ORIGINAL ARTICLE

CORRELATION OF CARRYING ANGLE WITH SHOULDER WIDTH AND PELVIC CIRCUMFERENCE MORPHOMETRICALLY IN MEDICAL STUDENTS OF UNIVERSITY COLLEGE OF MEDICINE & DENTISTRY

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ABSTRACT

Objective: Determination of the correlation of carrying angle with shoulder width and pelvic circumference between male and female medical students.

Methods: A quantitative, descriptive and cross- sectional research conducted at University of Lahore, for a period of 6 months. Carrying angle of 260 medical students (125 male & 135 female) between 18-21 years of age was measured. Data was collected after informed consent by measuring carrying angle of dominant upper limb with goniometer. Shoulder and pelvic circumference were measured in inches using measuring tape. Data was compiled and analyzed using SPSS 22. Shapiro-Wilk test was used to asses normality of data and then correlation tests were applied among the dependent and independent variables. Level of significance was 0.05.

Results: The results of present study proved that carrying angle correlates significantly with pelvic circumference in both genders (r_s =0.695). However, moderately significant correlation of carrying angle with shoulder width was seen in males (r_s=0.368) as compared to weak positive correlation in females (r_s=0.252).

Conclusion: Our study confirms significant correlation of carrying angle with shoulder width and pelvic circumference in both genders. In further studies more parameters like BMI should be included to see its relation with carrying angle.

Key-Words: Age, carrying angle, correlation, goniometer, shoulder circumference and pelvic circumference.

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INTRODUCTION

Carrying angle refers to the angle between long axis of arm and forearm directed downwards and medially. It can be observed when forearm is fully extended in a supinated position but disappears when arm is pronated or flexed since the axis arm and forearm becomes align.[1] The understanding of carrying angle variation is crucial for management of malunited supracondylar fractures of humerus and monitoring traumatic lesions that affect elbow joint.[2] Carrying angle is formed by the projection of the medial flange of the trochlea of humerus, which is approximately 6 mm deeper than the lateral flange.[2,3,4] The average value of carrying angle is around 170 degrees in males and 167 degrees in females.[5]

Minor differences in carrying angle have been reported due to age, gender, anthropometric measurements and dominant upper limb.[6] Variation of carrying angle in males and females is directly related to the variation in measurements of shoulder and pelvic width respectively.[3] Females tend to have greater carrying angle which is attributed to their comparatively short height, narrower pectoral region, broader pelvic region and greater joint laxity which allows greater degree of extension and allowing arm to swing without contacting pelvic region. On the other hand, males have wider shoulders and a tapered pelvic area, enabling their arm to align more closely with the long axis of arm and forearm.[7] The carrying angle holds significant importance as it allows the forearms to clear pelvic area and facilitates arm movement during walking and carrying objects.[8] The significance and variation of carrying angle between both genders and age groups have been reported. The present study establishes the relationship of carrying angle with both shoulder width and pelvic circumference in male and female students.

METHODS

A quantitative, descriptive and cross- sectional research conducted at University of Lahore, for a period of 6 months. The calculated sample size was 260 students including 125 male and 135 female medical students. It was calculated at 5% level of significance at desired power of studies of 90% assuming correlation of carrying angle with hip circumference is equal to 0.20.[9] The sample size is calculated by using below given formula; -

$$N = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2}{\frac{1}{4}\left[log_e\left(\frac{1+r}{1-r}\right)\right]^2} + 3$$

Where:

$Z_{1-\beta}$ is the desired power of study 90%.

$Z_{1-\alpha/2}$ is the desired level of significance = 5%

r is the correlation of carrying angle with hip circumference = 0.20

n = calculated sample size = 260

Sampling technique was non-probability convenient sampling

Inclusion criteria:

- Male and female medical students with healthy, normal architecture.
- 18-21 years of age.
- Participants who gave consent.

Exclusion criteria:

- Any previous history of fracture or surgical procedure of upper limb.
- Left dominant.
- Any congenital anomaly.
- Refusal to enroll.

Data collection procedure: After taking the approval from Ethical Review Board, UCMD, University of Lahore. (Annexure I), the data was collected from medical students after taking their consent. Goniometer was used to measure the carrying angle[10] while shoulder and pelvic circumferences[3] were measured with the help of measuring tape.

Data was compiled and analyzed using SPSS 22. Shapiro-Wilk test was used to assess normality of data and then correlation tests were applied among the variables. Significance level was 0.05.

RESULTS

The current study depicted the correlation of carrying angle (dependent variable) with shoulder width and pelvic circumference (independent variables). Results indicate a moderate positive correlation of carrying angle with shoulder width ($r_s = 0.367$) and pelvic circumference ($r_s = 0.695$) in both male and female students. The p-value also showed statistically significant correlation among these variables.

In male students, there was moderate positive correlation of carrying angle with shoulder width ($r_s = 0.368$) and pelvic circumference ($r_s = 0.650$). The p-value showed that these correlations were also statistically significant. Whereas in female students, there was moderate positive correlation of carrying angle with pelvic circumference ($r_s = 0.715$) while weak positive correlation with shoulder width ($r_s = 0.252$). The p-value showed that these correlations were also statistically significant (Table 1)

Table 1: Correlation of carrying angle with shoulder width and pelvic circumference in medical students

	Carrying Angle	Shoulder width	Pelvic circumference
Overall (n=260)	Spearman's correlation coefficient (r_s)	0.367	0.695
	p-value	< 0.001*	< 0.001*
Male (n=125)	Spearman's correlation coefficient (r_s)	0.368	0.650
	p-value	< 0.001*	< 0.001*
Female (n=135)	Spearman's correlation coefficient (r_s)	0.252	0.715
	p-value	< 0.001*	< 0.001*

DISCUSSION

The angle formed by the median axis of fully extended and supinated forearm, measuring its lateral obliquity is known as carrying angle. The misalignment of the long axis of the arm and forearm, along with the extension of the medial trochlear edge being 6mm longer than the

lateral edge, contributes to this condition. Additionally, the oblique orientation of the superior articular surface of the coronoid to the ulnar shaft partially contributes to it.[3,11,12] During pronation of forearm the medial flange of trochlear notch moves away from articular surface of humerus than lateral flange resulting in angulation of proximal part of ulna[13]. Previous studies performed by Nemuri S et al showed similar results.[14]

The present study was conducted to determine the carrying angle among both male and female medical students in relation to shoulder width and pelvic circumference. It has been observed that females have higher mean value of carrying angle as compared to males which is attributed to the hormonal differences resulting in deposition adipose tissue in pelvic region. This result is also consistent with results of other studies.[15,16,17]

The current study depicts that the females have a greater carrying angle in comparison to males. Table I indicates a moderate positive correlation of carrying angle with shoulder width ($r_s = 0.367$) and pelvic circumference ($r_s = 0.695$) in both genders. The p-value of < 0.001 shows statistically significant correlation among these variables. The previous studies also depicted significant difference between carrying angle in men and women as suggested by vichard et al.[18] and ruparelia et al.[19] The greater carrying angle in females as compared to males is attributed to the high sexual dimorphism in olecranon coronoid angle and due to secondary sexual characteristics.[14]

In male students, there was also moderate positive correlation of carrying angle with shoulder width ($r_s = 0.368$) and pelvic circumference ($r_s = 0.650$). The p-value shows that these correlations were also statistically significant. Whereas in female students, there was moderate positive correlation of carrying angle with pelvic circumference ($r_s = 0.715$) while positive correlation with shoulder width ($r_s = 0.252$). The p-value shows that these correlations were also statistically significant (Table 1).

The determination of gender differences using spearman's correlation coefficient indicates statistically significant differences in carrying angle, shoulder width and pelvic circumference. This infers that as there is a significant difference in these parameters in both genders, they can be used to differentiate genders especially during forensic investigations. This is consistent with the reports of previous studies.[20,21] Increased carrying angle causes elbow instability, reduction in flexion of elbow and more prone to elbow fractures when falling on outstretched hand.[22] The knowledge about variation of carrying angle is helpful for clinical practioners in treatment of displaced elbow, management and reconstruction of deformed elbow.[23] Increased carrying angle is also an independent risk factor for ulnar nerve neuropathy.[24] This study also depicts the presence of sexual dimorphism between females and males indicating carrying angle as a secondary sexual characteristic. Moreover, this study also depicts the relevance of shoulder width and pelvic circumference with carrying angle. The results of this study will be beneficial in the management of fractures of elbow and its surgical treatment.

CONCLUSION

Our study confirms greater carrying angle in females as compared to male along with significant correlation between shoulder width and pelvic circumference. In further studies more parameters like BMI should be included to see its relation with carrying angle.

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AUTHOR'S CONTRIBUTIONS

NI: Concept, manuscript writing, data collection
SA: Manuscript writing, literature research
SN: Statistical analysis, result
NR: Data collection
SF: Statistical analysis, proof reading
NK: Proof reading