

## A Comparative Study of Carrying Angle Between Children And Adult in Andhra Population.

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### Abstract

**Introduction :-** The evolution of carrying angle in early humans is related to the need to bring the centre of mass of the body beneath supporting hand during suspensory locomotion as seen in the lower limbs of human in which valgus knee bring the foot nearer the center of mass of the body during simple walk phase.

**Material And Methods:** 184 healthy adult volunteers with an average age range from 17- 38 years and 60 children volunteers were participated in this study. The carrying angle measurements were performed first on the dominant extremity and then on the non-dominant extremity. The carrying angle was measured with a full-circle manual goniometer . It was positioned on the anterior surface of the arm and was aligned with the mid-axis of the humerus to the extended elbow and mid-axis of the fully supinated forearm.

**Results :** In the males, the right carrying angle was  $14.2\pm 3.01$  and the left carrying angle was  $12.4\pm 1.12^\circ$  . in the females, right carrying angle was  $19.4\pm 2.91^\circ$  and left carrying angle was  $17.5\pm 2.48^\circ$ . Right and left carrying angles of females were found to be higher than carrying angles of males. In children Results Among 60 children examined, the mean carrying angle in males right hand was  $9.083\pm 0.51$  and in females  $12.77\pm 1.13$ . In the left side the carrying angle in male children is  $8.003\pm 0.95$  and female it is  $10.27\pm 0.35$ .

**Conclusion :** This study has established data on the carrying angle in coastal Andhra Pradesh., A.P adult and child population by anthropometric method. According to the study, the carrying angle of the females ranked higher than males and that of the dominant arm was found to be significantly higher than the non-dominant arm in both sexes. Greater carrying angle in female is considered as secondary sex characteristic. Carrying angle is increasing with age from childhood to Adolscent age . This study will assist the orthopedic surgeons and paediatric surgeons.

**Keywords:** Carrying angle, goniometer, adult and children.

### I. Introduction

The carrying angle is defined as the acute angle made by the median axis of the arm and that of fully extended & supinate forearm and thus it measures the lateral obliquity of the forearm. The level of elbow joint is situated 2cm below the line joining the two epicondyles. It slopes downwards and medially from from its lateral extremity and this obliquity produces the carrying angle<sup>(1)</sup> The angulation is as a result of the configuration of the articulating surfaces of the humerus and ulna which produce a normal valgus angulation of the forearm in relation to the humerus<sup>(2)</sup> . The evolution of carrying angle in early humans is related to the need to bring the centre of mass of the body beneath supporting hand during suspensory locomotion as seen in the lower limbs of human in which valgus knee bring the foot nearer the center of mass of the body during simple walk phase . Knowledge of the carrying angle can be important anthropologically for differentiation of sex in fragment ary skeletal remains<sup>(3)</sup> . It is also useful for reduction of fractures as the most common complication of supra condylar fracture or increase in carrying angle resulting in cosmetic deformity and for designing total elbow prosthesis. The angle is usually greater in females than in males and the difference has been considered to be a secondary sexual characters. The angle is usually greater in females than in males and the difference has been considered to be a secondary sexual characteristic. Langer<sup>(4)</sup> was of the opinion that the obliquity of the trochlea to the shaft of humerus is the cause. Developmental, ageing and possibly racial influences add further to the variability of this angle. The carrying angle can influence how objects are held by individuals those with a more extreme carrying angle may be more likely to pronate the forearm when holding objects in the hand to keep the elbow closer to the body.

### II. Materials And Methods

184 healthy volunteers with an average age range from 17- 38 years and 60 children volunteers were participated in this study. In total 184 adult volunteers 94 were male and remaining 90 were female. In 60 children 30 boys and 30 girls were taken. They are belongs to various areas of Andhra Pradesh., South India . children ages ranged from 8 to 15 years. The carrying angles were measured using a goniometer following the method described below .

### III. Method To Measure Carrying Angle

The subjects were asked to stand in anatomical position (stand up straight, the elbow was fully extended and the forearm fully supinated. The arms of the goniometer were kept into a straight line and the goniometer's measurement plate placed at the fulcrum of one elbow. One arm of the goniometer was aligned along the middle of the person's upper arm. The goniometer's other arm was swung/moved along until it lined up along the middle of the person's forearm. The angle was recorded from the readout on the measurement plate

### IV. Results

In the males, the right carrying angle was  $14.2 \pm 3.01$  and the left carrying angle was  $12.4 \pm 1.12^\circ$ . In the females, right carrying angle was  $19.4 \pm 2.91^\circ$  and left carrying angle was  $17.5 \pm 2.48^\circ$ . Right and left carrying angles of females were found to be higher than carrying angles of males. Results Among 60 children examined, the mean carrying angle in males right hand was  $9.083 \pm 0.51$  and in females  $12.77 \pm 1.13$ . In the left side the carrying angle in male children is  $8.003 \pm 0.95$  and female it is  $10.27 \pm 0.35$ .

### V. Carrying Angles Of Both Limbs In Adult And Children

	ADULT (R)	ADULT(L)	CHILDREN(R)	CHILDREN(L)
MALE	14.2±3.01	12.4±1.12°	9.083±0.51°	8.003±0.95
FEMALE	19.4±2.91°	17.5±2.48°	12.77±1.13°	10.27±0.35



### VI. DISCUSSION

The elbow joint is formed between the humerus in the upper arm and the Radius and Ulna in the forearm. When the arm is extended forward, the humerus and forearm are not perfectly aligned a deviation

occurs laterally towards the long axis of the arm, which is referred to as “ Carrying Angle”.<sup>(5)</sup> This angle is marginally greater in female than in male. Even Decker <sup>(6)</sup> after more than a century pointing out that the inner lip of the trochlea of humerus is a ridge [groove] which is much deeper distally than anteriorly so that the ulna [with the forearm] is deflected in full extension by this ridge. the angle is formed as a result of the trochlear groove being vertical anteriorly but on the posterior aspect it runs obliquely, distally and laterally. The groove of trochlea is limited medially by a sharp ridge that extends further distally. Laterally a lower and blunt ridge blends with articular surface of capitulum that tilt produces part of carrying angle<sup>(7)</sup> This results in the formation of ‘Carrying angle’ in extension when the posterior aspect of the oblique groove makes contact with the trochlear notch of ulna and the angle is masked during flexion when the trochlear notch lies on the vertical groove in the anterior aspect. William et al. <sup>(8)</sup> considered the medial edge of the trochlea of humerus partly responsible as it projects nearly 6 mm below the lateral edge and the obliquity of the superior articular surface of the coronoid process. The present study is conducted to measure the carrying angle in both girls and boys of similar age group. It has been documented that the carrying angle is greater in females than in males. The carrying angle of the elbow changes from infancy to adulthood in a predictable manner. Our study also revealed increase of carrying angle with age. The angle increases up to the age of 15 years. Thereafter it remains constant for the lifetime of the individual. Moore KL <sup>(9)</sup> knowledge of carrying angle is useful anthropologically for differentiation of sex in fragmentary skeletal remains. Carrying angle is of cosmetic significance. Moreover, Paraskevas G et al. <sup>(10)</sup> mentioned that according to An KN et al<sup>(10)</sup> the variability of the carrying angle is reflected in differences in design of resurfacing and semiconstrained elbow replacement implants.

The angle is greater in the dominant limb than the non-dominant limb of both sexes, suggesting that natural forces acting on the elbow modify the carrying angle. and this difference is considered as a secondary sexual characteristic. Punia RS et al. <sup>(3)</sup> conducted study on 50 males and 50 females from Northern States of India using radiographs, according to them mean carrying angle was 164.40 in males and 162.860 in females. They also reported the difference of mean between the two sexes was significantly greater than that in studies on western population using comparable technique. In the age group of 19–28 years, carrying angle was significantly greater in females. The carrying angle does not help in keeping the forearm away from the side of pelvis during walking as during walk the forearm is pronated and carrying angle disappears in pronation of forearm<sup>(12)</sup>. They found that carrying angle is inversely related to the height of a person, since the average height of females is lesser than the average height of males so average-carrying angle is greater in females than males. They came to the conclusion that the carrying angle develops in response to pronation of the forearm and is dependent on length of the forearm bones. Lesser the length of forearm bones greater is the carrying angle. So the carrying angle is more in shorter persons as compared to taller persons. Ruparelia S et al<sup>(13)</sup>, had done a study of carrying angle and its co-relation with various parameters. According to their study, height of the person was inversely related with the carrying angle. According to Mall the axis of the elbow joint is set obliquely at nearly 84° of both the humerus & ulna which is also agreed upon by Jones<sup>(14)</sup>. The carrying angle, which is found even in utero and is completely developed in a newborn is an outward angulation of the supinated forearm with the elbow extended. It exhibits considerable individual variation. The broad shoulders and narrow hips of the males, allow the arms to hang straight downwards with the long axis of the upper and lower segment approximately in the same straight line. Whereas in the females, the narrower shoulders and broader hips require a splaying out of the forearm axis in order that the hanging arms clear the hips. This observation made by Hooton (1946). A change in the carrying angle following a supracondylar fracture can result from malunion after inadequate/loss of reduction or as a result of growth disturbance at the lower end of humerus. . Potter<sup>(15)</sup> was the first to carry out an investigation on variation of carrying angle in male and female. He observed the greater carrying angle in females than in males.

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