

The Carrying Angle of the Ibo and Yoruba Ethnic Groups of Nigeria and its Relationship with the Height of Individuals

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Abstract

The carrying angle of five hundred and four students (275 males and 229 females) of the Ibo and Yoruba ethnic group of Nigeria were measured using an improvised goniometer. The age range of the subjects was between 18 and 35 years so as to minimize changes due to aging. Carrying angle was measured from both upper limbs, right and left. Height was measured using a mechanical measuring rod.

Results showed a mean carrying angle $17.63^{\circ} \pm 0.25$ and $15.05^{\circ} \pm 0.24$ for right and left sides respectively in males and $18.67^{\circ} \pm 0.35$ and $16.64^{\circ} \pm 0.33$ for right and left sides respectively in females of Ibo ethnicity. The mean carrying angle for the Yoruba ethnic group is $15.35^{\circ} \pm 0.35$ and $13.25^{\circ} \pm 0.35$ for right and left sides respectively for the males and $17.57^{\circ} \pm 0.39$ and $15.55^{\circ} \pm 0.37$ for right and left sides respectively for the females. There were significant differences between the different sides of the upper limb, between the two ethnic groups and also between the two sexes at $P < 0.05$. The Ibo ethnic group had higher carrying angles than the Yoruba ethnic group. The carrying angle of the right upper limb was significantly higher than the left upper limb at $p < 0.05$ and the females had significantly higher carrying angles at $P < 0.05$ than their male counterparts. The mean height for the Ibo males and females is $1.71\text{m} \pm 0.01$ and $1.62\text{m} \pm 0.01$ respectively and for the Yoruba males and females, $1.69\text{m} \pm 0.01$ and $1.59\text{m} \pm 0.01$ respectively. There was no particular relation between the height of an individual and the carrying angle.

Keywords: Carrying angle, height, gender, ethnic group.

1. Introduction

The carrying angle of the elbow is the clinical measurement of varus –valgus angulation of the forearm with the elbow fully extended and the forearm fully supinated. It is the acute angle made by the median axis of the upper arm with that of the fully extended and supinated forearm and is therefore a measure of the lateral obliquity of the forearm (Rai *et al.*, 1980). Knowledge of the carrying angle helps in the management of pediatric elbow injuries (Balasubramanian *et al.*, 2006), for correction of albitus varus deformity occurring after malunited supracondylar fractures of the humerus (Ruparella *et al.*, 2010) and for elbow disorders that require reconstruction (Beighton and Horan, 1970) or arthroplasties (An *et al.*, 1984). It can also be important anthropologically for differentiation of sex in fragmentary skeletal remains (Punia *et al.*, 1994).

Potter (1895) was the first to carry out a quantitative investigation on the obliquity between the upper arm and the fully extended and supinated forearm in man. He reported carrying angles of 6.83° and 12.65° for males and females respectively. Subsequently, other researchers (Mall, 1905 and Tukenmez *et al.*, 2004) have all shown the mean female carrying angle to be significantly greater than that of the male.

Till date, the role of carrying angle in sex determination and its cause of formation is a long debated issue in Anatomy and Anthropology. While some workers consider the gender difference in carrying angle as a secondary sex characteristic (Potter, 1895; Atkinson and Elftman, 1945; Keats *et al.*, 1966, Baugman *et al.*, 1974) others have reported no significant difference in carrying angle of males and female (Steel and Tomlinson, 1958; Smith, 1960 and Beals, 1976). It is speculated that this conflicting data produced is due to the variations in the populations studied (Khare *et al.*, 1999).

According to Khare *et al.*, 1999, the medial part of the trochlear notch moves more away from the humeral articular surface than the lateral part so that the medial flange of trochlea is not compressed and grows more than the lateral flange. When the forearm is pronated the proximal part of ulna angulates so the carrying angle is said to develop in response to pronation (Khare *et al.*, 1999). Some workers have reported greater carrying angle for the dominant upper limb (Takenmez *et al.*, 2004) and established a relationship with the height of an individual and the inter-trochanteric distance (Paraskevas *et al.*, 2004). While some other workers refute these facts (Balasubramanian *et al.*, 2006; Zampagni *et al.* 2008). Khare *et al.*, 1999 argued that the carrying angle is not related to the width of the pelvis and is not a secondary sex character as previously believed.

This present will aim at documenting sex specific data of the two ethnic groups under study, the possibility of using the carrying angle to separate individual into the different ethnic groups and also to establish any possible relationship with individual height.

2. Subjects and Methods

The study was carried out with five hundred and four subjects, two hundred and ninety-nine of the Ibo ethnic group and two hundred and five of the Yoruba ethnic group. The age range of the subjects was from 18-35 years. Both males and females were used in this study. Out of the two hundred and ninety-nine subjects of the Ibo ethnic group, one hundred and seventy were males while one hundred and twenty-nine were females. For the Yoruba ethnic group, one hundred and five subjects were males while hundred were females. The study was cited in two tertiary institutions, Federal University of Technology, Owerri located in a core Ibo land and the University of Ibadan, Ibadan located in a core Yoruba land. Informed consent was obtained from the ethical committee of the universities before commencement of the study. Demographical data was obtained from each subject including age, parental and grand parental heritage, environment where he or she was raised in the first fifteen years of life. The study was designed to include only subjects with parental and grand parental heritage of the chosen ethnic group, those that have spent the first fifteen years of their live in the chosen locality, those asymptomatic of any deformity, surgeries or fractures around the elbow joint, and right handed individuals.

An improvised goniometer was used to measure the carrying angle from both upper limbs, left and right side. Measurements were documented and subjected to statistical analysis to get the mean, and to test for significance using the students t-test between the different sides, the different sexes and ethnic group.

The standing height of all the subjects were measured in metres using a measuring rod for every subject. Different height ranges were chosen and their corresponding carrying angles matched with it to determine any possible relationship between the height and the carrying angle.

3. Results

Results are reported in the tables below

There was significant difference in the two sides of the upper limb at $P < 0.01$ with the carrying angle of the right being greater than that of the left.

Between the males of the two ethnic groups the mean carrying angle of the Ibo ethnic group is significantly greater at $P < 0.01$ while in the females the Ibo ethnic group is significantly higher at $P < 0.05$.

The mean carrying angle of the carrying angle is statistically greater in the females at $P < 0.01$ except for the right carrying angle of the Ibo ethnic group that is statistically significant at $P < 0.05$.

Tables 5a and 5b did not show any relationship between the height of individuals and the carrying angle.

4. Discussion

The carrying angle exhibits considerable individual variation (Beals *et al*; 1976). In this study, the mean carrying of the females were significantly greater than that of males. Purkait and Chandra (2004) reports that the carrying angle shows high sexual dimorphism. Yimaz *et al*; (2005), and Khare *et al*; (1999) have also recorded higher carrying angles for the females. This difference has been considered to be a secondary sex characteristic (Potter, 1895; Atkinson and Elftman, 1945; Keats *et al.*, 1966 and Baugman *et al.*, 1974). However, some workers reported no significant difference in carrying angle of males and females of any age group (steel and Tomlinson, 1958; Smith, 1960 and Khare *et al.*, 1999. Khare *et al.*, 1999 argued that the carrying angle is not a secondary sex character since it has no relationship with the width of the pelvis. They however, reported an inverse relationship of the carrying angle with the individual. Ruparella *et al.*, 2010 believes that this is responsible for the greater carrying angle in the females since they are shorter but this explanation does not account for the result got in this study. While some studies have reported relationship with the height of an individual (Khare *et al.*, 1999; Ruparella *et al.*, 2010), this present study Beals (1976) and Balasubramanian *et al.*, 2006 did not establish any relationship. Probably the more acceptable reason may be that proposed by Beals (1976) which explains the highest value in females to be due to the presence of ligamentous laxity. This may also explain the greater carrying angle recorded on the right upper limb which is the dominant limb.

Tukenmez *et al.*, 2004 and Paraskevas *et al.*, 2004 has also recorded greater carrying angle on the dominant limb.

This study has also established significant ethnic differences in the carrying angle at $P < 0.05$ for the female and $P < 0.01$ for the males.

5. Conclusion

From this study the Ibo ethnic group had greater carrying angle than their Yoruba counterpart. This difference is stranger in males at $P < 0.01$. The females had significantly greater carrying angle than males at $P < 0.05$ and this is believed to be due to laxity of the ligaments around the elbow joint. The right carrying angle was significantly higher than the left at $P < 0.01$.

No relationship was established between the carrying angle and the individual height. These are independent variables.

6. References

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Table 1: Mean carrying angle and Mean Height of the Ethnic Groups

PARAMETERS MEASURED		ETHNIC GROUP			
		IBO		YORUBA	
		Male (n=170)	Female (n=129)	Male (n=105)	Female (n=100)
MEAN CARRYING ANGLE \pm SEM (degrees)	RIGHT (in)	17.63 ⁰ \pm 0.25	18.67 ⁰ \pm 0.35	15.350 \pm 0.35	17.57 ⁰ \pm 0.39
	LEFT	15.05 ⁰ \pm 0.24	16.64 ⁰ \pm 0.33	13.25 ⁰ \pm 0.35	15.55 ⁰ \pm 0.37
MEAN HEIGHT \pm SEM (in meters)		1.71m \pm 0.01	1.62m \pm 0.01	1.69m \pm 0.01	1.59m \pm 0.01

SEM: Standard Error of Mean; n= number of subjects.

Table 2: Comparing the mean carrying angles of the left and right sides

Ethnic group	Sex	Side of the upper limb	Mean \pm SEM	SEM _D	t-ratio Table		
					calculated t-ratio	t-ratio P=0.05	t-ratio P=0.01
IBO	Male	Right	17.63 ⁰ \pm 0.25	0.35	7.37	1.96*	2.58*
		Left	15.05 ⁰ \pm 0.24				
	Female	Right	18.67 ⁰ \pm 0.35	0.48	4.25	1.96*	2.58*
		Left	16.64 ⁰ \pm 0.33				
YORUBA	Male	Right	15.35 ⁰ \pm 0.35	0.50	4.23	1.96*	2.58*
		Left	13.25 ⁰ \pm 0.35				
	Female	Right	17.57 ⁰ \pm 0.39	0.53	3.80	1.96*	2.58*
		Left	15.55 ⁰ \pm 0.37				

* Significant: SEM_D: Standard Error of Mean Deviation

Table 3: Comparing the mean carrying angles of the different ethnic group

Side of upper limb	Sex	Ethnic group	Mean \pm SEM	SEM _D	t-ratio		
					calculated t-ratio	Table t-ratio	P=0.01
RIGHT	Male	Ibo	17.63 ⁰ \pm 0.25	0.43	5.27	1.96*	2.58*
		Yoruba	15.35 ⁰ \pm 0.35				
	Female	Ibo	18.67 ⁰ \pm 0.35	0.52	2.11	1.96*	2.58*
		Yoruba	17.57 ⁰ \pm 0.39				
LEFT	Male	Ibo	15.05 ⁰ \pm 0.24	0.43	4.21	1.96*	2.58*
		Yoruba	13.25 ⁰ \pm 0.35				
	Female	Ibo	16.64 ⁰ \pm 0.33	0.49	2.22	1.96*	2.58*
		Yoruba	15.55 ⁰ \pm 0.37				

* Significant

Table 4: Comparing the mean carrying angles of the two sexes of the different ethnic groups

Ethnic group	Sides of upper limb	Sex	Mean \pm SEM	SEM _D	t-ratio		
					calculated t-ratio	Table t-ratio	
						P=0.05	P=0.01
Ibo	Right	male	17.63 ⁰ \pm 0.25	0.43	4.42	1.96*	2.58*
		female	18.67 ⁰ \pm 0.35				
	Left	male	15.05 ⁰ \pm 0.24	0.41	3.90	1.96*	2.58*
		female	16.64 ⁰ \pm 0.33				
Yoruba	Right	male	15.35 ⁰ \pm 0.35	0.52	4.24	1.96*	2.58*
		female	17.57 ⁰ \pm 0.39				
	Left	Male	13.25 ⁰ \pm 0.35	0.51	4.54	1.96*	2.58*
		female	15.55 ⁰ \pm 0.37				

* Significant:

Table 5a: Mean Height of Ibo males and their corresponding carrying angles.

Height range (m)	Mean height \pm SEM	Mean CA		Total number	Percentage
		Right	Left		
≤ 1.50	1.48m	22 ⁰	19 ⁰	1	0.59%
1.51-1.55	1.54m ± 0.99	16.67 ⁰ ± 37.99	13.67 ⁰ ± 64.00	3	1.77%
1.56-1.60	1.59m ± 0.02	19.00 ⁰ ± 0.81	16.30 ⁰ ± 0.71	10	5.88%
1.61-1.65	1.64m ± 0.004	17.09 ⁰ ± 0.65	13.81 ⁰ ± 0.57	32	18.82%
1.66-1.70	1.69m ± 0.004	17.27 ⁰ ± 0.48	15.46 ⁰ ± 0.46	44	25.88%
1.71 - 1.75	1.74m ± 0.004	17.92 ⁰ ± 0.47	14.65 ⁰ ± 0.49	48	28.24%
1.76 -1.80	1.79M ± 0.004	17.05 ⁰ ± 0.79	14.75 ⁰ ± 0.87	20	11.77%
>1.80	1.90M ± 0.02	16.50 ⁰ ± 0.97	14.25 ⁰ ± 0.90	12	7.06%

CA: Carrying angle

Table 5b: Mean Height of Ibo females and their corresponding carrying angles.

Height range (m)	Mean height \pm SEM	Mean carrying angle		Total number	Percentage
		Right	Left		
≤ 1.50	1.37m ± 0.06	18.00 ⁰ ± 1.48	15.63 ⁰ ± 1.23	8	6.20%
1.51-1.55	1.54m ± 0.01	20.50 ⁰ ± 0.09	17.83 ⁰ ± 1.64	12	9.30%
1.56-1.60	1.59m ± 0.01	18.30 ⁰ ± 0.74	17.06 ⁰ ± 0.73	33	25.58%
1.61-1.65	1.64m ± 0.004	18.20 ⁰ ± 0.54	15.83 ⁰ ± 0.53	40	31.01%
1.66-1.70	1.69m ± 0.01	18.60 ⁰ ± 0.98	16.20 ⁰ ± 1.02	20	15.50%
1.71 - 1.75	1.74m ± 0.02	20.22 ⁰ ± 1.86	16.56 ⁰ ± 1.91	9	6.98%
1.76 -1.80	1.78M ± 0.06	17.00 ⁰ ± 3.04	18.50 ⁰ ± 4.43	2	1.55%
>1.80	1.89M ± 0.02	20.00 ⁰ ± 0.55	17.60 ⁰ ± 0.45	5	3.88%