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Platymeric and Robusticity Index of the Femur in Nigerian Population.

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ABSTRACT

Background: Anatomical awareness of different femoral dimensions is important in anthropological and medico-legal practice for sex/racial determination and as well as to radiologist, rheumatologist and orthopedic surgeons for diagnosis and planning of treatment. Morphology and statistical analysis of femoral anthropometry has shown significant amount of variation and as such having reference data peculiar to a given population is key. Platymetry is the level of flattening of the superior diaphysis of a long bone while robusticity is the relative slenderness of a bone. The study sought to determine the platymeric and robusticity index of the right and left femur in Nigerian population
The study involved 148 femur bones (78 right and 70 left) obtained from Anatomy departments of various Universities in Nigeria. Digital sliding caliper and measuring tape were used to take measurements. The following measurements were conducted Platymetric index, Robusticity index. Data were analyzed using SPSS version 20. Data were expressed as mean ± standard deviation. T-test was used to compare mean values and a probability level of $p<0.05$ was considered significant. Measurements were taken in centimeters
Mean platymeric index of right and left femur was 89.21±8.61 and88.61±9.04 respectively. Mean robusticity index of right and left femur was 12.08±0.62 and 11.77±0.74 respectively. Statistical analysis showed no significant difference between the right and left femur for the playtemeric index and the robusticity index ($p>0.05$)
This study provides reference data of the playtimeric index and robusticity index of the femur for the Nigerian population which could be useful in forensics, prosthetics and in orthopaedical surgical procedures.

Keywords: Femur, Platymeric index, Robusticity index, Nigeria

INTRODUCTION

Anatomical awareness of different femoral dimensions is important in anthropological and medico- legal practice for sex/racial determination and as well as to radiologist, rheumatologist and orthopedic surgeons for diagnosis and planning of treatment [1]. The femur is the strongest and largest bone of the skeleton[2]. Femoral anthropometry has shown significant amount of variation as conditions such as climate, diet, heredity and other geographical factors related to lifestyle of a population are likely to affect it[3]. It is therefore important to have reference data peculiar to a given population[4]. Sex is seen as one of the simplest and most reliable determinations from skeletal remains if essential parts of the skeleton or bones are available in good condition [5]. However subsequent to drastic events such as mass disasters like plane crash, war situations, forest fires, earthquakes, tsunami and other natural disaster, proper and positive identification of victims becomes extremely important and perhaps sex becomes the most difficult task to encounter [6]. Due to the strength and density of the femur it is frequently recovered in forensic and archeological settings and therefore provides a good lead in the process of identification [7]. The morphology of the proximal femur is essential in the design and development of prosthetic implant for Total hipreplacement and as such inappropriate implant design and size could affect outcome of surgery with reported complications such as loosening, micro motion and stress shielding [8 9]. Most prosthetic implants used in Nigeria are imported from Europe and America with implant design presumably based on the morphology of their respective populations and the use of such implants in regions like Nigeria may not be appropriate as the design may not take into consideration the morphology of the local population [10]. Two major issues are associated withprosthesis designed based on other populations. Firstly, the difference in proximal femur anthropometry between ethnics due to difference in lifestyle, physical applied force and their distribution as seen from data published in various studies for other population. Secondly, is implant-morphology mismatch which can cause difficulties during implant placement and could lead to a fast deterioration of the life span of the implant thus affecting short- term and long -term outcome of the surgery [11 12 13 14 15 16].Platymetric index is coined from the word platymetry, which is the level of flattening of the superior diaphysis of any long bone. It is expressed as the division of the upper sagittal diameter by the upper transverse diameter

of the superior diaphysis multiplied by a hundred. Robusticity is the relative slenderness of a bone[17], particularly long bones. A measure of the robusticity of long bones is expressed numerically as the ratio of width divided by length. For convenience, this ratio may also be expressed as a percentage. The point at which the width is measured may be at the midpoint of the bone's shaft. Previous studies on the platymeric and robustcity index were carried out on South and Central India as well as West Bengal population [8 3 2]. There is the need to have reference data for the Nigerian population therefore the study sought to determine the platymeric and robusticity index of the right and left femur in Nigerian population.

MATERIALS AND METHOD

The study utilized 148 femur bones (78 right and 70 left) obtained from Anatomy departments of various Universities in Nigeria. The selected bones were normal without any form of pathology. Digital sliding caliper and measuring tape were used to take measurements according to standard anthropological methods [18 19]. The following measurements were conducted Platymetric index, Robusticity index.
The following formulas were used:

$$\text{Platymetric Index} = \frac{\text{Upper sagittal diameter}}{\text{Upper transverse diameter}} \times 100$$

$$\text{Robusticity Index} = \frac{\text{Sagittal diameter of midshaft} + \text{Transverse diameter of mid shaft}}{\text{Physiological length}} \times 100$$

Upper Transverse diameter of shaft/ Subtrochanteric Sagittal Diameter: It measures the transverse diameter of the upper end of the shaft, where it shows maximum lateral projection. When the projection is not clear, this measurement is taken 2.5cm below the base of lesser trochanter.

Upper Sagittal Diameter of Shaft: It measures the antero-posterior diameter of the upper shaft taken at right angle to the upper transverse diameter of shaft.

Sagittal Diameter of Middle of Shaft: It measures the distance from the anterior surface to posterior surfaces of the bone, just about the center of the Shaft i.e., the most prominent part of the lineaaspera or two points farthest apart in sagittal plane at mid-shaft.

Transverse Diameter of Middle of Shaft*:* It measures the distance between the margins of the bone at right angle to sagittal diameter of the middle of the shaft or two points farthest apart in coronal plane at mid-shaft

Physiological Length / Oblique Length: It measure the projective distance between the highest point of the head and the tangent to the lower surface of the two condyles.

Figure1: Measurement of Transverse Diameter of Upper Shaft

Figure2: Measurement of Sagittal Diameter of Upper Shaft

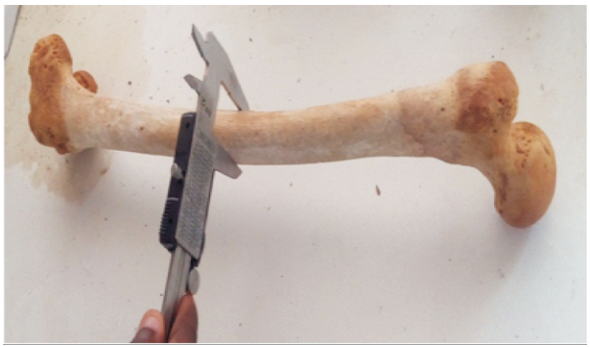

Figure 3: Measurement of Mid-shaft Sagittal Diameter

Figure 4: Measurement of Mid-shaft Transverse Diameter with the Aid of a Sliding Caliper

Figure 5: Measurement of the Physiological Length of Femur Bone with the Aid of a Measuring Tape

Data were analyzed using SPSS version 20. Data were expressed as mean ± standard deviation. T-test was used to compare mean values and a probability level of $p<0.05$ was considered significant. Measurements were taken in centimeters.

RESULTS

The result obtained from the study is presented in table 1.

Table 3: Showing the Mean, Standard Deviation and the P-Value for the Platymetric and Robusticity Index of the right and left femur bones

Parameters	N	Right (78)	Left (70)	P-value	Inference
Platymeric index	148	89.21±8.61	88.61±9.04	(P>0.05)	Not significant
Robutiscity index	148	12.08±0.62	11.77±0.74	(P>0.05)	Not significant

The results of present study showsthe mean Platymetric index of theright femur was 89.21±8.61 and that of the left femur was 88.61±9.04. The mean Robusticity index of the right femur was 12.08±0.62 and the mean robusticity index of the left femur was 11.77±0.7.Statistical analysis showed no significant difference between the right and left femur for the playtemeric index and robusticity index (p>0.05)

Table 2: Comparism of Platyeric Index and Robusticity Index of the Femur bone in present study (Nigerian Population) with that of other Populations

Authors	Population	PARAMETER Platymeric Index		P-Value	Robusticity Index		P-Value
Bokariya P. *et al.*, (2009)	Central India	R	86.89±8.77	P >0.05	R	13.11±0.93	P >0.05
		L	87.63±7.84		L	14.44±1.23	
Khan and Hussai, (2014)	South India	R	85.70±6.35	P >0.05	R	14.34±1.21	P>0.05
		L	86.32±6.15		L	15.26±1.17	
Datta M, *et al.,* (2004)	West Bengal	R	93.94±14.94	P >0.05	R	12.36±0.99	P >0.05
		L	89.76±9.57		L	12.50±0.80	
This study	Nigeria	R	89.21±8.61		R	12.08±0.62	p>0.05
		L	88.61±9.84	P >0.05	L	11.77±0.74	

Comparing values from this study with those of shows that Nigerian population haslower robuscity Index in both the right and left femur than Central India, South India as well as West Bengal population. The platymeric index of Nigerian population is higher in both the right and left femur than that of Central and South India population but lower in both the right and left femur than the West Bengal population.

Table 3: Showing the Different Levels of Platymetry

S.NO.	Flattening of Superior Femoral Diaphysis	PI Range(Min-Max)
1.	Hyperplatymetry	Less than 75.0
2.	Platymetry (moderate)	75.0-84.9
3.	Eurymetry (flattened)	85.0-99.9
4.	Stenometry (rounded)	100.0 and more

Discussion

In this study themean platymeric index of right and left femur was 89.21±8.61 and88.61±9.04. athough it showed a slight difference between the right and left femur but this was statistically not significant (p >0.05). This agreed with the studies of BokariyaP. *et al*.,[3] Khan and Hussain[8]as well as that of ofDatta M. *et al*[2]which did not report any significant difference in the platymeric index of the right and left femur for Central India, South India and West Bengal population respectively. In this present study 148 femora are categorized into the following groups: 6 femur bones (4left, 2right) were Hyperplatymeric, 46 femur bones (23left, 23right) were Platymeric, 70 femur bones (31left, 39 right) were Eurymeric and 26 femur bones (12left, 14 right) were Stenomeric. It was observed that about 47 percent femora belong to the "Eurymeric" group. Robusticity is the relative slenderness of a bone [15], specifically long bones. In this study, the mean Robusticity index of the right femur was 12.08±0.62 and that of the left femur was 11.77±0.74.Althoughslightly different, but not statistically significant (P ˂ 0.05). This also is in consonance with the studies of Bokariya P. *et al*., [3] Khan and Hussain[8] as well as that of ofDatta M. *et al*[2] which did not report any significant difference in the robusticity index of the right and left femur in Central India, South India and West Bengal population respectively. Slight bilateral variations in femoral anthropometry may be results of compounding factors such as nature of work, mode of life, metabolic status, continuous modification that may affect the characteristics of man and the effect of civilization on the composition of the human body in both positive and negative ways [3].The differences expressed in mean platymeric and robusticity index between populations may possibly be a result of factors affecting bone morphology such as genetics, nutrition, environment, and physical activity. This fact is useful inanthropological and medico- legal practice for sex/racial determination. Again, in using implants which have been designed for other races like the Asians, the chance of implant mismatch is at a high percentage.This in turn may lead to increase in the rate of aseptic loosening, greater implant subsidence, and increased incidence of anterior thigh pain, more number of intraoperative complications and shorter lifespan of the implant [20]. Implants that are designed by taking into consideration anthropometric data of a given population will help in designing patient specific implants thereby minimizing the complications. Numerous studies have also shown that there is increase in the rate of intraoperative complication in the event of using mismatched implants especially over size implants [16]. From this study, it is evident that regional variations in the playtimeric and robusticity index of the femur do exist. The present study provides a database for the playtimeric and robusticityindexof the femur which could come in handy in designing prosthetic implants specifically for the Nigerian population.

CONCLUSION

This study provides a database for the playtimeric and robusticity indexof the femur for the Nigerian population. Mean values recorded for both parameters showed no significant bilateral difference (p>0.05). Values showed variations when compared with those of other populations reported. Knowledge from this study will be useful in forensics, prosthetics and in orthopaedical surgical procedures and bone grafting.

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