ROLE OF SUB PUBIC ANGLE IN SEX ESTIMATION IN A NIGERIAN POPULATION

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ABSTRACT

This study is aimed at determining sex using subpubic angle, which is one of the is most critical issues raised when an unknown human skeletal remains are found. The angle is measured by drawing two lines at the pubic rami which intersect at the pubic symphysis. A goniometer is placed at the intersection of these two lines then, the angle measured. A total of 1500 Anterior posterior pelvic radiographs were measured (703 males and 797 females between ages 25-45years). Samples were collected from Radiology Department of the University of Port Harcourt Teaching Hospital (UPTH), Braithwaite Memorial Hospital (BMH) Port Harcourt, Federal Medical Center (FMC) Yenagoa, Niger Delta University Teaching Hospital (NDUTH) Okolobiri Bayelsa State, University of Nigeria Teaching Hospital (UNTH) Ituku-Ozalla, Enugu State, National Orthopedic Hospital Igbobi Lagos, University of Abuja Teaching Hospital (UATH) Gwagwalada, FCT, Nigeria.The results showed that, the mean value of the subpubic angle of Nigerian males and females are 88.09±8.03 and 133.88±12.21 ($p<0.05$). Demarking points of <97.25 is a male and assign sex accurately to 90% while >112.18 is female and could ascertain sex to about 96% of Nigerian a population. This study also revealed that, the males subpubic angle is about 74.82% acute angle and 25.18% obtuse angle while the female have 0.00% acute angle and 100.00% obtuse angle. This present study have showed that, the Nigerian females have more expanded subpubic angle than their males' counterparts ($p< 0.05$) which is a function of parturition.

KEYWORDS: Demarking Points, Parturition, Subpubic Angle.

INTRODUCTION

The pelvis is made up of the sacrum, coccyx and the two hip bones. It is a good area to differentiate between the male and female sexes. The skeleton of a female who has given birth will be identifiable by the fact that this space will have widened upon the birth of a child and although it will contract but, it will not contract fully back to its original size (Jack, 2015). For the fact that different races have different demarking points (Jit and Singh 1966), it is expedient to have a uniform or population specific data (dimensions of the pelvic parameters) for sex identification, parturition and prosthetic reason (for instance prosthetic materials produced for other populations like the Asians will not fit into Nigerians due to racial variations in body size and shape). In addition establishing population specific normative values of pelvic traits have broad applications and significance to the forensic anthropologist, anatomist, surgeon, obstetrician and archaeologist because values will expose physiological or anatomical normalcy or pathological condition. Nagesh (2007) stated that the determination of sex from the remains of human skeletal parts is important in medico-legal investigation. In the skeleton of a human, the hip bone has been found to be the most valid gender diagnosing tool.

Sex determination of unknown skeletal material is one of the most vital determinations made by forensic anthropologists. Sex determination processes vary and the accuracy to identify a person will rely on the available parameter. Different Sex determination techniques have been used on different populations using parameters of the pelvis. Discriminant Function Analysis by (Afrianty *et al.,* 2013; Steyn and Iscan, 2008; Macaluso, 2010; Osunwoke *et al.,* 2013). Demarking Points (Jit and Singh, 1966). Osteometric method by (Doshi *et al.,* 2011; Hideo, 2006). Kelly's Rule of Thumb by (Kelly, 1979; Mukhopadhyay, 2012; Maclaughlin and Bruce, 1986). The aspect of anthropology that is concerned with the application of anthropological ideas, skills and its proceedings to legal practice is forensic anthropology. Forensic anthropologists' use standard scientific skills developed in physical anthropology to identify remains of human

and use them to assist in medico-legal issues (Kristina, 2009). Sometimes during the course of a criminal investigation and its subsequent autopsy the pathologist may find his or herself faced with the task of identifying the sex of a skeleton after decomposition (Jack, 2015). Obviously before decomposition there are detailed differences between the forms of a male or a female but once decomposition has taken a hold and carried out the unpleasant tasks that nature has intended, all that remains is the skeletal form with teeth and possibly some hair to work with. Of course having teeth and hair does not always constitute enough material to make identification so the pathologist with perhaps the help of a forensic anthropologist will try to first of all work out what sex the skeleton was in life.

The accuracy of the subpubic angle in other to differentiate sex in life Anatolian Caucasians. 3-D computed tomography of the pelvis was done on 66 males and 43 females and the subpubic angle was seen and measured electronically. Demarking points were calculated and also t- test was used to detect gender difference.They drew the endpoint by saying that the subpubic angle is a trusted parameter for gender establishment (Hakki *et al.* 2013). Female possess significantly greater sub-pubic angle [p< 0.05], this could be as result of parturition function (Oladipo *et al.*, 2010). The subpubic angle of the females of both tribes could be obtuse and in their males it ranges between obtuse and acute (Oladipo *et al.*, 2010). Findings have made visible the existence of gender and ethnic differences among the two tribes. The outcome showed that the females possess significantly greater width of subpubic angle than males (p< 0.05).This is as a result of parturition factor. The Ikwerre and the Kalabari females had a obtuse angle and males are between acute and obtuse(Oladipo *et al.*, 2010). Differentiating sex using radiographs the sacrum and the subpuic angle have insurmountably shown to be vital items for gender classification and separation Ubi *et al*. (2014). There is a unique relationship between sub-pubic angle and various femoral head diameters and the gender variation of the subpubic angle (Anyanwu *et al.,* 2014). The demarking points of sb pubic angle identified 29% males and 32% females Osunwoke *et al*. (2013). A cross-sectional study on how to measure the subpubic angle in developing human fetuses of different gestational age, whether it is sex dependent and to compare the results with that in the adults. Subpubic angle was more in females during the first half and in the terminal part of gestation (Haque *et al.,* 2016). The subpubic angle remained acute throughout the intrauterine life, with significant widening in fetuses more than 30 weeks of gestation. Marked sexual dimorphism was noticed only in fetuses of 14–18 weeks and 19–22 weeks of gestation fetuses, although the values were invariably less than 90° (acute) in both the sexes but in females towards the higher side as in adults (Haque *et al.,*2016). Assessment of symphysis and subpubic arch during antenatal ultrasonography of pregnant women can be done to diagnose congenital

widening of the symphysis or absence of symphysis altogether(Haque *et al.,*2016). The range of the subpubic angle in males was found to be between (128^0 to 82^0) and the mean is 106^0. In females the range was found to be between (170^0 to 104^0) and the mean is 140^0 with significant statistical difference [p<0.05] (Abobaker and Kamal, 2014). These results are comparable to that obtained from other regional studies held in Africa with some minor differences that may reflect ethnic variation(Abobaker and Kamal, 2014). Sub pubic Angle and bilateral sided Greater Sciatic Notch Area of the females were statistically wider than males (p< 0.0001). That there were significant differences in SA, right GSNA, and left GSNA between males and females(Abiko *et al.,*2014). The demarking points of this parameter identified 29% males and 32% females Osunwoke *et al*. (2013).

MATERIALS AND METHOD
Materials used for this study include Goniometer, meter rule, pencil, pelvic radiographs and X-ray viewing box.

This is the angle formed by the anastomosis of ischial and pubic rami of the hip bone. It is measured by drawing two lines at the pubic rami which intersect at the pubic symphysis. A goniometer is placed at the intersection of these two lines then, the angle is measured.

Fig.1: Measurement of subpubic angle (degree).

RESEARCH DESIGN
This is a prospective cross-sectional study of pelvic parameter from patients investigated in Radiology Department of seven (7) University Teaching Hospitals in Nigeria.

POPULATION FOR THE STUDY
A total of 1500 Anterior posterior pelvic radiographs were measured (703 males and 797 females between ages 25-45years); which were distinguished as either masculine or feminine gender on the radiographs and

reinforced by gender details which was in the patient information card.

Radiographs were viewed with the help of an x-ray viewing box on which radiographs was placed before any measurement.

Inclusion Criteria
1. Only radiographic films that showed the complete pelvis were used
2. Radiographic films used were free from disease conditions and break in the continuity of the pelvis and sacrum.
3. Only radiographs showing completely ossified pelvic were used.

Exclusion Criteria
Fractured, not completely ossified pelvic radiographs were excluded.

SAMPLE AND SAMPLING TECHNIQUE
Convenient sampling technique was used.
Minimum sample size was calculated using (Moazzam, 2014 formula).

$$n=Z^2(P\,q)/d^2$$

Where,
n= minimum sample size
Z= the standard normal deviate (Standard Error) at 95% confidence level =1.96
p= proportion of the target population (estimated percentage of the population), if no estimate set as 0.5
q= 1-p

d or e= absolute precision or accuracy(acceptable sample error); set as 0.05
n=384

NATURE AND SOURCE OF DATA [STUDY AREA]
Samples were collected from Radiology Department of the University of Port Harcourt Teaching Hospital (UPTH), Braithwaite Memorial Hospital (BMH) Port Harcourt, Federal Medical Center (FMC) Yenagoa, Niger Delta University Teaching Hospital (NDUTH) Okolobiri Bayelsa State, University of Nigeria Teaching Hospital (UNTH) Ituku-Ozalla, Enugu State, National Orthopedic Hospital Igbobi Lagos, University of Abuja Teaching Hospital (UATH) Gwagwalada, FCT, Nigeria.

PRESENTATION OF DATA
The presented results are based on the methods with which data was collected and analyzed. The mean, standard deviation (S.D), and standard error (S.E) were presented for this pelvic parameter of Nigerians. Z-test was used to compare mean values between the males and the females at 95% confidence interval. Charts and figures were used to illustrate and expatiate the variations where applicable.
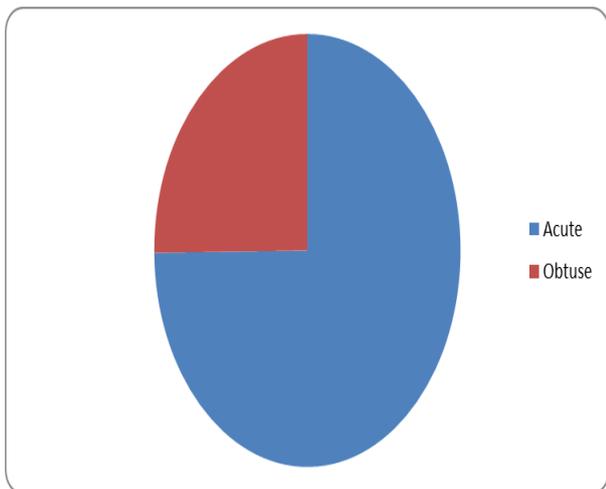
RESULTS
Table 1: Mean Values of Nigerians Subpubic Angle.

S/N	PARAMETER	Males	Females
1.	Subpubic Angle	88.09± 0.30	133.88± 0.43

Table 2: Statistical Test for Significance between Nigerian Males and Females.

S/N	PARAMETER	Calculated "Z"	Inference
	Subpubic Angle	84.62	P<0.05*

Table 3: Demarking Points and Percentages of Nigerians Pelvic Parameters Using (Jit and Singh, 1966 Formula).

S/N	PARAMETER	Sex	Mean± SD	Mean± 3SD	D.P	%
	Subpubic Angle	M	88.09±8.03	64.00 112.18	<97.25	90.00%
		F	133.88±12.21	97.25 170.51	>112.18	96.00%

Table 4: Comparison of Mean Values of Subpubic Angle of Present and Previous Studies.

Parameter	Sex	Present study Nigerians	Ubi *et al*. (2014)	Hakki *et al.* (2013) Caucasians	Haque *et al*. (2016)	Abobaker and Kamal. (2014) Sudanese
Subpubic	M	88.09±8.03	94.20± 7.40	65.90±7.20	<90	106 °
		Acute angle			Acute angle	
Angle (^{0})	F	133.88±12.21	117.10± 11.30	82.60±7.70	>90	140 °
		Obtuse angle			Obtuse angle	

All values=Mean± SD
Key: SD= Standard Deviation, M= Male, F= Female, <= Less than, >= Greater than, (^{0}) = Degree

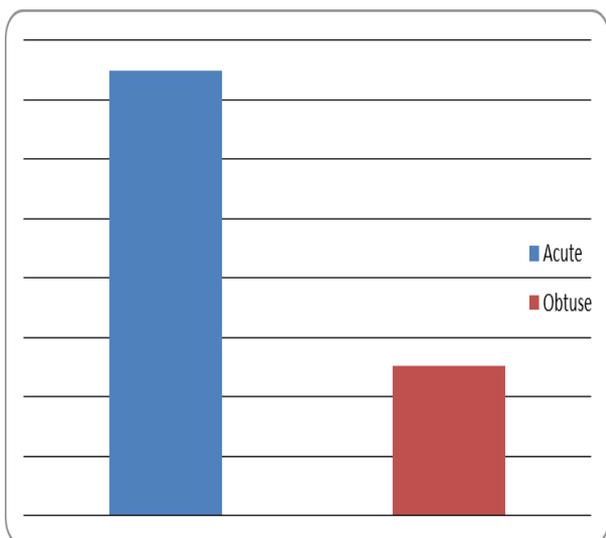**Figure 2: Pie Chart showing Percentages of Nigerian Males Subpubic Angle (^{0}).**

Figure 3: Bar Chart showing Percentages of Nigerian Males Subpubic Angle (^{0}).
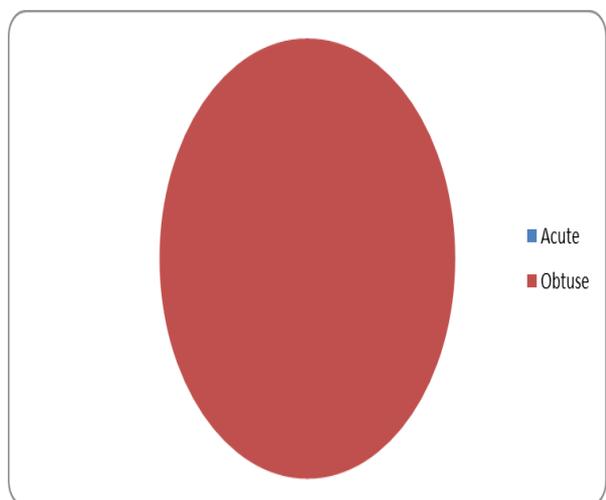

Figure 4: Pie Chart Showing Percentages of Nigerian Females Subpubic Angle (^{0}).
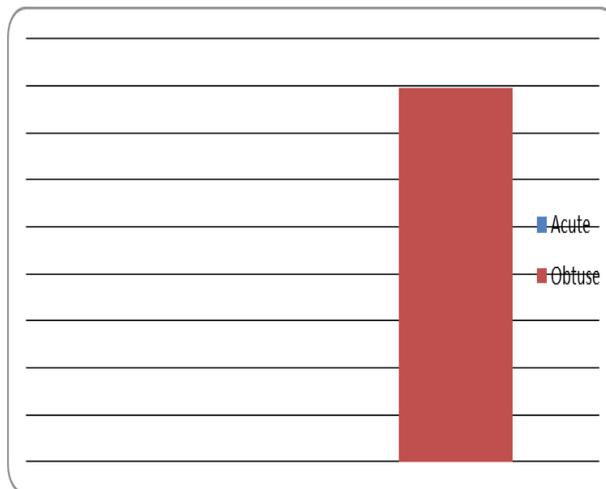
Blue = Acute
Brown = Obtuse

Figure 5: Bar Chart Showing Percentages of Nigerian Females Subpubic Angle (^{0}).

DATA ANALYSIS
The collected data from various University Teaching Hospitals of Nigeria was analyzed statistically (for Descriptive statistics) using SPSS software version 20.0 for windows. Z -Test was used and ($p < 0.05$) was considered significant. The angle was measured in degree.

Results in table 1, showed the mean value of the subpubic angle of Nigerian males which is 88.09 ± 8.03, while that of the females are 133.88 ± 12.21. The difference in their mean values of the subpubic angle was significant statistically ($p < 0.05$) which is presented in the table 2.

DISCUSSION OF FINDINGS
Physical difference seen between males and females within species as regards to stature is termed sexual dimorphism. These variations in body size and shape especially in the pelvic region occur after puberty which is influenced by both growth and sex hormones (testosterone, estrogen, progesterone, follicle stimulating hormone, luteinizing hormone, human chorionic gonadotropin, somatotropin) and continue throughout life. The distinction between sexes is a characteristic feature of the skeleton which is only possible in adulthood.

This present study have showed that, the Nigerian females have more expanded subpubic angle than their males' counterparts ($p < 0.05$) as seen in (table 1). It is intensively nice to say that the subpubic angle is a pivotal tool for sex determination with demarking points of <97.25 males and assign sex accurately to 90% while >112.18 is females and could ascertain sex to about 96% as shown in (table 3) of Nigerian a population. This study also revealed that, the males subpubic angle is about 74.82% acute angle and 25.18% obtuse angle while the female have 0.00% acute angle and 100.00% obtuse angle (figures 2-5). This result corroborates the findings of Haque *et al*., 2016; Abiko *et al.*, 2014. From

the above results it is obvious that the Nigerian females possess well expanded subpubic angles which by every indication is a good signal for parturition actions. Consequently, subpubic angle is a good trait for human identificaton and seperation for medico-legal settings.

CONCLUSION

Numerous studies have been done to ostensibly determine sex using the hip bone because it not just gives the routine variations in sexes, but in addition it reveals adaptive features of the female's pelvic bones to parturition functions. Detailed examination and evaluation of this linear pelvic parameter have shown that the pelvis is a good sex indicator specifically the subpubic angle for medico-legal issues in a Nigerian population.

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