

Carrying Angle and its Variations with Anthropometric Parameters among the Medical Students of Rupandehi District, Nepal

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Abstract: Carrying angle has been studied by many researchers and it is being studied to correlate with different parameters like age, sex, height and side. The study is aimed to determine the normal carrying angle between right and left hands. A cross-sectional study was conducted among 130 medical students of Devdaha Medical College and Research Institute, Rupandehi district, Nepal from October 2016 to December 2016. Carrying angle of each individual was measured by using manual metal goniometer and height was measured by using measuring tape. The data was recorded in MS Excel 2007 and further statistical analysis was performed for the descriptive statistics and independent sample t-test was performed to compare the means of the study population by using SPSS 16. In the present study, participants were in the age group of 18-25 years with the mean age of 20.90 ± 1.45 years including 21.98 ± 1.45 years in male and 20.37 ± 1.12 years in female. The mean carrying angle in right hand was $10.64^\circ \pm 2.57$ whereas $9.69^\circ \pm 2.52$ in the left hand with the significant differences between right and left hand. There were no significant differences between age, sex and height with the carrying angle in the study. The mean carrying angle value was higher in case of males than in females. This study is helpful for the anatomists, anthropologists, cosmetic surgeons and orthopaedic surgeon for the correction of the fractures and other associated elbow disorders.

Keywords: Age, carrying angle, goniometer, height.

INTRODUCTION

Carrying angle is the distinguishing feature of human beings because of the upright position [1]. It has been the area of interest among the anthropologists, orthopaedic surgeons, anatomist and forensic medicine for sex identification and surgical correction.

The variation in the carrying angle is reported according to the physiological conditions like age, sex and positions of elbow movement as well as the dominance of the upper limb [2-6]. It has been determined that the mean carrying angle is slightly larger in females ($10-15^\circ$) than in males about 5° [7, 8]. Potter had observed the higher mean value of carrying angle in females as compared to that of male population [3,9,10]. Similarly a study conducted in Nigeria and India had reported higher value of carrying angle in dominant upper limb [6,11,12]. Some of the studies have shown that females had the larger carrying angles than the males [6,13].

Very few researches have been conducted in the context of Nepal. This study is helpful to establish the relationship between the carrying angle and different anthropometric parameters for the sex identification in forensic medicine as well as clinical purpose in management of fractures.

MATERIALS AND METHODS

A cross-sectional descriptive study was performed among 130 medical students including 43 males and 87 females of Devdaha Medical College and Research Institute and Devdaha College of Science and Technology, Rupandehi district, Nepal within the period of October 2016 to December 2016. The ethical clearance was taken from the Ethical committee of

Devdaha Medical College and Research Institute. The participants were informed about the study protocol and verbal consent was taken prior to the study.

Age among the study population was noted verbally in years and the height was measured in centimeter by using the measuring tape in anatomical position with bare foot from the vertex to heel. Carrying angle of both right and left hand of each participant were measured by using the manual metal goniometer in degree. The participants with the history of fracture were excluded from the study. The goniometer was placed with the fixed arm along the median axis of the

arm and forearm with fully extended elbow joint. The data was entered in Microsoft Excel 2007 and the descriptive analysis was performed to determine the mean values, standard deviation and independent sample t-test was performed to compare the means between different study parameters.

RESULTS

In the present study, 130 medical students were involved for the measurement of carrying angle as well as the height. Among them most of the participants were females (66.9%) whereas nearly one third (33.1%) of the participants were males as shown in table 1.

Table 1: Frequency distribution of the study population (n=130)

Sex	Frequency	Percentage (%)
Male	43	33.1
Female	87	66.9
Total	130	100

As shown in table 2, the mean age was higher in males which is 21.98±1.45 years whereas mean value 20.37±1.12 years was seen in female population with the significant differences between male and female population (p<0.001). The mean carrying angle among male population in right hand was 10.74 ± 2.82 and in

left hand as 10.05 ± 2.79 with the lower mean value in females as 10.59±2.45 in right hand and 9.69±2.38 in left hand without significant differences. The mean height among the male population was 166.04 ± 4.85 cm with the higher values among female and combined population.

Table 2: Descriptive statistics for the carrying angle and height (n= 130)

Variables	Sex	Mean ± SD	Minimum	Maximum	p-value
Age (years)	Male	21.98± 1.45	19	25	0.000
	Female	20.37± 1.12	18	23	
	Combined	20.90±1.45	18	25	
Carrying angle right (degree)	Male	10.74±2.82	5	15	0.743
	Female	10.59±2.45	5	16	
	Combined	10.64±2.57	5	16	
Carrying angle left (degree)	Male	10.05±2.79	5	16	0.450
	Female	9.69±2.38	4	15	
	Combined	9.81±2.52	4	16	
Height	Male	166.04±4.85	152.5	172.5	0.000
	Female	153.72±4.12	147.5	165	
	Combined	157.80±7.27	147.5	172.5	

In table 3, among the study participants age and sex had the significant correlation within males and females. Also, significant correlation was observed between the sex and height of the participants. The

carrying angle of right and left hand showed strong positive correlation (r = 0.695) with significant differences among male and female population.

Table 3: Correlation between different study variables (n= 130)

Variables	Carrying angle left (degree)		Carrying angle right (degree)		Height		Sex		Age	
	r	p	r	p	r	p	r	p	r	p
Age	0.105	0.236	0.088	0.320	0.534	0.000	-0.524	0.000	-	-
Sex	-0.067	0.450	-0.029	0.743	-0.800	0.000	-	-	-0.524	0.000
Height	0.061	0.487	-0.021	0.810	-	-	-0.80	0.000	-0.53	0.000
Carrying angle right (degree)	0.695	0.000	-	-	-0.021	0.810	-0.029	0.74	0.088	0.32
Carrying angle left (degree)	-	-	0.695	0.000	0.061	0.487	-0.04	0.045	0.105	0.236

DISCUSSION

Carrying angle and its variation with different anthropometric parameters is the area of keen interest for many researchers. In the present study, among the 130 medical students the mean carrying angle in right hand was $10.64^{\circ} \pm 2.57$ whereas $9.69^{\circ} \pm 2.52$ in the left hand. It seems that the carrying angle was higher in the dominant hand which is consistent with the study conducted by Paraskevas *et al* and Yilmaz *et al* [11,12]. Higher mean values of carrying angle was observed in studies conducted by Baughman *et al*, Rai *et al*, Keats *et al* and Khare *et al* which is inconsistent with the findings of the present study [10, 14-16]. However, in a study performed by Ruparelia *et al*, lower mean value of 6.9° was observed in male and higher mean value of 11.8° was reported which is inconsistent than the present study [17]. It has been suggested that the variation in carrying angles of right and left hand may be due to ligamentous laxity at the medial elbow or asymmetrical bone growth. The mean carrying angle values for right and left hands in males were $10.74^{\circ} \pm 2.82$ and $10.05^{\circ} \pm 2.79$ respectively, whereas lower mean values $10.59^{\circ} \pm 2.45$ and $9.69^{\circ} \pm 2.38$ respectively were observed in the present study. Similar findings were observed in studies conducted in Eastern India [18]. A study conducted in Gujarat, India has reported the mean height of 166.8 cm in males whereas 153.9 cm in females which is consistent with the findings of the present study [17].

In contrast to the findings of the present study, some studies in India and Nigeria reported higher mean values of carrying angle in both right and left hands of females than in males [19, 20]. Also the study conducted by Van *et al* determined higher mean value of carrying angle in females [21]. In the study significant differences was observed between the carrying angle of right and left side in both male and female population which is in agreement with the study conducted in Eastern India [18] and different findings was reported by Kumar *et al* [22].

The study is conducted among the medical students and the sample size is even minimal. So, further studies are essential in different age groups and different areas of Nepal in large sample size to determine the national data for the carrying angle and its variations with different anthropometric parameters

CONCLUSION

In the present study, the mean carrying angle of both left and right hands in males is found as 10.39° and in females it is 10.14° which is slightly higher in males. Similarly, the mean height is also higher among males which is 166.04 cm and lower in females which is 153.72 cm. The determination of carrying angle can be helpful for the orthopaedic surgeons for surgical correction of elbow disorders.

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