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Crural Index and its Possible use in Identification

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ABSTRACT

Allen's rule predicts that limbs are more elongated under warmer climates and shortened under colder ones. Crural index is assumed to vary from population to population and race to race due to climatic changes. This study seeks to establish crural index in the Urhobo people of Nigerians and see its possible use in identification. This cross sectional study comprised of 400 volunteer Urhobo subject 200 males and 200 females. The mean tibia length/ mean femur length multiplied by 100 gave crural index, which was 84.99% in males and 85.24% in females. These values are not different from other studies in African as well as in black Americans. This study therefore partially agrees with Allens rule. In conclusion, crural indices overlap among all race types. It should therefore not be used in identification although it has great application sport science.

KEYWORDS: Identification, Crural index, Climate, limbs, Urhobo

INTRODUCTION

Forensic anthropologists take interest in identifying individuals who may have been victims of war, accident and mass disaster from isolated body parts and body dimensions.

Human body dimensions are believed to vary from race to race and population to population. This has been frequently explained by Ecogeographical clines. Climatic adaptation in particular is often believed to be the primary cause of these variations.^{1,2,3,4}

Several authors claimed the most significant factors influencing patterns of human skeletal morphology is climate which is primarily due to thermoregulatory advantages associated with different physical characteristics.^{5,6,7,8,9} In a study done in Egypt, brachial and crural indices were calculated to examine intralimb proportions. Their study highlights the complex relationship between ecogeographic patterning and adaptation¹⁰

Clinal variations within broadly distributed mammalian species demonstrates individuals in cold climates tend to have higher body mass and shorter limbs than populations in hot climates.¹¹ Human populations from cold climates tend to have greater body mass and body breadth as reflected by bi-iliac breadths and lower brachial and crural indices, representing the relationship between lengths of the forelimb segments (radius and tibia) relative to upper limb segment lengths (humerus and femur).^{5,6}

Allen's rule predicts that limbs are more elongated under warmer climates and shortened under colder ones because longer limbs increase the surface area exposed to the environment relative to the volume of the organism.¹¹ This rule has also been confirmed for humans^{6,12} even though the effect is currently modified by nutrition and other environmental factors.^{13,14}

Some other studies supports Allen's rule by stating lower limb bones are on average longer in African populations than in European populations, both in adults and even in foetuses.^{8,9,15} Inter population differences in limb length have also been established.^{16,17} There is a sharp contrast in crural indices of those people living at Neanderland compared to those at the equator.

This study therefore seeks to establish crural index in Nigerians since the index is assumed to vary from population to population and race to race and see its possible use in identification. This study also seeks to compare derived result with existing data from other parts of the world.

Crural index is the ratio of the lower leg (tibia) divided by the length of the upper leg (femur) multiplied by 100. Crural index is also = leg length / thigh length. The crural index is the ratio of tibia length to the femur length. The leg is the section of the lower limb extending from the knee to the ankle, it is mostly involved in walking, jumping, running and kicking with two bones tibia and fibular. While the thigh extends from the hip to the knee with one bone, the femur.¹⁸

From previous studies it is observed that a larger crural index provides an athlete the advantage in jumping and running. Some advantages have also been associated with those sprint swimmers that have higher Crural Index.¹⁹ Bramble and Lieberman (2004) stated that greater leg length reduces energy expenditure as a result of lower cadence and a higher stride length. Hence individuals with longer trunk length will be able to produce more force needed in high jump.²⁰

MATERIALS AND METHODS

This cross sectional study comprised of four hundred volunteered Urhobo subjects (200 males and 200

females) from Southern Nigeria between the ages of 17-35years after due ethical considerations and approval. The measurements were taken on individual with no skeletal deformities or trauma to the lower limb. All measurements were taken at same time of the day to avoid diurnal variations. The thigh and tibia length were measured as follows.

- Femur length: the distance between the proximal end of the greater trochanter and the distal lateral femoral condyle.²¹
- Tibia length: measured from just below the knee cap to the ankle
- Crural index: this is obtained by dividing the tibia length by the femur length and multiplying it by 100.

All measurements were taken twice and the average reading subjected to statistical analysis.

RESULTS

Table 1: Average femur and tibia lengths in male Urhobos

	Average	SD
	lengths	
Average Femur	50.32cm	± 3.68
Length		
Average Tibia	42.77cm	± 4.26
length		
Crural index	84.99%	

Table 1 reveals average femur and tibia length in male Urhobos and the calculated crural index.

-	-	
	Average	SD
	lengths	
Average Femur	47.30cm	± 3.67
Length		
Average Tibia	40.32cm	± 3.04
length		
Crural index	85.24%	

Table 2: Average femur and tibia lengths in Female Urhobos

Table 2 reveals average femur and tibia length in female Urhobos and the calculated crural index.

TABLE 3: Crural index value	es around the world		
GROUP .		CRURAL	INDEX
Lapp			79%
Eskimo .			81.5%
Belgium			82.5%
American	White		82.6%
S.African	White		83.2%
Bushman			83.4%
Yugoslav			83.75%
NewMexico	Indian		84.6%
Melanesian			84.8%
Egyptian			84.9%
Pygmy			85.1%
American	Black		85.25%
Arizona	Indian		85.5%
S. African Blacks			86.4%
Marks forum biodiversity.com	2009-2012		

DISCUSSION

The crural index for male (84.99%) and female (85.24%) Urhobos compares well with other black populations previously studied. American Black (85.25%), Arizona Indian (85.5%), Egyptian (84.9%), S. African Black 86.4%.²² Comparism could not be made with other studies done in other parts of Nigeria as limited literature was available on this subject.

Raxter gave a range for Caucasoid (Europeans) -R: 80.0 - 85.9 Negroid ("West African") - R: 83.3 - 88.3.²³ Our study falls within the range for West African according to Raxter.

Crural index in blacks is quite higher than American whites and Europeans, this is in agreement with Allens rule that individuals in cold climates tend to have higher body mass and shorter limbs than populations in hot climates. Comparism of present study with black Americans reveals blacks generally have same crural index irrespective of geographical location as shown in table 3 and this contradicts Allens Rule. We can therefore say differences observed in limbs proportion is affected mainly by genetics and not climate as such it application in Identification of race is not possible.

Crucal index has great application in sport science. It plays a vital role in sport training, talent discoveries, *talent selection* and *talent development*. Crural index is applicable to sprinters, swimmer, long jumper and soccer players. Speed plays a crucial role in the majority of competitive sports such as running, cycling and soccer. Many factors affect the athletes, factors such as height, leg length, weight, brachial index, crural index etc. A high crural index is advantageous to sports like long-jump since it enables the jumper to apply a force against the ground for a longer time than someone with a low crural index.²⁴ According to Ackland (2006) higher crural index is advantageous to sprint swimmers.²⁵A sport scientist tries to achieve the best result from his client, by making use of brachial index, crural index and relative sitting height test.

CONCLUSION

In conclusion, crural indices overlap too much among all race types. It should therefore not be used in identification, although it has great application in sport science for talent identification, selection and training.

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