaws and Igbos. Asia J. Med. Sci., 1(2): 26-29.

Phenice, T.W., 1969. A newly developed visual method of sexing the Os pubis. *Am. J. Physiol.*, 30: 297-302.

Schultz, A., 1999. The skeletal of the trunk and limba of higher primate. *Hum. Biol.*, 2: 303-456.

Tague, R.G., 1989. Variation in pelvic size between males and females. *Am. J. Physiol. Anthropol.*, 80: 59-71.