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Correlation Between Cervical Posture and Cervical Proprioception Among Chronic Smartphone Users

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ABSTRACT

Background: The Smartphone, an invention of humanity, became an inherent part of human life. The gradual escalation of its use from a "habit" to an addiction is growing with a need to gauge them. It has been reported that smartphone users maintain head flexion of 33°–45°; continuation of this attitude may alter muscle length and its orientation, followed by a change in the joint position of the cervical spine. Cervical posture and proprioception are critical in postural stability, reflex activity, and head-and-eye coordination. Therefore, this study is conducted to assess the changes and determine and alleviate the adverse effects among chronic smartphone users.

Methods: A non-experimental study design and correlational study type with a convenient sampling method were performed. One hundred ten participants of both genders aged 18-25 years from in and around Chennai were scrutinized for smartphone addiction. Participants' cervical posture and proprioception were assessed using the Joint position error test and photogrammetry method for men and women who obtained more than or equal to 31 and 33, respectively.

Results: This study shows a weak positive correlation between cervical posture and proprioception (r=0.053, p=0.715) among smartphone users.

Conclusion: This study concludes that various medical ailments can be avoided with early intervention and adequate awareness concerning smartphone usage and its detrimental impacts. These findings shed light on the potential health risks associated with smartphone usage, providing valuable insights for medical professionals, researchers, and individuals.

Keywords: Smartphone addiction, cervical posture, cervical proprioception, Craniovertebral angle, photogrammetry method, Joint position error test.

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INTRODUCTION

The evolution of technology has had a significant impact on humankind. It's hard to deny thatwe live in a technologically advanced world. Smartphones, which have become an integral part of human life, have brought many positive and negative effects. The employment of smartphones has progressed to the point where it has become an addiction rather than a habit.

Repetitive and excessive use of any substance or device despite knowing its adverse effects is known to be an 'addiction' [1]. The World Health Organization describes addiction as "dependence on or persistent use of something for relief or relaxation that induces longing when it is not present." Smartphone addiction, internet addiction, and cell phone addiction are a few examples of recent addictions. Chronic smartphone users have used their phones for over six months [2,3].

Smartphones have been among the most compulsive amenities of today's youth worldwide. Young adults, especially college students, are more likely to use smartphones. According to estimates, India's smartphone users are expected to exceed 820 million by 2022 [4]. The prevalence of mobile phone addiction was low in 27%, moderate in 30%, and extreme in 43% of those between the ages of 18 and 25. The 1st most common musculoskeletal symptoms endured by smartphone users among university students, as per Tonga et al. (2017), were in the neck (59.6%), shoulder (51.82%), and upper back regions (54.4%) [5].

Excessive smartphone use harms both physical and mental psychological well-being. There is a need to evaluate, minimize, and prevent the adverse effects of smartphone use among teenagers and young adults aged 18-25, including postural sway, altered eye movement regulation, disturbed head and neck perception, and decreased reflex function [6].

Among Chronic smartphone users, back pain, tendon injuries, carpal tunnel syndrome, neck pain, thumb and wrist pain, radiation-related difficulties, inattention blindness, anxiety, headache, insomnia, depression, poor sleep quality, exhaustion, reduced focus, and cell phone dependence are all common complaints. A good posture is described as the proper alignment and positioning of body segments about gravity. Correct posture is accomplished by maintaining musculoskeletal equilibrium with minimal stress on the body, and it is a critical factor to consider when assessing one's health [7].

Smartphone users have a common head-shifted position, which may contribute to forward head posture [8]. It has been recorded that users sustain a head flexion of 33°–45° from vertical when looking at a smartphone [9]. This asymmetrical position is described as having a forward head position with the lower cervical vertebrae flexed, and the upper cervical vertebrae hyperextended [10].

Peterson-Kendall et al. state that when the external auditory meatus is aligned with the shoulder joint, it is positioned anterior to the plumb line [11]. This alignment is typically measured using the craniovertebral angle, as defined by Wickens and Kiputh (1937) [12].

Long-term smartphone use can trigger forward head position, rounded shoulders, and other musculoskeletal complications [13]. Because the smaller mobile screen is kept so that the user holds a head flexion position for an extended period, the user's posture and strain are altered.

Proprioception is the sense of movement and spatial orientation resulting from stimuli inside the body in space. In basic terms, it is the sense of joint location. Proprioception is essential for maintaining body alignment and balancing the body.

Cervical proprioception especially plays a vital role in maintaining head and neck coordination. It has a significant role in proprioception due to densely compacted mechanoreceptors in the muscle spindles at the cervical region. Head and neck coordination, postural awareness, and gait regulation all function these muscle spindles.

Smartphone users' erroneous posture can potentially harm the spine's structures. Sustained pressure on the neck joints sends disturbed signals to the brain, leading to issues with balance and neck proprioception.

As a result, frequent smartphone use can lead to an awkward posture, which can distort and shorten muscle length, culminating in proprioception deficits.

However, there is a lack of studies investigating cervical posture and craniovertebral angle among smartphone users correlating the variables here. The results of this study would be helpful in early detection, prevention, and development ofa structured exercise regimen.

This study aimed to eliminate the knowledge gap on this vital subject by investigating cervical posture and proprioceptive function and correlating them with chronic smartphone users.

METHODOLOGY

The Institutional Ethics Committee (IEC)—2254(A)/IEC/2020 of SRM Medical College Hospital and Research Centre approved the study. An Observational study was conducted on 110 participants in and around Chennai (Tamil Nadu, India) pursuing undergraduate and postgraduate courses. The data was collected from November 2020 to May 2021. Based on the inclusion criteria, willing participants gave informed consent to participate in the study.

This study included young adults aged 18 to 25 years, including men and women studying undergraduate and postgraduate courses in English. Willing participants using Smartphones for more than six months and obtaining a score of more than or equal to 31 (men) and 33(women) on the Smartphone Addiction Scale-Short Version were also included.

Participants with a history of any cervical trauma, recent cervical fracture, progressive neurological disease, any vestibular pathology or dizziness, migraine congenital

spinal deformities, limb length inequality, rheumatic disease, Torticollis, Lumbar kyphoscoliosis, and also using spectacles we not included in the study.

An explicit description of the study was given before assessing cervical posture and proprioception. An in-depth orthopedic evaluation and cervical examination were accomplished using all protection and preventive approaches.

To check Smartphone addiction, A Smartphone Addiction Scale-Short Version questionnaire was issued to 110 participants [14,15]. Kwon et al. (2013) created and validated a 10-item adolescent self-reported questionnaire. It employs a six-point Likert scale ranging from "strongly disagree" to "strongly agree" [15]. The Smartphone Addiction Scale-Short Version questionnaire (SAS-SV) covered five content areas: everyday life disturbances, withdrawal, cyberspace-orientated relationships, overuse, and finally, tolerance. The participants who scored over or up to 31 (men) and 33(women) were assessed for cervical posture and proprioception.

Smartphone addiction was detected in 50 out of 110 participants, and their cervical posture and proprioception were assessed.

Photogrammetry was used to determine the cranial-vertebral angle. With participants standing, a lateral photograph was taken with a digital camera. All pictures were taken from the participant's right side [16]. The angle between the skull and the vertebrae is 49.9 degrees.[17] The camera was poised approximately 1.5 meters from the subjects and calibrated to their shoulders. To determine the craniovertebral angle, the spinous process of the 7th cervical vertebra and tragus of the ear were labeled with adhesive tape. Participants were asked to flex and stretch their necks to palpate the spinous process of the 7th cervical vertebra.

Figure 1: Cervical Posture

Figure 2: Measurement of Craniovertebral Angle

The photograph was taken and analyzed by Markus Bader (MB) ruler software to calculate the craniovertebral angle (the intersection of a horizontal line passing through the spinous process of the 7th cervical vertebra and the line entering the midpoint of the tragus of the ear is known as the craniovertebral angle). A smaller craniovertebral angle is associated with a more forward head posture [18,19].

To evaluate the accuracy of joint position sense of the neck, the Cervicocephalic Relocation Test (CRT) was incorporated [20]. A laser pointer placed on a lightweight headband is often used to determine cervical location sense in clinical settings. Participants were instructed to sit in a very relaxed position with their feet on the floor, knees, and hips at 90 degrees and to concentrate on the normal resting head position fora few seconds while sitting 90 cm away from the wall [20].

Figure 3: Joint Position Error Test

The participants were instructed to shift their heads to the right or left with their eyes

closed, then return to the resting position as precisely as possible. The participants completed three trials of cervical-lateral rotation. The difference in centimeters between the laser beam's starting and resting positions was measured and converted to degrees (angle = tan-1[error distance/90 cm]) [21]. The average of three attempts was determined, and joint position error was reported. An error distance of approximately 7.1 cm corresponds to a meaningful error of 4.5 degrees. Errors of morethan 4.5 degrees are thought to reduce head and neck relocation accuracy [22].

RESULTS

The obtained scores were interpreted using the IBM Statistical Package of Social Science (SPSS) version 20 for Windows. Descriptive and inferential statistics were performed. Descriptive statistics comprised the mean and standard deviation of age group, gender distribution, qualification, smartphone addiction, cervical posture (Craniovertebral angle), and cervical proprioception (Joint position sense). Inferential statistics were implemented to detect statistical correlation and significance between cervical posture and proprioception. The **Spearman correlation** was used to correlate the variables. The level of importance of the study was setat $p < 0.05$.

Table 1: Age Distribution

AGE	18	19	20	21	22	23	24	25
FREQUENCY OF PARTICIPANTS	5	7	6	7	9	6	5	5

Table 2: Gender Distribution

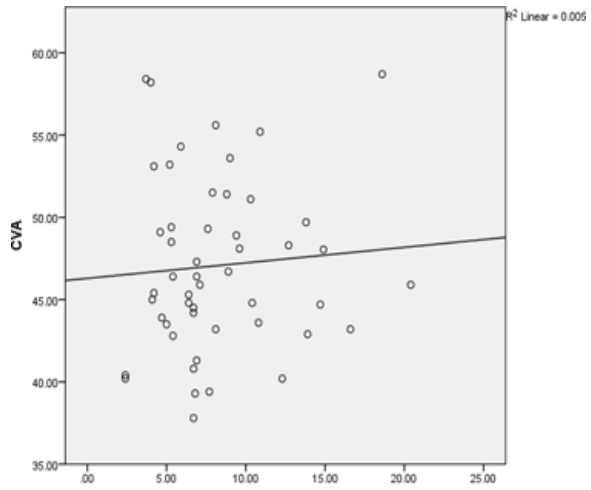
GENDER	MALE	FEMALE
FREQUENCY	21	29
PERCENTILE	58	42

Table 3: Qualification Distribution

GRADUATION	UG	PG
FREQUENCY	34	16
PERCENT	68	32

Table 4: Correlation Of Cervical Posture With Cervical Proprioception Among Chronic Smartphone Users

JPE		CVA		SPEARMAN CORRELATION	'P'Value
Mean	S.D	Mean	S.D		
8.228	4.051	47.068	5.233	0.053	0.715



The total number of participants is n=50, Mean and Standard Deviation of age is

20.64 & 1.078, mean & Standard Deviation of Joint position error is 8.228 & 4.051,mean & Standard Deviation of Craniovertebral angle is 47.068 & 5.233.

The Spearman correlation reveals a weak positive correlation (r = 0.053) between the variables and is not statistically significant (p = 0.715).

DISCUSSION

The study was done to determine the correlation between cervical posture and cervical proprioception in chronic smartphone users. Participants who volunteered for the study were asked to sign an informed consent form.

Participants aged 18 to 25 from Chennai and the surrounding areas participated in the study. After an in-depth orthopedic evaluation, participants were evaluated for smartphone addiction levels using the Smartphone Addiction Scale Short Version questionnaire. Out of 110 Participants, 50 were found to be smartphone addicts. These participants were assessed for cervical posture and proprioception. The average age of the participants in the sample was 20.64.

The photogrammetry technique determines cervical posture by measuring the craniovertebral angle [23]. Reveal developed the Cervicocephalic Relocation Test. et al. (1991), which determined the joint position error [20].

According to the results of this study, Daniel S. Harvie et al. (2016) found that proprioceptive defects can be present in neck pain subjects [24]. Also, according to Chihhsiu Cheng et al. (2010), a proprioceptive deficit is present in younger adults with chronic pain [25]. A small sample size in this study may also cause a weak positive correlation between variables.

The result of the study by Andrew Portelli et. Al. (2018) stated that more significant proprioceptive errors are related to neck pain in younger adults who spend prolonged periods on electronic devices [26].

Excessive smartphone use can have a variety of negative consequences. Gazing at the phone for a longer duration causes constant downward neck flexion, likely resulting in musculoskeletal disorders. Smartphone-obsessed young adults can develop poor posture due to continual neck flexion, putting them at risk for spine abnormalities.

Smartphone users have a forward head posture, represented by a flexed neck. The entire spinal postural musculature, mainly the cervical spine, endures increased stress and strain in this position because the head is anterior to the body's center of gravity.

Forward head posture can result in the evolution of several musculoskeletal problems, including neck pain, cervicogenic headache, temporomandibular disorders, and muscular dysfunction. It is found to be present in patients with lower cranial vertebral angles. According to reports, Forward head posture may affect the cervical spine, thoracic spine, and shoulder blades, resulting in musculoskeletal imbalance.

Smaller display devices, such as smartphones and tablet computers, cause people to look down and change their posture, resulting in neck and shoulder fatigue and strain.

Flexed neck posture may influence cervical spine muscle length, disrupting proprioceptive function and balance and elevating the risk of falls and musculoskeletal injuries, significantly affecting daily activities.

Muscle weakness and loading of neck and shoulder muscles are among the musculoskeletal disorders associated with smartphone use, which are caused byrepetitive movements of the hands, wrists, and arms, resulting in discomfort and stiffness in the neck, arm, and shoulder [27]. According to Junhyuk Park et al. (2015), heavy smartphone use can cause changes in the cervical curve and pain tolerance of themuscles around the neck [28].

The constant use of a monitor and a smartphone induces overuse of the upper trapezius and neck muscles, resulting in muscle fiber damage, cumulative trauma damage, and

muscle fatigue in the neck and shoulders. Repeated damage of frail lower cervical and upper thoracic erector spinae, scapular retractor muscles, and capital flexors may result in forward head posture [29].

Illusions of skewed body perception may be caused by disrupted proprioceptive input (Lackner, 1988) [30]. Afferent feedback from multiple systems simultaneously is required for proper balance, equilibrium, and regulated head and eye movements. The knowledge from these systems, which include vision, vestibular, and proprioception systems, must be combined depending on the mission and environment. Slumped input of cervical proprioceptive and maladaptive changes within the central mechanism of sensorimotor coordination causes postural control dysfunction [31].

The relay of data to the central nervous system is mediated by a variety of receptors, including Ruffini receptors and Pacinian corpuscles; however, the receptors in the muscle called muscle spindles play an essential role in proprioception.Musculoskeletal issues such as forward head posture arise from changes in musclelength caused by atypical posture over an extended period (Forward head posture). The fundamental cause of multifactorial problems in this area is a loss of joint sense [31].

Lee et al. (2014) observed that forward head posture had an increased error value when cervical position sensing was examined for forward head posture and normal head posture. One study indicated that the Forward Head Posture alters the length of the neck muscles, which has a detrimental effect on muscle spindle function involved in proprioception and a diminution in joint position sensing [32].

Participants with recent cervical trauma, postural defects, congenital spinal deformities, recent neck fractures and surgeries, vestibular pathology, and limb length inequality were excluded from the study as they could influence the measurementsand cause inconsistencies in the results [33, 34].

According to a previous analysis, the craniovertebral angle is negatively linked to repositioning error compared to a more upright stance. According to Min-Sik Yong et al. (2016), forward head posture is associated with more repositioning errors than upright posture [35].

Hence, given smartphones' popularity, it is vital to consider their negative impact on health and take appropriate steps.

CONCLUSION

Smartphones play a central role in today's world; however, prolonged use of them in various deviant postures for extended periods is a cause for concern becauseit has the potential to negatively impact physical, psychological, and societal levels of life. Despite the results of this study, which indicates a weak positive association between variables, it is essential to focus on the negative effect of smartphones on younger adultsand take adequate measures. Hence, this study recommends proper education and knowledge about smartphone use and its negative consequences to ensure appropriateuse and prevent various medical ailments.

LIMITATIONS

This study had a limited sample size due to the unavailability of access to the students during a pandemic and was only constrained to younger adults. The Craniovertebral angle and Joint position error were measured during smartphone use, and the hours of smartphone usage per day were not considered.

RECOMMENDATIONS

Strong recommendations on rehabilitation measures will be formulated for future studies, considering the elderly population and using advanced assessment methods.

Abbreviations' List

Cervicocephalic Relocation Test (CRT).

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