

Evaluation of Wrist Muscles and Grip Strength in Smartphone Users - An Observational Study

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ABSTRACT

Background: - Prolonged usage of smartphone may lead to pain around thumb and wrist. Thus, there is a need to assess the muscles strength of wrist and hand among smartphone users.

Method: - 140 (70 males and 70 females) young college going adults with age group between 17-23 years were randomly selected for the study. Wrist muscle strength and power grip strength were assessed using hand held dynamometer. Pinch grip strength was assessed using pinchometer.

Results: - Peak mean strength of wrist flexor was 10.40(4.43) Kg, wrist extensor was 10.48(4.79) Kg, power grip was 30.73(13.69) Kg and pinch grip was 5.58(1.59) Kg. Spearman's correlation coefficient ranged from 0.6 to 1 between wrist and grip strength.

Conclusion: - Currently there is no adverse effect of smartphone usage on pinch and power grip but wrist muscles are found to be weak.

Keywords: - Wrist muscles, Grip, Handheld dynamometer, Pinchometer

INTRODUCTION

Modern society has always seemed to have a bit of an obsession with technology. But no single device has had as much of an impact on the world than the mobile phone. Back in the early days of mobile phones, their sole use was for calling other people whilst on the move. Soon after, the ability to 'text' other mobile phones was introduced. Nowadays you can use mobile phones to do literally everything. From paying for your next meal to tracking your sleeping habits, the smartphone of today has almost no limits. As technology has developed, there has been a very rapid evolution of mobile phones. These days, they do so much more than simply keep us connected. We can now carry out everyday tasks with ease, such as: internet banking,

playing games, paying for goods and services, staying connected with our customers, sharing pictures and stories via social media, browsing the internet, navigating to specific locations and attending online classes.

In the past decade usage of smartphone increases tremendously amongst college going students. An average college going student use smartphone 2-5 hrs a day and the time of usage increasing exponentially as years are passing and cases of smartphone addiction also increasing tremendously which is very dangerous for the youths.

Given the nature of smartphones, users often hold the device with a single hand which forces only the thumb to use. Single handed smartphones compel

individuals to engage in flexion extension of wrist. These repetitive movements are involved in the etiopathogenesis of many disorders like Carpal Tunnel Syndrome, DeQuervain's disease, etc. [1].

Several studies are done that states that high smartphone usage leads higher grip strength and its usage is related to wrist/hand pain [1,2]. But none of the study states the association between smartphone use, wrist muscle and grip strength. Thus, there is a need to investigate the wrist muscles strength and grip strength in smartphone users.

The primary objective of the present study was to assess the strength in wrist flexors and extensors muscle in smartphone users, to assess cylindrical grip and pinch grip strength in smartphone users. The secondary objective was to find the relationship between wrist muscles and grip strength in smartphone users.

MATERIALS AND METHOD

Observational cross-sectional study was conducted in 140 individuals (70 male & 70 female) in age group of 17 – 23 years. Subjects whose usage of smartphone was minimum for 2 hours in a day, who were able to understand the technique and willing to participate were enrolled. Subjects with Malignancy, Neck pain and radiating in upper limb (unilateral/bilateral), Deformities of upper limb, Recent fracture around upper limb and neck, Recent surgery, Peripheral nerve injuries affecting upper limb, Neuromuscular conditions were excluded. Samples were collected from different colleges of Jamnagar (India).

Ethical clearance was taken from Institutional ethical committee. Random sampling technique was used. Written consent was taken from all the subjects for the participation in the study.

Demographic data and familiarization with the technique was done before the actual commencement of the procedure. Wrist flexors and extensors strength and power (cylindrical) grip was measured with Hand held dynamometer

(Saehan CE 2195), pinch grip was measured with Pinchometer (Baseline ® Hydraulic Pinch Gauge).

Wrist flexors strength - High sitting position with elbow flexed to 90°. Fully supination with wrist flexed upto middle range with flexion of IP Joints. Hand held dynamometer was placed over middle phalanx region of fist. Subject was instructed to perform wrist flexion against the resistance of hand-held dynamometer. Maximum force generated by the subjected at that point was noted down in kgs. The process was repeated for 3 times & average of 3 repetitions was used for analysis [3].

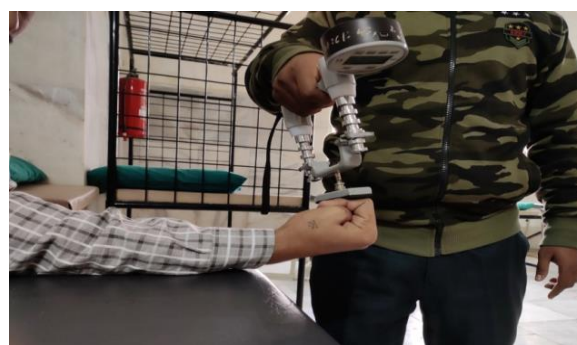


Figure 1: Wrist flexors strength

Wrist extensors strength - High sitting position with elbow flexed to 90°. Fully pronation with wrist extended upto middle range with flexion of IP Joints. Hand held dynamometer was placed over middle dorsum region of fist. Subject was instructed to perform wrist extension against the resistance of hand-held dynamometer. Maximum force generated by the subjected at that point was noted down in kgs. The process was repeated for 3 times & average of 3 repetitions was used for analysis [3].



Figure 2: Wrist extensors strength

Cylindrical grip strength - High sitting position with elbow flexed to 90° with mid prone and wrist in neutral. The grip strength was measured bilaterally using dynamometer in 2nd position. The subject was asked to squeeze the dynamometer as hard as possible without moving the rest of the body. 30 seconds rest time interval was maintained between each handgrip strength testing. Maximum value recorded in kilogram will be considered. Three repetitions were attempted and the average of them was used for analysis [4].



Figure 3: Cylindrical grip strength

Pinch strength - The subject was in sitting position on a chair with arm rest with shoulder adducted and neutral rotation with elbow 90° flexed, forearm supinated and

wrist in 20° of extension. Subject was asked to hold pinchometer device between pulp of thumb and pulp of index finger and generate maximum force. Three recordings were taken with sufficient rest period of 30 seconds between them. Average of three was used for final analysis. Measurements was done alternately on both hands [5].



Figure 4: Pinch grip strength

Statistical Analysis - Data was analysed using SPSS version 20. Mean and Standard Deviation (SD) for all the parameters. Spearman's Correlation analysis was done between wrist muscles and grip strength.

RESULT

Table 1: - Descriptive data of subjects

	N	Age (Years)	Height (Meters)	Weight (Kgs)	Body Mass Index (Kg/mt ²)
Male	70	19.35(1.33)	1.69(0.05)	58.47(10.72)	20.31(3.73)
Female	70	19.04(0.78)	1.57(0.05)	49.5(8.54)	19.89(3.05)
Total	140	19.20(1.10)	1.63(0.08)	53.98(10.65)	20.10(3.4)

Data is represented in Mean (SD)

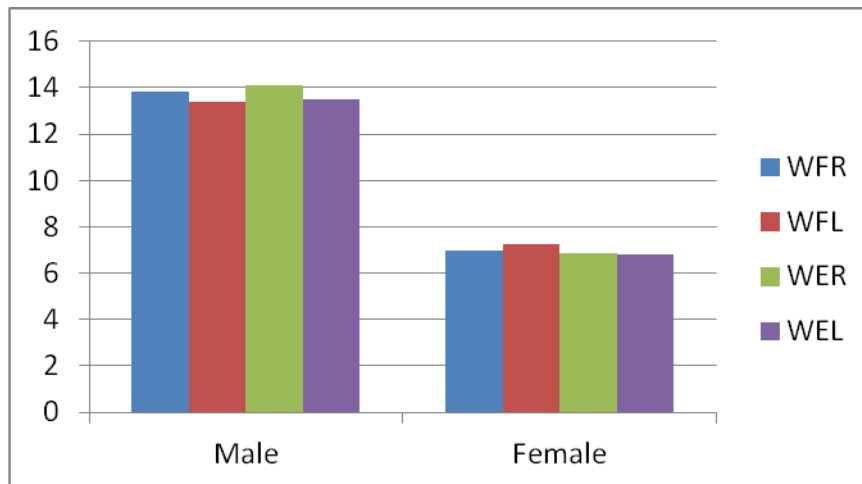
Table 1 shows mean age and body mass index of all the subjects.

Table 2: - Strength of wrist flexors and extensors muscle

	Wrist flexors (Kgs)		Wrist extensors (Kgs)	
	Right	Left	Right	Left
Male	13.82(3.73)	13.39(3.82)	14.10(4.12)	13.50(5.79)
Female	6.98(1.39)	7.26(1.32)	6.86(1.67)	6.83(0.97)

Data is represented in Mean (SD)

Table 2 shows mean strength of wrist flexors and extensors. It is shown that males have higher strength compared to females.



WFR- wrist flexors right; WFL- wrist flexors left; WER- wrist extensors right; WEL- wrist extensors left

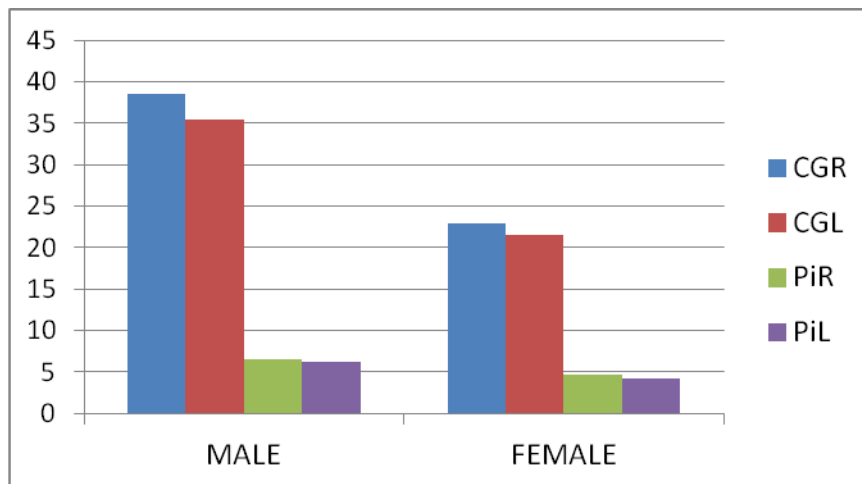
Graph 1: Wrist flexors and Wrist extensors strength

Table 3: - Mean Cylindrical and Pinch Strength

	Cylindrical grip (Kgs)		Pinch (Kgs)	
	Right	Left	Right	Left
Male	38.50(15.46)	35.39(6.85)	6.57(1.51)	6.15(1.35)
Female	22.97(4.04)	21.60(4.17)	4.60(0.92)	4.15(1.04)
Total	30.73(13.69)	28.49(8.93)	5.58(1.59)	5.15(1.56)

Data is represented in Mean (SD)

Table 3 shows mean strength of cylindrical and pinch grip strength. It is shown that males have higher strength compared to females.



CGR- cylindrical grip right; CGL- cylindrical grip left; PiR- pinch grip right; PiL- pinch grip left

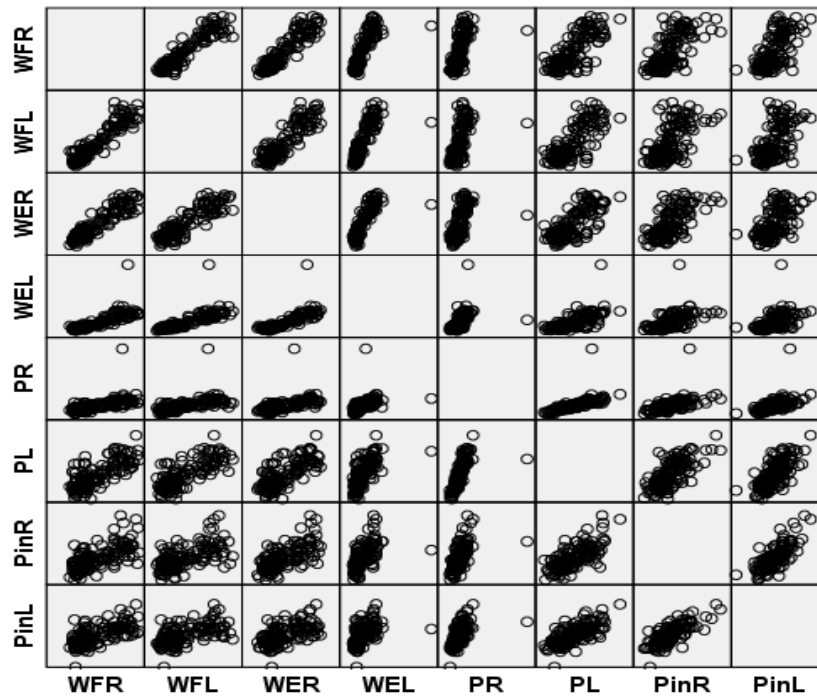
Graph 2: Cylindrical and Pinch grip strength

Table 4: Correlation between wrist flexors, wrist extensors, cylindrical and pinch grip

	WFR	WFL	WER	WEL	CGR	CGL	PiR	PiL
WFR		.89**	.89**	.88**	.76**	.71**	.67**	.66**
WFL			.83**	.87**	.76**	.73**	.61**	.60**
WER				.88**	.74**	.72**	.67**	.64**
WEL					.74**	.72**	.67**	.64**
CGR						.92**	.71**	.73**
CGL							.71**	.73**
PiR								.76**

** P value < 0.01; WFR- wrist flexors right; WFL- wrist flexors left; WER- wrist extensors right; WEL- wrist extensors left; CGR- cylindrical grip right; CGL- cylindrical grip left; PiR- pinch grip right; PiL- pinch grip left

Table 4 shows positive correlation between wrist flexors, extensors, cylindrical and pinch grip strength in smartphone users.



WFR- wrist flexors right; WFL- wrist flexors left; WER- wrist extensors right; WEL- wrist extensors left; CGR- cylindrical grip right; CGL- cylindrical grip left; PiR- pinch grip right; PiL- pinch grip left

Graph 3: Scattered matrix for correlation of wrist muscles and grip strength

DISCUSSION

The present study was conducted on college going students to assess the strength of wrist muscles and grip strength and pinch strength.

In our study cylindrical grip strength on Right side was 38.50 kg, 22.97 kg for male and female respectively and on Left side it was 35.39 kg and 21.60kg for male and female respectively. According to Reis et al. results of present study showed that subjects are having strong cylindrical grip strength as per the normal reference values [4]. Pinch grip strength on Right side was 6.57kg and 4.60 kg for male and female respectively and on Left side it was 6.15 kg and 4.15kg for male and female respectively, according to Sorani et al. which was also higher as per normal reference values [5].

Wrist flexors strength on Right side was 13.82kg and 6.98kg for male and female respectively and on Left side was 13.39kg and 7.26kg for male and female respectively. Wrist extensors on Right side was 14.10kg and 6.86kg on for male and female respectively and on Left side was 13.50kg and 6.83kg for male and female

respectively. Hence, according to Harlinger et al., Wrist extensors in both genders and wrist flexors in females were found to be weaker compared to standard reference values, whereas wrist flexors in males were stronger compared to standard values [6].

Positive correlation was obtained between wrist strength and grip strength in which we found that more the duration of smartphone usage higher is the grip and pinch because of enlargement of flexor tendons Hence these findings are consistent with Motimath et al who stated that high smartphone users shower higher grip strength [1]. Present findings are in contrast with Inal et al according to which larger cross-sectional area of median nerve in high smartphone users can cause pain around hand and hence decrease hand function [7].

According to Sharan et al. hand-held devices like smartphones promotes the predominant usage of thumb or only one finger while texting or gaming are associated with higher prevalence of musculoskeletal disorders of upper extremities [8].

Results of the present study shows moderate to high positive correlation between wrist muscles and grip strength.

Weakness in wrist muscle function could lead to poor grip strength in later stages and it can be associated with pain around wrist and hand

Limitations of the study include that present study did not consider one hand or two hands usage on smartphone, exact duration of smartphone usage was not noted, non-smartphone users were not included and small sample size.

CONCLUSION

There is no adverse effect of smartphone usage on grip/pinch strength but wrist muscles are found to be weak.

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Ethical Approval: Approved

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