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# **Effects of smartphone addiction on sitting neck posture & hand discomfort: A cross sectional study**

**Rani Ojha**

Student MPT (Orthopedics), SGT University, Gurugram

**Dr Bijender Sindhu**

Associate Professor, SGT University, Gurugram, Haryana

**Dr Siddhartha Sen**

Professor, SGT University, Gurugram, Haryana

**Abstract**--Background: The expanding number of Smartphone users, on the other hand, has sparked concerns about the impact of smartphones on human health and life. Neck posture, particularly in a sitting position, is regarded an essential contributing factor to the development and long-term maintenance of neck pain and headache. Purpose: The purpose of the study was to see how smartphone addiction affected on sitting neck posture, along with hand discomfort among university students in the SGT age group (18 to 25). Method: The current study was conducted at SGT University, where 150 students from various professions were chosen at random basis from the age group of 18 to 25 years old with both men and women. The study included those who used their smartphones for more than 4 hours every day. The abbreviated version of the Smartphone Addiction Scale was used to determine the extent of smartphone addiction. The Cornell hand discomfort questionnaire was used to assess hand discomfort, and the sitting neck posture (neck flexion, craniocervical angle, and cervicothoracic angle) was assessed using the photographic method. Result: According to the findings of this study, many SGT university students are addicted to using their smartphones. SAS with craniocervical angle, neck flexion with cervicothoracic angle, neck flexion with craniocervical angle, continuous Smartphone usage were all significantly different. Conclusion: The study concluded that prolonged use of Smartphone reduces the cranio-cervical angle, cervico-thoracic angle and increases the forward neck flexion.

**Keywords**--smart phone addiction, sitting neck posture, hand discomfort.

## Introduction

The Smartphone has become a need for the current age, and today everyone is reliant on it. Unlike a regular mobile phone, a Smartphone can be used to access the internet, providing additional benefits to users. [Alosaimi, F. D et al., 2016]. The expanding number of Smartphone users, has sparked concerns about the impact of smartphones on human health and life. Several research highlights included recent critical facts and research analysis of the smartphone on several human health difficulties with which certain populations are unaware of some severe adverse effects that are hurting their health on a daily basis [Tim Robinson, Thomas Cronin et al., 2013]. The smartphone has made life easier by bringing various items to the front door; with the assistance of the Smartphone, it is now easier to carry out work anywhere at any time; there is no need to queue; thus, the Smartphone has made life easier and much more comfortable. However, looking at the other side of the coin, the Smartphone has had a significant impact on our lives, as individuals are now more likely to spend time on their phones rather than engaging in other activities [Lee, H. et al., 2017]. Prolonged use of the Smartphone has also affected posture, resulting in many muscular skeletal disorders or improper posture, among other things. [Wu, R. C., Morra et al., 2010]. Neck posture, particularly in a sitting position, is regarded an essential contributing factor to the development and long-term maintenance of neck pain and headache [Lee, J., et al., 2014]. A common clinical brief that a more forward head posture is connected with neck pain and headaches has prompted researchers to look into sagittal neck posture in a sitting position. Because of the increased gravitational moments and torque at C7, forward head posture may increase load on passive cervical structure (joints, ligaments) and posterior neck musculature. [Karen V.Richerd et.al, 2016]. FHP weakness causes the deep cervical flexor muscles, the mid-thoracic rhomboid muscle for scapular retraction, and the mid and lower trapezius muscular activity to increase more FHP than in the right anatomic position, causing muscle overuse pain in the majority of patients. Fatigue and stress in the neck and shoulder are more common with touch-screen computers than with desktop computers, according to Kim, S. Y., et al., 2016 small display devices such as smartphones and tablets have smaller monitors. People who use computers stoop and look down more than those who use desktop computers. Smartphones have small monitors that are often held downwards near the laps, users mostly use them in a static position and with their neck and shoulders unsupported heads to see the screen increasing activity in the neck extensor muscles overloading the neck and shoulder increases muscle fatigue decreases work capacity and effects the musculoskeletal system [Lee, S. Y. et al., 2016]. Long and continuous Smartphone use causes postural alterations in the cervical and lumbar vertebrae, as well as proprioception deficits in the cervical vertebrae, according to one study but no study has yet investigated changes in proprioception with respect to the graduate of Smartphone addiction [Lee H et al., 2017]. Unlike traditional telephones, smartphones incorporate a range of digital gadgets. Smartphones have accelerated societal transformation by meeting consumers' wants and providing conveniences that have substantially increased their availability when working on computers and operating system. Given the mobility nature of smartphones, users frequently hold the device with a single hand, forcing just the thumb to utilize the keypad, which can be associated with physical health problems such as discomfort and musculoskeletal disorders

of the hand and thumb [Akodu, A. K., et al., 2018]. Furthermore, it has been observed that university students spend an average of >3.5 hours per day on their phones for texting, emailing, scheduling, and browsing the internet since they frequently experience pain at the base of the thumb when using a single-handed device. Smartphone addiction is similar to internet addiction in many ways, but there are some differences, such as the ease of real-time internet access and easy and direct communication features of the Smartphone behavior addiction, such as Smartphone addiction is difficult to define because it affects not only the physical but also the social and psychological aspects of life [Baabdullah, A., et al., 2020].

## **Methodology**

### **Sample**

The current study included 150 students from all of SGT university's professional streams who were between the ages of 18 and 25, and who used their smartphones for more than 4 hours per day. Sample size was calculated using G\*Power 3.1.9.4 Software for Windows. All the subjects were included using Convenient Sampling method. Subjects were excluded from the study who have any Neurological and musculoskeletal conditions like cervicogenic condition, neck fracture etc.

### **Ethical Approval**

The study design received ethical approval from the SGT University department research committee, Faculty of Physiotherapy, with reference number SGT/FOP/2020/36.

### **Procedure**

The participants were given four booklets, each including an informed consent form, an evaluation form, an SAS-SV questionnaire, and a hand discomfort questionnaire. The participants were first requested to sign the consent form, after which the following process was carried out. The subjects were asked to circle the statement that most closely described their Smartphone use characteristics using the English version SAS-SV scale, which consisted of 33 questions and six factors with a six-point scale ranging from (1) strongly disagree to (6) strongly agree, based on self-reporting and was asked to circle the statement that most closely described their Smartphone use (Min Kwon et.al 2013). The individuals were instructed to fill out the Cornell hand discomfort questionnaires by ticking the statements that most closely described their hand-discomfort characteristics listed on the questionnaire.

Sitting neck posture was calculated by the neck flexion angle, cervicothoracic angle, and craniocervical angle. A red dots stickers were applied on the bony landmarks over outer canthus, tragus, C7 spinous process, and T12 spinous process on the participants' right side to assess sitting neck posture. A lateral view photograph was taken by using NIKON DSLR camera. Nikon (D7100) was mounted on a tripod 80cm from the floor and 250cm perpendicular to the

participant. A 25cm plumb line was suspended from the stool to calibrate distance and calculate vertical distance. Participants sat on a stool with their thighs horizontal and knees flexed to 90 degrees for right-sided lateral photographs. Each participants were advised to sit normally, relax, and look straight ahead, according to the standardized instructions used to position them in order to achieve the regular posture of the head and neck. Corel Draw software version 17.0.0.491 for Windows 10 was used to draw the angle of neck posture. The images were loaded to a Lenovo idea pad 330 laptop, for measuring the angle. (Sen, S., & Singh, A. D. 2017).

Hand discomfort was measured using cornell hand discomfort scale. The questionnaire was given to the respondents in order to determine the region of hand discomfort and their mobile usage, and they were requested to fill it out. In the questionnaire, a shaded area depicted the pain and discomfort, based on the shaded area specified in the questionnaire. The subjects were asked to tick the box if they had any pain or discomfort mentioned on the picture. The questionnaire was split into two sections: left and right, each hand was separated into six locations, each of which was further subdivided into three categories: (1) duration of discomfort/pain, (2) severity of discomfort/pain, and (3) did discomfort/pain interfere with the patient's ability to work (Kishor Kumar Damodaran et.al 2019)

## Results & Discussion

### Results

Statistical analysis for Smartphone addiction, sitting neck posture, and hand discomfort of 100 subjects were done by using software SPSS 21.00 for windows version. The results were considered statistically at  $p < 0.05$ . Pearson correlation test was used was used to analyze the correlation between SAS versus neck flexion, craniocervical angle, cervicothoracic angle and discomfort. The result showed significant correlation between SAS and craniocervical angle (.0001). Pearson correlation test was used to find out the difference between SAS versus cervical error (.947), SAS versus neck flexion (.923), SAS versus cervicothoracic angle (.890), SAS versus craniocervical angle (.000), SAS versus discomfort (.149). Therefore, it is analyzed that only the relation between SAS versus craniocervical angle was significant. The result was used to find out difference of neck flexion versus craniocervical angle (.028), neck flexion versus discomfort (.076) was statistically insignificant. Only the relation between neck flexion and cervicothoracic angle (.000) was significant.

Variables	N	Mean $\pm$ SD
Age	150	
Height	150	166.20 $\pm$ 7.37
weight	150	59.09 $\pm$ 7.31
BMI	150	21.16 $\pm$ 2.60

Table1: Correlation between Addiction and Neck posture

Variables		Mean± SD	r-value	p-value
SAS versus Neck flexion	SAS	.55 ± .97	-.010	.923
	Neck flexion	59.57 ± 10.60		
SAS versus Cervicothoracic angle	SAS	.55 ± .97	-0.14	.890
	Cervicothoracic angle	143.62 ± 6.76		
SAS versus Craniocervical angle	SAS	.55 ± .97	-.642	.0001
	Craniocervical angle	143.92 ± 15.72		
SAS versus discomfort	SAS	.55 ± .97	-.146	.149
	Discomfort	11.63 ± 1.54		

Table1: Correlation of different neck posture

Neck flexion Versus Cervicothoracic angle	Neck flexion	59.57 ± 10.60	-.440	.000
	Cervicothoracic angle	143.62 ± 6.76		
Neck flexion Versus Craniocervical angle	Neck flexion	59.57 ± 10.60	-.221	.028
	Craniocervical angle	143.92 ± 15.72		
	Discomfort	11.63 ± 1.54		
Cervicothoracic angle versus Craniocervical	Cervicothoracic angle	143.62 ± 6.760	.239	0.17
	Craniocervical	143.92 ± 15.72		
Cervicothoracic angle versus discomfort	Cervicothoracic angle	143.62 ± 6.760	-.067	.512
	Discomfort	11.63 ± 1.54		

## Discussion

The current study looked into the relationship between Smartphone usage length and hand discomfort, sitting neck posture, cervical repositioning error, forward head posture, and other issues among young people, such as college students aged 18 to 25. Overuse of smartphones has been linked to increased fatigue and weakness of the deep flexor and dorsal neck extensor muscles at high force levels compared to subjects who use their phones for less than 4 hours per day and maintain proper posture, resulting in cervical repositioning error and increased cranio-cervical and cervical-thorax angles (Roren et.al 2009). Reduced muscle strength and tiredness can modify sensory receptor firing (Golgi tendon organ or muscle spindles) and so influence afferent inputs, resulting in impaired proprioception. (Hill JM, 2001 & Pedersen J et al, 1998).

This study discovered a highly significant relationship between Smartphone addiction (SAS) with cranio-cervical angle and neck flexion with cranio-cervical angle and cervicothoracic angle Because when a person uses a phone whether in sitting or standing position he or she bends the head forward and looks down at

a 45 or 65 degree angle placing about 50 to 60 pounds of force on the neck, the neck is unable to sustain this kind of pressure for an extended period resulting in neck pain and an increase in the cranio-cervical and cervicothoracic angles.

If not addressed the continuous use of Smartphone could cause forward head posture, which may worsen over time and lead to even more pain and reduced mobility in the neck, upper back and shoulder. In some cases, the excessive forward head posture may exacerbate or accelerate degenerative condition in the cervical spine such as cervical degenerative disc disease (Alsalamah, A. M, 2019) When high frequency Smartphone users were compared to low frequency Smartphone users, multiple musculoskeletal difficulties such as increased neck flexion angle (cranio-cervical angle), cervical thoracic angle, and hand discomfort were reported. It was also discovered that people who used their phones for more than 4 hours per day were more likely to have cervical repositioning error, increased cranio-cervical angle, and cervicothoracic angle than people who used their phones for less than 4 hours per day (Ahmad Osailan, 2021). When comparing individuals with neck-shoulder discomfort to those who do not have shoulder-neck pain, the upper trapezius and cervical erector muscles exhibit increased activity while texting.

Using a smartphone, participants were asked to keep their heads in a flexion position (33-45 degrees) from vertical. According to the findings, when texting or doing other duties on a cellphone, the head is in a higher flexion posture. The study's findings also suggest that texting is becoming more popular, and that it is the leading source of neck pain (Luk, T. T et al., 2018). There is a link between the amount of time spent on a smartphone and neck, shoulder, and back pain while the head is in the flexion position. Electromyography is used to measure muscular fatigue in the trapezius upper fiber and the cervical erector spine muscle. This illustrates that as the amount of time spent on a smartphone increases, so does the amount of pain and exhaustion (Kim, S. E et al, 2015).

The flexion angle of the cervical and lumbar spines, as well as the error of the cervical spine, are linked to the amount of time spent on a smartphone. After 300 seconds of smartphone use, the repositioning error in the upper and lower cervical spine, as well as the flexion angle in the lower cervical and lumbar spine, increased dramatically. [Cha, S. S., et al., 2018] It has been determined that prolonged cell phone use causes alterations in cervical proprioception, as well as changes in cervical and lumbar posture. When evaluated with an inclinometer, there is a substantial flexion of the cervical spine while using a smartphone, as well as an error was found in cellphone-addicted people. The survey found that smartphone addiction has a negative impact on cranio-cervical angle and posture, as well as the occurrence of muscle difficulties in teens who are addicted to smartphones (M. Hussain Iqbal et al, 2017).

High-frequency smartphone users exhibited an expanded higher pain in the thumb, and lower pinch strength and hand functioning. The majority of previous studies found that excessive smart phone use has negative impacts on the hands, neck, and median and ulnar nerve integrity. (Aygul, T. A., et al., 2019). The usage of a Smartphone for an extended period of time increased the repositioning error of the upper and lower cervical vertebrae (Mustafaoglu, R. et al., 2021). Patients

with chronic neck discomfort had a bigger repositioning mistake than healthy individuals according to (Cho, G. Y., et al., 2014). Furthermore, severe neck flexion caused by the usage of a smartphone might harm the surrounding structure around the cervical vertebrae and ligaments, leading to forward head position. Sitting in a bending position for an extended period can raise the craniocervical angle and the cervicothoracic angle (Al-Barashdi, H. S et.al 2015).

Smartphone and tablet screens are more usually viewed when flat on a table or lap than TVs and personal computers, which means the screen angle is more severe. As a result, the neck and head are typically leaned further forward to watch Smartphone than other screens. (Liu, C. H et al., 2016). There was also a significant relationship between BMI and craniocervical angle and discomfort in this study. This is because extra weight is not only detrimental for the lower back, but it can also induce tension in the upper back and neck, as well as raise the craniocervical angle. Chronic neck pain can be caused by poor posture and unequal weight distribution. People with a BMI of 25 or higher, based on their height, weight, and age, were considerably more likely to report chronic neck discomfort and a higher neck flexion angle. (Nejati, P et al., 2015).

Overall, the findings imply that using a Smartphone for an extended period can alter proper posture by inducing forward head position and raising the craniocervical and cervicothoracic angles, which can contribute to musculoskeletal disorders. Limitation of the study was that the size and the weight of the Smartphone was not mentioned, as its also plays a role for generating neck pain, the age group was limited only younger generation was considered and any other musculoskeletal condition except neck & shoulder pain was not examined.

## **Conclusion**

The results of this study revealed that the craniocervical angle, neck flexion, cervicothoracic angle, and craniocervical angle were all significantly increased because of long-term or excessive Smartphone use as compared to hand discomfort.

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