Annals of Clinical and Medical Case Reports

Research Article

ISSN 2639-8109 | Volume 6

Relationship of Smartphone Addiction with Hand Grip Strength and Upper Limb Disability

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Keywords:

Smart phone addiction; Young adult; Upper limb disability; Hand strength

Received: 04 Feb 2021
Accepted: 19 Mar 2021
Published: 24 Mar 2021

Citation:

Din ST. Relationship of Smartphone Addiction with Hand Grip Strength and Upper Limb Disability. Ann Clin Med Case Rep. 2021; V6(6): 1-7.

1. Abstract

1.1. Background: Due to evolution of technology smart phone has become our necessity. Where on one hand it has made our lifestyle more comfortable in the form of browsing internet, important conversation and source of entertainment now a day. On the other hand, it has negative impacts on our lifestyles too.

1.2. Objective: This study aimed to determine the relationship of smart phone addiction with the hand grip strength and upper limb disability.

1.3. Methodology: After approval from research committee of Superior University, a total of 112 participants aged between 18 and 24 years were taken. Their smart phone addiction levels was determined according to SAS-SV questionnaire. A hand dynamometer was used to measure hand grip strength and function of hand and upper extremity was scored on the basis of quick DASH questionnaire. Pearson's co-relation coefficient and t-test were used to analyze the data.

1.4. Results: The mean score of SAS-SV was found to be 42.2054 whereas mean score of quick DASH was 31.36 showing mild to moderate level of disability. Mean reading from dynamometer was found 34KG with minimum 15KG and maximum 70KG.

1.5. Conclusion: This study concluded that there is high level of smart phone addiction among young adults. Increasing smart phone addiction decreases hand grip strength and increases upper limb disability. Whereas smart phone addiction was found slightly higher among female students. Upper limb disability was found mild to moderate level, which was found slightly higher among male students. Hand grip strength was found very high among male students than female.

2. Introduction

2.1. Literature review

In 21st century technology plays an important role in human life. Well among all its gadgets Smartphone is a fine revolution to our modern technology [1]. It has become one of the most ubiquitous communication device for past few years. People are not only using smart phones for communication, texting or browsing internet but it has greatly become a mode to play games of one's own choice, listen to music and watch videos. It would be better to say that it has become an essential part of life [2]. Hence, it has become an ideal device for malicious users [3].

Moreover it is a portable and accessible device that makes it possible to use it anywhere at any time. A research shows that the smart phone usage is estimated to be 2.87 billion users worldwide in 2020 [4]. It is said by youngster that they cannot exist without smart phone as it has become a part of their life. And it is no longer common to see youngsters carrying their smart phone in their hands while driving, eating or walking through a street [5].

Therefore it's tempting features has persuaded our adolescents to spend a lot of their time on smart phones for socializing and communicating with others which is initially a habit but later on becomes an addiction [6]. Many studies have reported that adolescents spend approximately 10 hours on social media daily [7].

Where on one hand it provides us a lot of amazing features there on the other hand its widespread use has negative outcomes on physical and mental health. It's extensive use can be associated with musculoskeletal complications that is pain in neck and hand after continuous usage of many hours [5].

Frequent smart phone usage requires interaction of thumb and fingers to use mobile screen. Previous reports have shown that while carrying smart phone in your hands with an awkward posture of wrist may lead to wrist joint disorders. Repetitive hand's steady motion may prevent supply of nutrients to muscles and also decrease blood supply of hands thus leading to muscle fatigue [8].

A study by Fiaq and Huseyin et al in 2018 stated that phone use has been increased in recent years and it can cause many diseases of hands. It can lead to carpel tunnel

syndrome by affecting median nerve. It also stated that De Quervain's disease occurs commonly in smart phone users who type more than 50 messages a day. Furthermore, there are applications used to send and receive messages on smart phone so researchers diagnosed a disease called bilateral extensor pollicis longus tendinitis also named as Whatsappitis [9].

Another study by Esra Erkol et al concluded after an observational study that overuse of smart phone can cause pain and numbness in thumb. It can also increase the median nerve's cross-sectional area and ultimately decreasing hand function and pinch strength [10]. However, many other researches reported the relation of smart phone usage and musculoskeletal disorders which concludes that repeated fingers and thumb movements and repeated grasping activities could lead to dysfunction of upper limb [11]

Moreover a previous study by Nadia et al compared high frequency smart phone users and low frequency smart phone users and stated that function and pinch strength of hand was found to be decreased in high frequency smart phone users [1]. Further Zhiyong ming et all discussed the cause of a case report to aware people which stated that people who are using smart phones since three years can face upper limb impairments [12].

Despite such extensive usage of mobile phone, the effects on hand performance have not elaborated yet. Very few studies have been conducted on children or people of older age but not on young adults. People are experiencing pain and paresthesia in hand after using cell phone. So awareness among young adults who are addictive is required. Therefore this study will highlight the effect of using a smart phone on hand performance.

3. Methodology

3.1. Study design

It was analytical cross sectional study.

3.2. Sampling technique

Convenient sampling technique was used to collect the data.

3.3. Study Settings

The data was collected from Superior university Lahore.

3.4. Duration

6 month

3.5. Sample Size

Sample size was 112. Data was analyzed through SPSS version 23.

3.6. Eligibility Criteria

This study was conducted after the approval from ethical review board of the concerned institutes. An informed consent from Superior University Lahore was assigned to confirm the proceeding of the study in institute.

3.7. Inclusion criteria

- Students aged between 18-24 years.
- who use smart phone at least 4 hours a day were included in the study.

3.8. Exclusion criteria

- Students having no history of smart phone use were excluded from the study.

Number of students who fulfilled the inclusion criteria were provided with questionnaire form. An informed consent was taken from the subjects. Quick DASH questionnaire, Smartphone addiction-short version(SAS- SV) form and a tool named dynamometer was used for data collection. The data was collected under proper COVID-19 protocol i.e proper social distancing among students, wearing a mask and use of sanitizer after dynamometer tool use. The data collection procedure proceeded once the informed consent form was filled. The particulars of the research were explained to the students prior to the data collection and any query was clarified. Quick DASH questionnaire whose reliability was found to be 0.97 was used to measure the level of disabilities of upper extremity of the subjects. SAS-SV(Smart phone addiction scale -short version) whose validity was 0.967, sensitivity value 0.867 and specificity value 0.893 was used to measure the smart phone addiction level of the subjects. Incomplete Questions were not included in the data entry (Table 1-16).

Demographic data

Table 1: Gender of the participants

	Frequency	Percent
Male	55	49.1
Female	57	50.9

N=112

Male and female percentage was almost equal

Table 2: Mean age of the participants

	N	Minimum	Maximum	Mean	Std. Deviation
Age	112	18	24	20	2.321

N=112

Mean age was found 20 years with minimum 18 years and maximum 24 years

Table 3: Smart phone addiction scale

		Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Missing planned work due to smart phone use.	N=112	2	3	9	31	47	20
	%age	1.8	2.7	8	27.7	42	17.9
Having a hard time concentrating in class, while doing assignments or while working due to smart phone use.	N=112	0	4	13	34	45	16
	%age	0	3.6	11.6	30.4	40.2	14.3
Feeling pain in the wrists or at the back of neck while using a smart phone.	N=112	16	31	43	16	6	0
	%age	14.3	27.7	38.4	14.3	5.4	0
Won't be able to stand not having a smart phone.	N=112	5	2	6	38	42	19
	%age	4.5	1.8	5.4	33.9	37.5	17
Feeling impatient and fretful when I am not holding my smartphone.	N=112	2	6	7	38	43	16
	%age	1.8	5.4	6.3	33.9	38.4	14.3
Having my	N=112	3	5	16	43	39	6
smartphone in my mind even when I am not using it.	%age	2.7	4.5	14.3	38.4	34.8	5.4
I will never give up using my smartphone even when my daily life is already greatly affected by it.	N=112	4	15	23	40	24	6
	%age	3.6	13.4	20.5	35.7	21.4	5.4
Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook.	N=112	5	7	12	32	35	21
	%age	4.5	6.3	10.7	28.6	31.3	18.8
Using my smartphone longer than I had intended.	N=112	2	3	7	39	49	12
	%age	1.8	2.7	6.3	34.8	43.8	10.7
The people around me tell me that I use my smartphone too much.	N=112	2	1	5	28	49	27
	%age	1.8	0.9	4.5	25	43.8	24.1

Table showing smart phone addiction scale answers

Table 4: Smart Phone Addiction Score

	N	Minimum	Maximum	Mean	Std. Deviation
Smart Phone Addiction Score	112	14	57	42.2054	6.80903

N=112

Mean smart phone addiction score was found 42 out of total 60 with minimum 14 and maximum 57 scores. The score ranges from 10 to 60 with highest score being maximum presence of smart phone addiction. The cut off value for male is 31 and for female is 33.

Table 5: QUICK Disability of arm, shoulder and hand (Quick DASH)

		Frequency	Percent
Open a tight or new jar.	NO DIFFICULTY	83	74.1
	MILD DIFFICULTY	28	25
	MODERATE DIFFICULTY	1	0.9
Do heavy household chores (e.g., wash walls, floors).	NO DIFFICULTY	57	50.9
	MILD DIFFICULTY	48	42.9
	MODERATE DIFFICULTY	7	6.3
Carry a shopping bag or briefcase.	NO DIFFICULTY	46	41.1
	MILD DIFFICULTY	65	58
	MODERATE DIFFICULTY	1	0.9
Wash your back	NO DIFFICULTY	54	48.2
	MILD DIFFICULTY	58	51.8
	MODERATE DIFFICULTY	0	0
Use a knife to cut food	NO DIFFICULTY	108	96.4
	MILD DIFFICULTY	4	3.6
	MODERATE DIFFICULTY	0	0
Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g.,	NO DIFFICULTY	50	44.6
	MILD DIFFICULTY	56	50
	MODERATE	6	5.4
golf, hammering, tennis, etc.).	DIFFICULTY		

N=112

74.1% have NO DIFFICULTY in Opening a tight or new jar, 50.9% have NO DIFFICULTY in Doing heavy household chores (e.g., wash walls, floors), 58% have MILD DIFFICULTY in Carrying a shopping bag or briefcase, 51.8% have MILD DIFFICULTY in Washing back, 96.4% have NO DIFFICULTY in Using a knife to cut food, 50% have MILD DIFFICULTY in Recreational activities in which take some force or impact through arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).

Table 6: Disability of arm, shoulder and hand (Quick DASH): During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups?

	Frequency	Percent
NOT AT ALL	48	42.9
SLIGHTLY	58	51.8
MODERATELY	6	5.4

N=112

In 51.8% participants arm, shoulder or hand problem have interfered with normal social activities with family, friends, neighbors or groups, During the past week. 42.9% have felt no interference at all

Table 7: Disability of arm, shoulder and hand (Quick DASH): During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?

	Frequency	Percent
NOT LIMITED AT ALL	47	42
SLIGHTLY LIMITED	60	53.6
MODERATELY LIMITED	5	4.5

N=112

53.6% were slightly limited in work or other regular daily activities as a result of arm, shoulder or hand problem, during the past week. 42% were not limited at all

Table 8: Disability of arm, shoulder and hand (Quick DASH): Please rate the severity of following symptoms in the last week**:**

		Frequency	Percent
Arm, shoulder or hand pain	NONE	47	42
	MILD	48	42.9
	MODERATE	17	15.2
Tingling (pins and needles) in your arm, shoulder or hand.	NONE	47	42
	MILD	44	39.3
	MODERATE	21	18.8

N=112

42.9% have mild pain in Arm, shoulder or hand and 42% have no pain. 42% have no Tingling (pins and needles) in arm, shoulder or hand and 9.3% have mild Tingling (pins and needles) in arm, shoulder or hand.

Table 9: Disability of arm, shoulder and hand (Quick DASH): During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand**?**

	Frequency	Percent
NO DIFFICULTY	38	33.9
MILD DIFFICULTY	48	42.9
MODERATE DIFFICULTY	23	20.5
SEVERE DIFFICULTY	3	2.7

N=112

42.9% experience mild difficulty in sleeping because of the pain in your arm, shoulder or hand, 33.9% have no difficulty in sleeping

Table 10: Disability of arm, shoulder and hand (Quick DASH): QUICK Disability of arm, shoulder and hand (Quick DASH)

	N	Minimum	Maximum	Mean	Std. Deviation
DASH score out of 55	112	11	25	17.25	3.74
DASH range out of 0- 100	112	20	46	31.36	6.806

N=112

Each item has 5 score scale which are calculated ranging from 0(no disability) to 100(most severe disability). Mean DASH score was found 31.36 out of 100 with minimum score 20 and maximum score 46. So participants were having mild to moderate level of disability

Table 11: Hand Dynamometer Reading (KG)

	N	Minimum	Maximum	Mean	Std. Deviation
Hand Dynamometer Reading (KG)	112	15	70	34.08	13.026

N=112

Mean reading from dynamometer was found 34KG with minimum 15KG and maximum 70KG.It is a device used to measure maximum isometric strength of hand and forearm muscles. The instrument is scored using force production in kg (0-90) or in pounds (0- 200).

Table 12: Independent sample t test: Gender Vs. Smart Phone Addiction Score

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Smart Phone Addiction Score	Male	55	41.42	6.534	0.881
	Female	57	42.96	7.038	0.932

N=112

P value 0.231

P value shows that there is non-significant difference of Smart Phone Addiction Score between male and female although female were found having slightly higher Smart Phone Addiction Score than male.

The score ranges from 10 to 60 with highest score being maximum presence of smart phone addiction. The cut off value for male is 31 and for female is 33.

Table 13: Independent sample t test: Gender Vs. DASH range out of 0-100

	Gender	N	Mean	Std. Deviation	Std. Error Mean
DASH range out of 0- 100	Male	55	31.63	6.939	0.936
	Female	57	31.09	6.726	0.891

N=112

P value 0.678

P value shows that there is non-significant difference of DASH range out of 0-100 between male and female although male were found having slightly higher DASH range out of 0-100 than female. Each item has 5 score scale which are calculated ranging from 0(no disability) to 100(most severe disability).

Table 14: Independent sample t test: Gender Vs. Hand Dynamometer Reading (KG)

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Hand Dynamometer Reading (KG)	Male	55	45.13	8.905	1.201
	Female	57	23.42	4.935	0.654

N=112

P value 0.000

P value shows that there is significant difference of Hand Dynamometer Reading (KG) between male and female and male were found having higher Hand Dynamometer Reading (KG) than female. The instrument is scored using force production in kg (0-90) or in pounds (0-200).

Table 15: Pearson's Correlations

		Hand Dynamometer Reading (KG)	Smart Phone Addiction Score
Hand Dynamometer Reading (KG)	Pearson Correlation	1	-.208*
	Sig. (2-tailed)		0.028
	N	112	112
Smart Phone Addiction Score	Pearson Correlation	-.208*	1
	Sig. (2-tailed)	0.028	
	N	112	112
*. Correlation is significant at the 0.05 level (2-tailed).			

P value .028

Table shows that correlation value is -.208, which shows that there is negative correlation between smart phone addiction and hand grip strength. Increasing smart phone addiction decreases the hand grip strength. P value shows that there is significant correlation

Table 16: Pearson's Correlations

		Smart Phone Addiction Score	DASH range out of 0-100
Smart Phone Addiction Score	Pearson Correlation	1	0.035
	Sig. (2-tailed)		0.716
	N	112	112
DASH range out of 0-100	Pearson Correlation	0.035	1
	Sig. (2-tailed)	0.716	
	N	112	112

N=112

P value .716

Table shows that correlation value is .035, which shows that there is positive correlation between smart phone addiction and upper limb disability. Increasing smart phone addiction increases the upper limb disability.

P value shows that there is non-significant correlation

4. Discussion

It is presently common in our young generation to spend numerous hours each day on mobile phones playing games, conversations and browsing internet [4]. As a result of this extensive usage we can assume awkward and poor postures of upper limb. And therefore suffering from musculoskeletal complications [21]. This study examined the effects of smart phone addiction with hand grip strength and upper limb disability in young adults.

The results of this study reveals that increasing smart phone addiction decreases the hand grip strength and increases the upper limb disability. The percentage of males and females participants were almost equal. The mean age taken was 20 years with minimum 18 years and maximum 24 years. Mean smart phone addiction score found was 42 out of total 60 with minimum 14 and maximum 57 scores. Another quick DASH questionnaire was used to predict level of upper limb disability. Mean DASH score was found 31.36 out of 100 with minimum score 20 and maximum score 46. So participants were having mild to moderate level of disability.

The Independent sample t test between Gender and Smart Phone Addiction Score(P value is 0.231) showed that there is non-significant difference of Smart Phone Addiction Score between male and female although female were found having slightly higher Smart Phone Addiction Score than male.

Independent sample t test between Gender and Hand Dynamometer Reading (KG) P value showed that there is significant difference of Hand Dynamometer Reading (KG) between male and female and male were found having higher Hand Dynamometer reading(KG) than female. Pearson's corelation test showed there is significant negative correlation between smart phone addiction and hand grip strength. It was also found that there is non-significant positive correlation between smart phone addiction and upper limb disability.

A previous observational study was conducted by Nadia L.Radwan in 2020. It consists of two groups with children aged 9 and 15. One group contain high frequency smart phone users and other contain low frequency smart phone users. The aim of study was to determine effect of smart phone usage on hand grip and pinch strength. It was concluded that high level of smart phone use diminished hand and pinch grip strength [1]. Comparing previous study with this study, a total of 112 participants based on inclusion criteria were included. The analysis of this study reveal that level of upper limb disability found by quick DASH was of mild to moderate level. The Smartphone addiction scale(SAS-SV) was found to be maximum. The aim was to determine hand grip strength and upper limb disability due to excessive smart phone usage. The results showed that there is significant co- relation of smart phone addiction with hand grip strength and non significant co- relation with upper limb disability.

Another study by Noha Soliman et al in 2018 conducted an observational study including 420 students of physical therapy. The title of study was Smartphone addiction and its relation to musculoskeletal pain in Egyptian physical therapy students. The aim of study was to evaluate the prevalence of Smartphone

addiction and its relation to musculoskeletal pain among both male and female physical therapy students. Comparisons of males and females was made by t-test and Chi-square tests. The prevalence showed that females were seemed to be more addictive to smart phones as compared to males and percentage of addiction was found to be 62.4%. Results showed a significant relation of smart phone addiction among physical therapy students with musculoskeletal complications [17]. While in this study out of 112 participants, 55(49.1%) were males and 57(50.9%) were females. The analysis revealed that smart phone addiction was found to be slightly higher in females than males.

M. Megna et all in 2017 conducted an observational study. This study narrates that Smart phone usage requires repeated movement and overuse of distal interphalangeal joints and nails. The aim was to determine the impact of smart phone addiction on hand joints of young psoriatic patients. Each subject underwent an ultrasound examination of both hands. It was found that Smartphone overuse was linked with inflammation of musculoskeletal structures of hands joints. Therefore, overuse can be a factor which facilitate of development of psoriatic arthritis [22]. In contrast with the results of this study it shows that smart phone addiction has significantly positive co- relation with upper limb disability.

Aly et al reported that repetitive strain injuries can be caused by repeated movement of fingers which is performed for longer periods at high velocity [23]. Previous studies on hand pain due to repetitive task show that hand function and pinch strength was found to be decreased because of frequent smart phone use. This study's results is supported by Kim et al who found that frequent smart phone use results in reduced hand grip strength and function [24].

In this context, poor postures such as prolonged wrist flexion and repeated thumb movement while using smart phone can affect median nerve. Ilik et al reported that repeated wrist-flexion and extension motions can have enlarged and swollen median nerves among high-frequency smart phone users [9].

Continuous contraction of muscles of upper limb with little or no resting time in between smart phone usage results into fatigue and weakness of muscles. Thus main a muscles of hand the upper trapezius, extensor pollicis longus, and abductor pollicis are affected. This is consistent with finding by El-Azab et al. who reported a positive correlation between routinely smart phone usage time and the severity of upper-limb symptoms such as pain, exhaustion, and poor posture which impact upper-limb functions [25].

5. Conclusion

This study concluded that there is remarkably increased level of smart phone addiction among young adults. Smart phone addiction was found slightly higher among females. Upper limb disability was found mild to moderate level, which was found slightly higher among male students. Hand grip strength was found very high among male students than female. It was found that there is significant negative correlation between smart phone overuse and hand grasp strength in young adults. It was also found that there is non-significant positive correlation between smart phone addiction and upper extremity dysfunction.

6. Limitations and Recommendations

A cross-sectional survey was conducted. There was no follow-up in this study.

Further longitudinal cohort studies are recommended.

Due to covid-19 access was limited to get the desired population.

The study can be conducted by specifying a certain type of mobile brand.

Specific screen size of mobile effects on upper extremity should be studied furthur.

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