DOI: https://doi.org/10.53350/pjmhs22166751

ORIGINAL ARTICLE

Mean Carrying Angle of Elbow in Children Less Than Ten Years of Age

ZULFIQAR ULLAH[1], AHMADZEB[2], AKHTAR HUSSAIN[3], FARMANULLAH KHAN[4], SHEHRIYAR KHAN[5], MOHAMMAD SHOAIB KHAN[6]
[1,2]Medical officer, Khyber Teaching Hospital, Peshawar
[3]Assistant professor, Mercy Teaching Hospital, Peshawar
[4,5]Medical officer, Khyber medical college, Peshawar
[6]Professor of Orthopaedics, Khyber Teaching Hospital, Peshawar
Corresponding author: Ahmadzeb, Email: dr.Ahmadzeb@yahoo.com

ABSTRACT

Introduction: The median axes of the arm and forearm form an angle known as carrying angle when fully supinated and extended. This posture is crucial while carrying objects because it enables the forearms to pass across the hips in swing motions when walking

Objective: To find out the mean carrying angle of elbow in children less than ten years of age.

Methodology: This study was Cross Sectional Study carried out at the Outpatient Department of Orthopedic Surgery, Khyber Teaching Hospital, Peshawar for duration of six months from 20 Dec, 2021 to 20 Jun, 2022. Goniometer was used for the measurement of the carrying angle. All information such as age, height, weight, length of arm, and carrying angle was documented in a pre-designed Performa.

Results: Totally, 250 children were included in this study. On the basis of gender wise distribution, 194 (77.6%) children were recorded as male children and 56 (22.4%) children were recorded as female children. The mean (SD) age, height, length of forearm, weight and carrying angle was 6 (1.05) years, 105.5 (3.75) cm, 18.2 (2.23) cm, 12 (2.84) kg and 8.5 (0.82) degree respectively. Significant association of carrying angle was observed with height, weight, forearm length and limb dominancy ($p \leq 0.05$).

Conclusion: Our study concluded that age, gender, height, weight and dominant side are important factors that affect the value of the carrying angle.

Keywords: Elbow; Carrying Angle; Correlation

INTRODUCTION

The median axes of the arm and forearm form an angle known as carrying angle when fully supinated and extended. This posture is crucial while carrying objects because it enables the forearms to pass across the hips in swing motions when walking [1]. The carrying angle of the elbow may be determined using goniometry; the mean (SD) carrying angle for females is roughly 12.78 (5.35 degrees), while for males the carrying angle is about 11.20 (4.45) degrees. From infancy to the age of 16, when they gradually rise, they stabilize [2]. It relies on factors including dominant side, age, body mass index and sex [3], with dominant side upper extremity size being larger than non-dominant side. It is abnormal if the carrying angle changes with age, sex, or the side of the upper extremity [4].

Understanding how to quantify carrying angle is crucial for managing elbow fractures, dislocations, and arthroplasties. The arms may protrude excessively from the body as a result of some elbow fractures that raise the carrying angle of the elbow. The excessive carrying angle is the term used for this. A gunstock malformation occurs when the angle is reduced such that the arm pointing out in the direction of the body. When assessing a carrying angle issue, the comparison of one elbow with another is critical since the carrying angle differs from person to person [5].

Most carrying angle alterations are reported in paediatric supracondylar humeral fractures. Stiffness of elbow is a frequent side effect of elbow injury. There may be a need for surgical intervention in as much as 12% of all posttraumatic elbows. It has lately been widely accepted that open arthrolysis of the elbow is an effective treatment for elbow stiffness. But on the basis of our experience carrying angle of few children's alter following open arthrolysis. The head of radius is a secondary barrier to the lateral instabilities brought on by cubitus valgus and varus according to earlier biomechanical research employing cadaver elbows whereas the primary constraint is medial collateral ligament (MCL). But, other factors that affect changing carrying angles have not been carefully investigated [6]. According to a study carried out by Terra BB et al., carrying angles for males and females under the age of 10 vary from 6.80-10.50 and 6.80-10.60, respectively [2].

According to a research, the mean carrying angle for males and females was 6.7 degrees and 13.6 degrees, respectively. Significant correlation was found between the carrying angle and forearm length [7]. In a different research, the average (SD) carrying angle was 9.81°(±2.82°) for males and 13.99° (±3.97°) for females [8].

The goal of the current research is to gather local information on children's carrying angles since this information is crucial for determining the cause of elbow deformities and for treating patients who have elbow fractures, stiffness, or elbow arthroplasty. No previous research is done on in this area locally. This research will be very helpful to orthopedic surgeons in correcting the cubitus varus deformity that develops after a supracondylar humerus fracture in pediatric trauma, enhancing patients' quality of life and providing better medical care.

MATERIALS AND METHODS

This study was Cross Sectional Study carried out at the Outpatient Department of Orthopedic Surgery, Khyber Teaching Hospital, Peshawar. Totally, 250 children were included in this study by using WHO calculator for determination of sample size. Sampling technique used was consecutive non probability sampling. The study duration was six months from 20 Dec, 2021 to 20 Jun, 2022.

Inclusion criteria

1 All children presented to Outpatient Department of Orthopedic Lady Reading Hospital Peshawar, with complaints other than elbow pathology between 5 and 10 years of age.
2 Both genders.
3 All children having normal elbow bony configuration confirmed on physical examination and antero posterior (AP} and lateral x-rays

Exclusion criteria

1 Elbow deformity due to congenital and acquired causes confirmed on anteroposterior (AP) and lateral x-rays showing absent or hypoplastic and flattened capitellum
2 Children with age less than 5 years and more than 10 years

Study approval was properly taken from the hospital ethical and research committee. The informed consent was taken from the parents/guardian of the children. A history in detail, such as name, age, gender, address, about elbow deformity which is not due to congenital or traumatic pathologies, followed by clinical and radiographic examination was performed. Goniometer was used for the measurement of the carrying angle. The age, height, upper limb dominancy, length of forearm was also be recorded. All this was assessed by an orthopedic surgeon. Moreover, all information

such as age, height, weight, length of arm, and carrying angle was filled in a pre-designed Performa.

The data was entered and analyzed by the statistical program SPSS version 22.0. Mean and SD was calculated for quantitative variables like age, weight, height, length of fore arm and carrying angle for male and female children. Frequency and percentages was calculated for qualitative variable like gender and upper limb dominancy. All the variables was calculated for total number of children as well as stratified for male and female gender. Post stratification student t-test was carried out for quantitative variables and chi square test for qualitative variables keeping P Value <0.05.

RESULTS

The current study was carried out on a total of 250 children. On the basis of gender wise distribution, 194 (77.6%) children were recorded as male children and 56 (22.4%) children were recorded as female children. (Figure 1) On the basis of age wise distribution, 169 (67.6%) children were recorded in 5-7 years age group while 81 (32.4%) children were recorded in 8-10 years age group. (Figure 2) Based on limb dominancy, 210 (84%) children were with right limb dominancy, while 40 (16%) children were with left limb dominancy. (Figure 3) The mean (SD) age, height, length of forearm, weight and carrying angle was 6 (1.05) years, 105.5 (3.75) cm, 18.2 (2.23) cm, 12 (2.84) kg and 8.5 (0.82) degree respectively. (Figure 4)

Stratification of carrying angle with age, gender, height, weight and limb dominancy is present at Table No 1. Significant association of carrying angle was observed with height, weight, forearm length and limb dominancy ($p \leq 0.05$) while no significant association of carrying angle was observed with gender and age ($p > 0.05$). (Table 1)

Figure 1: Gender wise distribution of the children

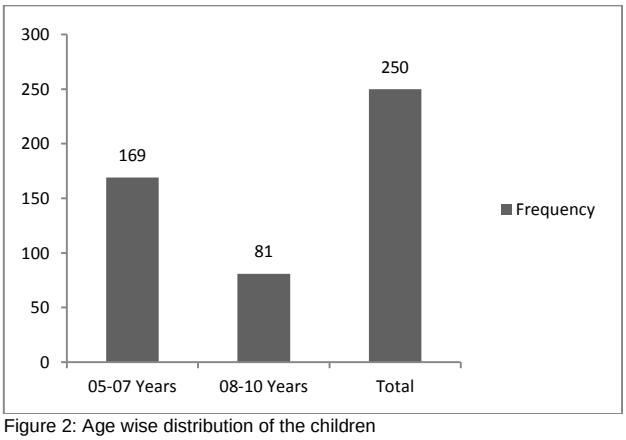

Figure 2: Age wise distribution of the children

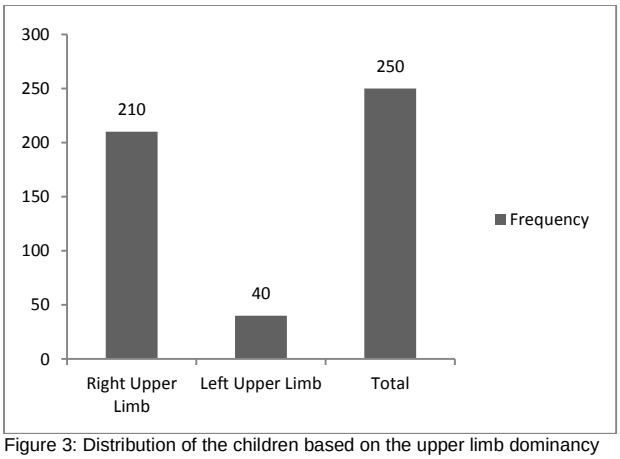

Figure 3: Distribution of the children based on the upper limb dominancy

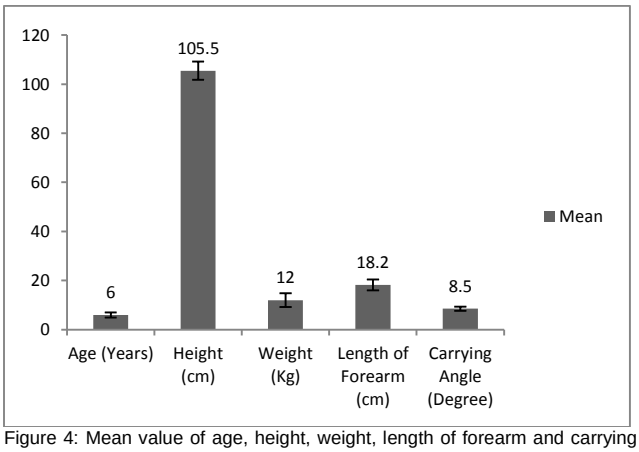

Figure 4: Mean value of age, height, weight, length of forearm and carrying angle

Table 1: Stratification of carrying angle with age, gender, height, weight and limbdominancy

Parameter	Sub category	Carrying angle	P value
Gender	Male	8.5+0.82	0.4788
	Female	8.5+0.82	
Age	5-7 Years	8.5+0.82	0.4491
	8-10 Years	8.5+0.82	
Upper limb dominancy	Right	8.5+0.82	0.0196
	Left	8.5+0.82	
Weight	< 12 kg	8.5+0.82	0.0196
	> 12 kg	8.5+0.82	
Height	< 105.5 cm	8.5+0.82	0.0196
	> 105.5 cm	8.5+0.82	
Length of forearm	< 17.5 cm	8.5+0.82	0.0196
	> 17.5 cm	8.5+0.82	

DISCUSSION

When evaluating for traumatic elbow injuries and dislocations in children and adults, it is very important to have a good understanding of how to determine the carrying angle of the elbow as well as the changes that occur within that angle. Additionally, it is significant in elbow arthroplasty and reconstruction [2]. The carrying angle of the elbow might rise with some elbow fractures, making the arms protrude excessively from the body. Most carrying angle alterations are reported after distal humeral supracondylar fracture. A variety of methods, ranging from basic hand-held goniometers to more involved radiological techniques, have been used to determine carrying angle [8-10]. The primary goal of our research was to determine the average carrying angle in a paediatric population, and the secondary goal was to examine how carrying angle related to other characteristics.

In the present study sample size of 250 children was taken and mean carrying angle was found out to be 8.5 +/- 0.82, mean carrying on the right side was found out to be 8.5 +/- 0.82 and that of left was 8.5 +/- 0.73. In our study mean carrying angle in female was 8.5 +/- 0.82 and male was 8.5 +/- 0.82. Beals RK et al. conducted study on various age groups in New Zealand. According to his study , the mean carrying was found out to be 17.80 and difference between male and female was statistically not that much relevant [11]. While a study by Terra BB et al conducted in Brazil showed mean carrying angle of 12.88 degree +/-5.92, with 10.97 degree +/-4.72 in males and 15.07 degree +/-4.95 in females. This study showed increase in carrying angle among females [2]. Other studies also have same type of result with greater carrying angle in females as compared to males, except in three to five years age group in which the male had greater carrying angle [12].

The findings of the present study are less than the mentioned study because the subjects in our study were between five and ten years of age. Our study showed that length of forearm has inverse relationship to that of carrying angle. Because of the shorter lever arm, Rupareila et al. and Terra BB came to the conclusion that if a person is shorter, the proximal end must angulate more in order to place the hand in pronation for everyday tasks [2, 13]. Because of this, the carrying angle is increased in the shorter individual because the medial section of the trochlear notch of the ulna moves farther from the medial flange of the trochlea.

Studies have shown that carrying increase in carrying angle is in accordance with the age until the skeletal maturity [14]. In our study we had a very small age group, so we couldn't observe any data change of carrying angle with age.

Our study has been conducted on pediatric age group and that too between 5 and 10 years, so further studies are necessary in different age groups to determine a local data for the carrying angle and its variation with the different anthropometric parameters.

CONCLUSION

Our study concluded that age, gender, height, weight and dominant side are important factors that affect the value of the carrying angle. Our study was an attempt to evaluate the carrying angle for orthopedic applications and measurements recorded may benefit in the elbow pathology management.

Our study recommends further studies at the local level to look for the correlation of anthropometric parameters with carrying angle on a wider reference population.

REFERENCES

1. Sharma K, Mansur D, Khanal K, Haque M. Variation of carrying angle with age, sex, height and special reference to side. Kathmandu University Medical Journal. 2013;11(4):315-8.
2. Terra BB, Silva BCM, Carvalho HBFd, Dobashi ET, Pinto JA, Ishida A. Evolution of the carrying angle of the elbow: a clinical and radiographic study. Acta Ortopedica Brasileira. 2011;19:79-82.
3. Shiva Prakash S, Amardeep G, Manjappa C. Evaluation of the carrying angle of the elbow joint in children's and adolescents and its correlation with various parameters. International Journal of Orthopaedics Sciences. 2017;3(3):996-9.
4. Goldfarb CA, Patterson JMM, Sutter M, Krauss M, Steffen JA, Galatz L. Elbow radiographic anatomy: measurement techniques and normative data. J Shoulder Elbow Surg. 2012;21(9):1236-46.
5. Kothapalli J, Murudkar PH, Seerla LD. The carrying angle of elbow-a correlative and comparative study. International Journal of Current Research and Review. 2013;5(7):71.
6. Fan D, Wang W, Hildebrand KA, Fan C-y. Open arthrolysis for elbow stiffness increases carrying angle but has no impact on functional recovery. BMC Musculoskelet Disord. 2016;17(1):1-5.
7. Rajesh B, Reshma V, Jaene R, Somasekhar I, Vaithilingam A. An evaluation of the carrying angle of the elbow joint in adolescents. International Journal of Medicine and Biomedical Research. 2013;2(3):221-5.
8. Acikgöz AK, Balci RS, Göker P, Bozkir MG. Evaluation of the elbow carrying angle in healthy individuals. International Journal of Morphology. 2018;36(1):135-9.
9. Inagaki K. Current concepts of elbow-joint disorders and their treatment. J Orthop Sci. 2013;18(1):1-7.
10. Layson J, Best BJ. Elbow dislocation. 2019.
11. Beals RK. The normal carrying angle of the elbow. A radiographic study of 422 patients. Clin Orthop Relat Res. 1976(119):194-6.
12. Koh KH, Seo SW, Kim KM, Shim JS. Clinical and radiographic results of lateral condylar fracture of distal humerus in children. Journal of Pediatric Orthopaedics. 2010;30(5):425-9.
13. Ruparelia S, Patel S, Zalawadia A, Shah S, Patel S. Study of carrying angle and its correlation with various parameters. NJIRM. 2010;1(3):28-32.
14. Dai L. Radiographic evaluation of Baumann angle in Chinese children and its clinical relevance. Journal of Pediatric orthopedics Part B. 1999;8(3):197-9.