"Correlation between Carrying Angle and Grip Strength of dominant hand among School going Children (An observational cross sectional study)

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ABSTRACT

Background:
 The elbow joint is basically a hinge joint. The normal carrying angle is elaborated as the longitudinal axis of humerus and longitudinal axis of ulna and is mostly seen in fully extended elbow and fully supinated forearm. This may have an effect on grip strength.
 Grip strength is an integrated performance of muscles that can be produced in one muscular contraction. Grip strength is the control of the fingers to hold objects and is an important factor when assessing hand function.Actually, grip strength is a measure of upper extremity and bone strength and determines the functional performance of an individual. Carrying angle and hand grip strengths have a great importance in the upper limb. Hand grip strength has been considered as an upper muscular extremity, shoulder and forearm function indicator.

Objectives: This study was conducted to determine the relationship between carrying angle and hand grip strength among school going children.

Material and Methods: The study was conducted among school going children of Society Public School. This study recruited 30 participants of either sex,and age. A purposive sampling technique was used. Carrying angle and hand grip strength of dominant hand was measured. Carrying angle was measured by universal goniometer and hand grip strength by handheld dynamometer. Independent Samples T Test was used**.** Correlation of all variables was calculated through SPSS version 20.

Results: Weak correlation exists between carrying angle and hand grip strength of the dominant hand.

Conclusion: The carrying angle indicates weak correlation with. Hand grip strength of dominant hand

Key words: Carrying angle; Goniometer; Hand grip strength; Dominant hand; Hand held dynamometer; Correlation

INTRODUCTION

The normal carrying angle is elaborated as the longitudinal axis of humerus and longitudinal axis of ulna and is mostly seen in fully extended elbow and fully supinated forearm. (Nemuri et al., 2020) Normally, it is greater in females than in males, but there is some variability of carrying angle seen with the age group of 3-5 years in males because of variations in secondary sexual characters in females. The normal carrying angle is 10° in male and 13° in a female adults.(Hasegawa et al., 2017) The increase and decrease in the carrying angle may lead to cubitus valgus and cubitus varus respectively. (Bohannon, 2019)

If there is variability in carrying angle of an upper extremity, then the strength of that extremity especially hands will be affected.(Hogrel, 2015) The carrying angle changes with skeletal growth and maturity. The angle is always greater on the side of the dominant hand. This angle permits the forearms to clear the hips in swinging movements during walking and is important when carrying objects.

It is important to know the carrying angles of both elbows in the evaluation of deformities which may be seen after treatment of distal humerus fractures. This study will be performed to determine the basal values of the carrying angle in specific age groups as it may change with skeletal growth . (Tomori et al., 2018a)

Increasing the carrying angle may lead to elbow instability and pain during exercise or in throwing activities of sports may reduce function of elbow flexion [predispose to risk of elbow dislocation and increase evidence of elbow fracture when falling on the outstretched hand and fracture of the distal humeral epiphysi. (Langenskiöld and Kivilaakso, 1967)

Hand Grip strength is an integrated performance of muscles that can be produced in one muscular contraction. Carrying angle and hand grip strengths have a great importance in the upper limb. Hand grip strength has been considered as an upper muscular extremity, shoulder and forearm function indicator.Grip strength is the control of the fingers to hold objects and is an important factor when assessing hand function. Hand grip strength plays an important role in hand function mainly to recognize the level of impairment of upper limb and to establish treatment requirements.Grip is not simple action performed solely by fingers and wrist but

require accurate functioning of forearm, prescapular and shoulder muscles.Actually, grip strength is a measure of upper extremity and bone strength and determines the functional performance of an individual. All muscle actions of hand involved in gripping are also related to grip strength. In upper extremity, hands are mainly involved in almost every daily life activity and gripping is one of them.(Sharma et al., 2013)

Alterations in carrying angle may disrupt the hand grip strength . Grip Strength checks the strength of upper muscular extremity.(Rashed et al., 2019)

To determine the relationship of Carrying Angle with Grip Strength of dominant hand among School going Children, Goniometer and Hand held dynamometer are used. These tools are reliable for measuring and to find the relationship of carrying angle with isometric grip strength and for the stability of the upper limbs and evaluation of grip strength .(Katchy et al., 2016)

Measuring the grip strength helps in assessing those children who have reduced functional activities due to poor hand gripping. (TÜKENMEZ et al., 2004)

The purpose of this study is to correlate the relationship of carrying angle with hand grip strength of dominant hand among School going Children. There were previous studies on the relationship of carrying angle with hand grip strength, but not specifically its effect on the dominant hand of school going children .Because sometimes we neglect the weakness in grip strength among children. This study will be helpful in finding the variation of carrying angle between girls and boys of school going age and how it affects their gripping. Also, it will be productive in determining the children having poor grip strength and have reduced functional activities due to poor hand gripping. It will help in restoring their maximal performance in daily activities by increasing the strength of hand muscles. Clinically, these findings will be helpful for physiotherapists during upper extremity rehabilitation.

METHOD

After the approval of IRB form, data will be collected from Society Public School,Lahore. From this school, The subjects (children) were recruited on the basis of inclusion criteria by purposive sampling and counseled about study procedure. The

purpose and procedure of the study will be explained to the children. Then consent form will be provided to each child. Recruitment was done after taking the written consent.

Subjects were guided, when there was any ambiguity. After signing the consent, the whole process about the test was guided and demonstrated in front of (the children) the participants how to perform. The whole procedure will take only five minutes.

Prior to study,dominant side of upper extremity will be assessed and the basic demographics by age, weight and height will be noted.

Height of the subject will be measured in centimeter by stature meter, from the point of vertex to heel surface of the child with barefoot on the ground positioned in the anatomical position. The weight of the subject will be recorded in kilograms by weighing machine.

The subject was then requested to be in (standing) anatomical position, feet supported and arms unsupported. Universal goniometer will be used to measure carrying angle in anatomical position. The carrying angle was measured by placing the fulcrum at the elbow joint.The immoveable arm of the goniometer will be placed at the mid of the upper arm. The moving arm of the goniometer will be placed in line with the middle of the subject's forearm.Then, the carrying angle will be measured only once in degree unit and there was no follow up.

To measure the dominant hand grip, every subject was instructed to sit comfortably on an armless chair with feet touching the ground and the trunk upright. A subject had to hold the hand held dynamometer in the hand and squeeze the handle of the dynamometer as hard as possible and generate the maximum possible force only once. The face of the tool was positioned away from the face. The reading of hand grip strength was recorded in kilograms.

The whole procedure will take only five minutes.

4.RESULTS:

A total of 30 participants (18 females and 12 males) school going children (students) was recruited for this study from ages 08 to 17 years.

The correlation between carrying angle and grip strength was performed by using SPSS software version 20. The carrying angle and grip strength showed great variability between the genders at a different age. The data were not distributed normally, hence Spearman's correlation test was used to analyze the data.
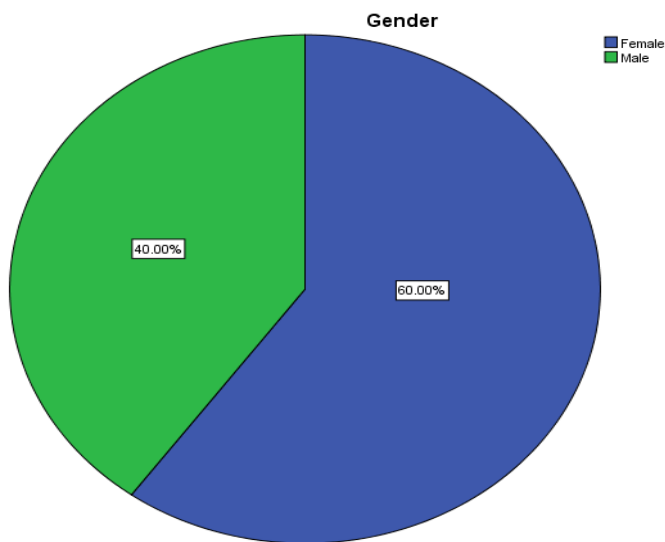
Table 4.1: Demographic variables.

Frequencies distribution according to gender:

Gender	Frequency	Percent
Female	18	60.0
Male	12	40.0
Total	30	100.0

Among the children 18 (60%) were boys and 12 (40%) were girls.
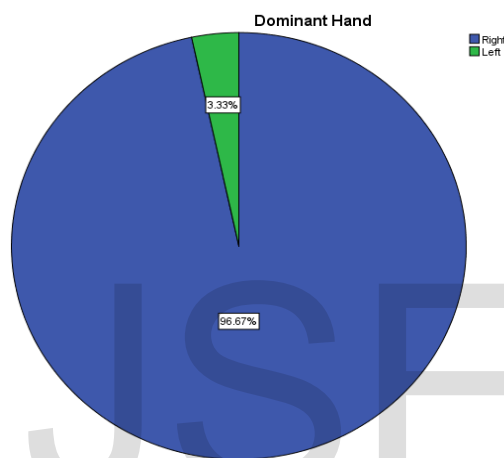
Figure 4.1: Gender Distribution

Among the children 18 (60%) were boys and 12 (40%) were girls.

Table 4.2:

Dominant Hand

Dominant Hand	Frequency	Percent
Right	29	96.7
Left	1	3.3
Total	30	100.0

Most of the study participants' 'dominat hand was right hand 29(96.7%)

Table 4.3:

T-Test

Group Statistics

	Gender	N	Mean	Std. Deviation	p-value
Age(Years)	Female	18	12.56	2.06	0.403
	Male	12	13.33	2.96	

Independent Samples Test

Frequencies
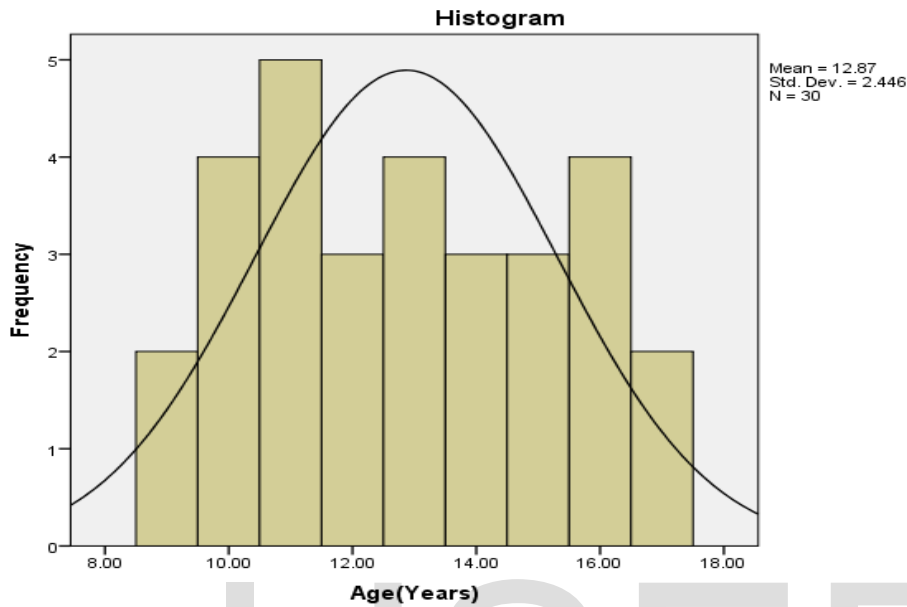
Table 4.4:

T-Test

	Female	Male	p-value
Weight	49.22±18.19	56.67±14.45	0.245
Height	148.72±8.54	153.33±10.30	0.193
Carrying Angle	12.82±4.79	11.17±2.69	0.289
Hand grip Strength	15.29±5.23	18.40±4.69	0.108

Independent Samples Test

Mean Weight of females was 49.22±18.19kg and mean weight of male was 56.67±14.45kg.
There is is not statistically significant difference (p-value0.245)

Mean Height of females was 148.72±8.54cm and mean Height of male was 153.33±10.30cm.
there is is not statistically significant difference (p-value0.193)

Mean Carrying Angle of females was 12.82±4.79 degree and mean Carrying Angle of male was 11.17±2.69 degree. there is is not statistically significant difference (p-value0.289)

Mean Hand grip Strength of females was 15.29±5.23kg and mean Hand grip Strength of male was 18.40±4.69kg. there is is not statistically significant difference (p-value0.108)

Table 4.5:

Correlations

	Age(Years)	Weight(Kg)	Height(cm)	Angle(degree)
Weight(Kg)	.673[**]			
Height(cm)	.704[**]	.796[**]		
Angle(degree)	0.321	.497[**]	0.23	
Strength(Kg)	.433[*]	.436[*]	0.36	0.103

[**]. Correlation is significant at the 0.01 level (2-tailed).

[*]. Correlation is significant at the 0.05 level (2-tailed).

This table shows the Correlation between Carrying Angle and Grip Strength of dominant hand among School going Children.

There was a moderate and direct relationship between Weight and Age and (r=0.673)

There was a moderate and direct relationship between height and Age (r=0.704)

There was a weak and direct relationship between Angle and Age (r=0.321)

There was a weak and direct relationship between Strength and Age (r=0.433)

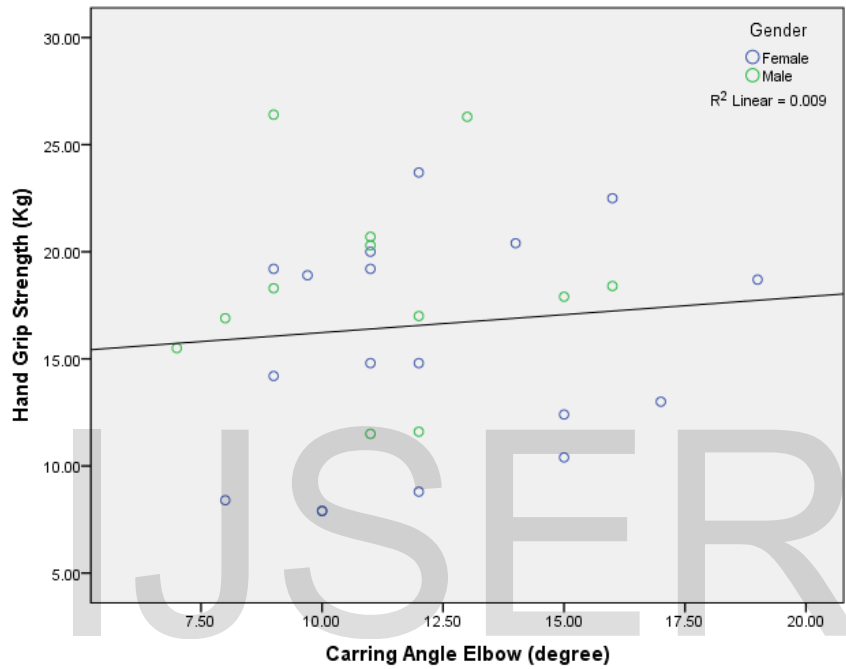There was a moderate and direct relationship between Height and Weight (r=0.796)

There was a weak and direct relationship between Angle and Weight (r=0. 497)

There was a weak and direct relationship between Strength and Weight (r=0.436)

There was a weak and direct relationship between Angle and Height (r=0.23)

There was a weak and direct relationship between Strength and Height (r=0.36)

There was a weak and direct relationship between Strength and Angle (r=0.103)

Graph: Correlation between right CA and GS.

This graph shows a weak and direct correlation between right carrying angle and grip strength.

Discussion:

This study recruited 30 participants, age 08-17 years .After obtaining the consent from the participants who were fulfilling the inclusion criteria, Carrying Angle and hand grip strength of dominant hand are measured. Each reading was taken only once to prevent the fatigue.

The present study correlates Carrying Angle with hand grip strength of dominant hand among School going Children, this study also calculates the difference between boys and girls' carrying Angle and hand grip strengths of dominant hand among School going Children. The result suggests that there is a weak correlation between carrying angle and grip strength which means as the carrying angle increases, grip strength has not a significant effect on it. The present study aimed to correlate carrying angle and grip strength among school going children.In the present study, There was a moderate and direct relationship between Weight and Age and ($r=0.673$).There was a moderate and direct relationship between height and Age ($r=0.704$) .There was a weak and direct relationship between Angle and Age ($r=0.321$).There was a weak and direct relationship between Strength and Age ($r=0.433$) .There was a moderate and direct relationship between Height and Weight ($r=0.796$) .There was a weak and direct relationship between Angle and Weight ($r=0. 497$) .There was a weak and direct relationship between Strength and Weight ($r=0.436$) .There was a weak and direct relationship between Angle and Height ($r=0.23$) .There was a weak and direct relationship between Strength and Height ($r=0.36$) .There was a weak and direct relationship between Strength and Angle ($r=0.103$)

However, according to Jason Shea, (Alahmari et al., 2019) increase in carrying angle increases the stretch on long finger flexors near its origin. Hence, carrying angle does affect the grip strength. The synergistic action of flexors and extensors muscles and the interplay of the muscle groups is an important factor in strength of the resulting grip.Variation of body joint angles had some effects on grip strength. Mathiowetz et al studied the effect of elbow position on grip strength and found it to be higher with the 90⁰ of elbow flexion. (De, S., et al. (2011)
In the previous studies, effect of body posture was seen on hand grip. The grip strength was assessed in sitting posture. The grip strength was measured by hand held dynamometer with the subject sitting on a chair, arm unsupported, shoulder in a neutral position, elbow at 90⁰ of flexion

and forearm in mid prone position. Each subject was instructed to exert their maximum grip strength for 5 seconds.

This can be attributed to the study done by Incel et al reported that the hand grip strength is to be higher in dominant hand with right-handed subjects, but no such significant differences between sides could be documented for left-handed people. De, S., et al. (2011) However, there was a weak and positive correlation between carrying angle and grip strength in females and males. The reason for including demographic components in the current study is that grip strength cannot be influenced by multiple variables, not only age, sex and, hand dominance but also by height, weight, hand length, etc.

In the current study, carrying angle in female was observed to be more than to male. Potter was the first one to carry out an investigation on the variation of carrying angle in male and female. His observation was the same.(Bohannon, 1987)

This study tells that hand span has a significant positive correlation with the hand grip strength and pinch grip strength measurements. Hand grip and pinch strength were significantly correlated with anthropometric measurements and hand dimensions. (Alahmari, 2019) while during our study we observed a insignificant and direct correlation between carrying angle and hand grip strength .

Normative Values for Grip and Pinch Strength in children and young adults was measured by Victoria A. McQuiddy. She demonstrated that age and sex had a significant effect on hand strength values as it increased with age, as well as greater hand strength in males than in females. Hand dominance was not shown to have a significant effect on hand strength (McQuiddy, 2015). While this study demonstrated that if the values of Carrying angle increase, it will not directly affect the hand grip.

CONCLUSIONS

Carrying Angle shows weak and direct correlation with Hand grip of dominant hand among School going children.

With the weak correlation between carrying angle and grip strength, it was proved that grip strength does not have a significant effect with increased carrying angle and vice versa. Other factors such as height and weight showed a moderate correlation with the grip strength.

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