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Effect of chronic smartphone use on upper extremity muscle activity and pain threshold

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ABSTRACT

Background

The use of Smartphone has increased rapidly leading to musculoskeletal disorders. A prevalence of 35% for neck pain and musculoskeletal injuries associated with chronic Smartphone use has been reported in the recent studies. Among them, musculoskeletal disorders occur predominantly in the fingers, neck, back and shoulder. Poor posture is the contributing factor for all the musculoskeletal disorders such as fatigue, stress, neck pain, and increased muscle activity.

Objective The study is aimed to review the effect of chronic Smartphone use on upper extremity muscle activity and pain threshold.

Methodology

An extensive literature review was done on various electronic handprint databases which included Pedro, pub med, science direct, Ovid. Total 7 articles were reviewed and reported based on eligibility criteria, which includes 2 Prospective cohort study and 5 Cross sectional study.

Conclusion

Based on the 7 articles reviewed, chronic Smartphone use was associated with poor posture leading to neck pain and increased muscle activity. Timely interpretation and interventions along with good knowledge about postural correction will be the key entities to deal with text neck.

Keywords: Smartphone, Neck pain, Upper extremity muscle activity, Pain threshold.

INTRODUCTION

Smartphone is a mobile hand-held device with advanced computing capability, such as internet communication, information retrieval, video, e-commerce and other capabilities [1]. Smartphones have made ubiquitous internet access possible, with no bounds on time or place, and are used for a wide range of purposes ranging from simple pleasure and

communication to business [2]. In modern society, the use of Smartphone has increased rapidly and there are now more than 299.24 million Smartphone subscribers in India. 91% of the university students in their 20s use Smartphone, which is much higher than other age groups [3]. It also implies that the duration of Smartphone usage is increasing causing poor social interaction; they

interrupt the momentum which can affect our productivity, and has negative impact on health. Most of the musculoskeletal disorders are caused by repeated use of the system, resulting in damage to the muscle fibres and tone [5]. Recent studies have estimated a prevalence of 35% for neck pain and musculoskeletal injuries associated with chronic Smartphone use. The symptoms of Smartphone addiction can be classified into 2 categories: psychological disorders, including sleep disorders, aggressive or depressive symptoms, and antisocial personality disorders and physiological disorders including dry eyes, carpal tunnel syndrome, migraine headaches and musculoskeletal disorders. Among them, musculoskeletal disorders occur predominantly in the fingers, neck, back and shoulder, which are the regions mainly involved in chronic Smartphone use. Increased usage can also cause significant alterations in upper cervical posture [2]. Causes continuous mechanical stress on the tendons, muscles, and perimetric tissue, which can induce 'Visual Display Terminal' syndrome (VDTs). Work with VDTs cause pain in the neck and shoulders due to increased tension caused by continuously flexing the neck [1]. Mobile device users frequently adopt prolonged forward head posture while looking down at the screens of mobile devices. It directly affects the spine while flexing the head forward at varying degrees. This issue is a major concern with children, since their heads are larger in relation to their body size than adults, and thus they have an increased risk [6]. Forward head posture causes shortening of the muscular fibres around the articulation points of the atlantooccipitalis and over stretching of muscles around the joints, producing chronic neck pain. It may not only affect the neck but also the thoracic spine and shoulder blades, leading to imbalance in the musculoskeletal system [7]. Poor postures lead to fatigue, which can have negative effects, such as reduced physiological function, description of the autonomic nervous system, and affects on both

visual and musculoskeletal systems, leading to fatigue, stress, neck pain, and loading for neck and shoulder muscles [8]. These musculoskeletal disorders are generally characterized as, 'text neck syndrome' (Dr. Dean L Fishman), term 'text neck' or 'turtle neck posture' can be described as a repeated stress injury and pain sustained from chronic Smartphone use [9]. The chronic use of Smartphone will lead to increased muscle activity which results in decreased pain threshold of the cervical or the neck muscles resulting in increased pain and muscle spasm. This study is intended to review the chronic effect of Smartphone use on upper extremity muscle activity, pain threshold and their impact on musculoskeletal system. The findings challenge the belief that neck posture during mobile phone texting is associated to the growing prevalence of neck pain. This study would also possibly review the injury surveillance, pathomechanics and associated risk factors leading to text neck.

MATERIALS AND METHODS

Design- Literature Review. An extensive literature review was done on various electronic handprint databases which included Pedro, pub med, science direct, Scopus, EMBASE, Springer, and Ovid. Total 7 articles were reviewed and reported based on eligibility criteria, which includes 2 Prospective cohort study and 5 Cross sectional study. Inclusion criteria: Articles published from 2010-18, Articles in English language. Exclusion criteria: Free full text availability. Literature search was conducted in above mentioned databases using search strategies and key words, and 592 articles were retrieved. The three step process- title, abstract, full text was used to select articles: Based on the title the number of article obtained 99. Using eligibility criteria 39 articles were selected based on abstract. Using eligibility criteria 7 articles were selected based on free full text and was used for literature review.

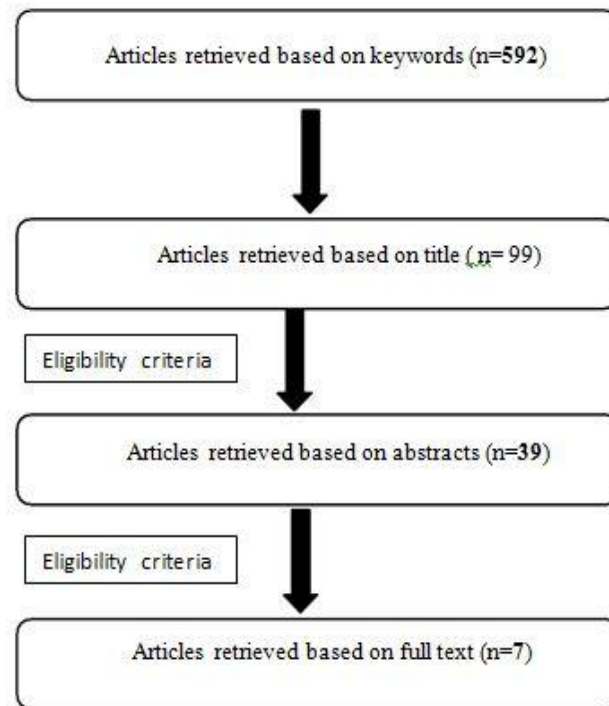


Figure 1- Flow chart of data extraction

RESULTS AND DISCUSSION

Total 7 articles were reviewed and reported based on eligibility criteria, which includes 2 Prospective cohort study and 5 Cross sectional study. The objective of this review was to provide material that could be used to identify help prevent musculoskeletal disorders caused or exacerbated by Smartphone use. According to the results relating to smart phone use, 42.5% used smart phones for chatting, 38.2% used them for searching the Internet, 12.5% used them for playing games, 3.8% used them for other activities, and 3.0% used them for writing documents. Chatting and searching the Internet accounted for 80.7% of use, which indicates that most students use their Smartphone for these activities. The majority used their smart phone at home (58.4%) and most preferred sitting (40.0%) or lying on their back (34.9%) when using a smart phone [8]. Prevalence of musculoskeletal complaints in different body regions ranges from 1.0% to 67.8%. Consistently, the neck has the highest prevalence rate, which is from 17.3% to 67.8%. [10] It was observed that neck pain and shoulder pain were the most commonly experience kinds of pain. Fernandez and his colleague reported that neck musculoskeletal disorder (such as altered cervical posture) is related to thoracic kyphosis and rounded shoulder posture. The hypothesis was that-

irregular lower trapezius condition and serratus anterior positions by abnormal scapular tilt can lead to rounded shoulder posture. [1, 2] According to studies by Bendix, and by Mekhora et al, the longer that display terminals are used, the more the bending angles of the neck bone and the waist bone are increased. According to studies by Burnett and O'Sullivan et al, adapting an incorrect posture for a long period of time can lead to a lowering in the function of waist muscles, triggering pain in the waist. Therefore, it is evident that using Smartphone while in a sitting posture for a long time can trigger musculoskeletal disorders. [8] The repeated upper extremity movements required by mobile phone use induce continuous muscle contraction in the neck and shoulders, which may result in susceptibility to musculoskeletal disorders because of microscopic damage. The static and asymmetric position adopted during Smartphone use may also be a potential risk factor of musculoskeletal disorders. [1, 2] Kim et al. reported that the long and continuous use of Smartphone increased repositioning errors of the upper and lower cervical vertebrae while, Cheng et al. reported that patients with chronic neck pain had larger repositioning errors than normal healthy adults [3]. The cervical load increases from about 10 pounds in the neutral position to 60 pounds at 60

degrees. Therefore, the excessive cervical load of a more flexed posture might cause considerable damage to the tissues that support the head and neck, including the muscles, ligaments, and joints, subsequently predisposing the addicted teenagers to cranio cervical dysfunction and pain [1, 2]. The forward pull of the weight of head puts undue stress on the vertebrae of the lower neck, contributing to degenerative neck problems. Similarly, this posture causes the muscles of the upper back to continually overwork to counterbalance the pull of gravity on the forward head. The position is often accompanied by forward shoulders and a rounded upper back, which not only feeds into the neck problem but can also cause shoulder pain. The lower cervical vertebra c5 and c6 may be slightly slide or shear forward relative to one another as a result of the persistent pull of gravity on a forward head [1, 2, 9]. A sustained flexed neck posture adapted by mobile device users is probably one of the key factors to explain the high prevalence rate of neck complaints in the current review. The result implies that correcting awkward neck postures while using mobile devices is an important strategy to reduce or prevent neck pain among users of mobile devices.

Human-device interaction-rest patterns may be an important factor in the development of musculoskeletal complaints. The phenomenon of superficial muscles being continuously activated has been proposed to be a key contributing factor for chronic musculoskeletal disorders in computer users (Heagg, 1991; Szeto et al., 2005). Regular rest breaks during work is demonstrated to be beneficial to relieve work-related musculoskeletal complaints among office workers (Galinsky et al., 2007; van den Heuvel et al., 2003). Therefore, work-rest patterns while interacting with mobile devices in addition to total daily duration of use should be included as a more comprehensive variable while evaluating the risk factors for musculoskeletal complaints associated with mobile handheld devices. [10] As a text neck is a repetitive stress injury, it can be easily relieved or prevented by taking frequent breaks from the mobile device, like every 20 minutes. Other alternatives are to hold the mobiles/electronic devices higher, so that it is aligned with the eyes and the stress on the neck muscles is reduced. Posture focused exercises, such as Pilates, yoga and flexibility, will reduce the stress on the neck and upper extremity.

Table 1- Summary

SL. NO	TITLE/AUTHOR/ YEAR OF STUDY	TYPE OF STUDY	SAMPLE SIZE	OUTCOME MEASURES	RESULT
1.	The Effect of Posture on Neck Flexion Angle While Using a Smartphone according to Duration Sang-Yong Lee et al 2016	Cross sectional study LOE: 3a	N = 16	2-way ANOVA - Cervical range of motion instrument	Neck flexion is affected by the posture while using a Smartphone and the duration of Smartphone usage ($p < 0.05$). Hence, as the usage time increases, there is increase in neck flexion angle.
2.	The effects of Smartphone use on upper extremity muscle activity and pain threshold Minkyung Lee et al 2015	Cross sectional study LOE: 3a	N = 10	Electromyography	Higher muscle activity in one-handed Smartphone use than its two-handed use observed. Hence Smartphone operation with one hand caused greater pain and induced increase upper extremity muscle activity.
3.	Influence of neck pain on cervical movement in the sagittal plane during	Cross sectional study LOE: 3a	N= 27	Ultrasound-based motion analysis system	During Smartphone use, the mild neck pain group (MNP) exhibited greater upper cervical and lower

	smartphone use Man-Sig-Kim 2015				cervical flexion angles than the control group. Hence, young adults with MNP are more careful and more frequently utilize a neutral neck posture than young adults without MNP when using a Smartphone.
4.	A Comparison of Cervical Flexion, Pain, and Clinical Depression in Frequency of Smartphone Use Junhyuk Park et al 2015	Prospective cohort study LOE: 2b	N= 20	• Smartphone Addiction Proneness Scale, • Pain Pressure Threshold • Cervical Angle Measurement • Beck Depression Inventory	Heavy Smartphone use may produce considerable stresses on the cervical spine, thus changing the cervical curve and pain threshold of the muscles around the neck. Smartphone can also cause negative effects on a person's psychological status, such as depression.
5.	Effects of the Use of Smartphones on Pain and Muscle Fatigue in the Upper Extremity Gyu Yong Kim et al 2012	Cross sectional study LOE: 3a	N=43	Digital pressure algometer	The pressure pain threshold of the upper trapezius, the Smartphone and computer use groups showed significant decreases after performing the task compared with before it.
6.	Effect of duration of smartphone use on muscle fatigue and pain caused by forward head posture in adults. Seong-Yeol Kim et al 2016	Prospective cohort study LOE: 2b	N= 34	Electromyography Visual Analog Scale (VAS)	There was a significant difference in the degree of fatigue in the left upper trapezius muscles in group 2 and left cervical erector spinae and bilateral upper trapezius in group 3 (p <0.05) The VAS showed significant differences in all groups before and after the experiment and between groups 1 and 3. Smartphone texting was associated with higher activity in neck extensor and thumb muscles but lower activity in upper and lower trapezius as well as wrist extensors.
7.	A comparison of muscle activity in using touch screen smartphone among young people with and without chronic neck-shoulder pain. YanfieXie et al 2016	Cross sectional study LOE: 3a	N= 40	Surface electromyography	

CONCLUSION

As stated in the review Smartphone induced neck pain and associated problems are of chronic progressive in nature. Timely interpretation and interventions along with good knowledge about postural correction will be the key entities to deal with text neck. Further trials recommending the effectiveness of current practice and also possibly identifying the risk factors will be of great use in understanding and designing evidence based

protocol. The Smartphone technology is also rapidly evolving and new products with different screen sizes and different input methods are being produced for the consumers all the time. Hence the research needs to keep pace with the new products in order to produce knowledge about the current state of the art in this technology era and its impact on musculoskeletal system.

REFERENCES

- [1]. Lee M et al. The effects of smartphone use on upper extremity muscle activity and pain threshold. *J. Phys. Ther. Sci*27(6), 2015, 1743-5.
- [2]. Kee IK et al. The presence of altered craniocervical posture and mobility in smartphone-addicted teenagers with temporomandibular disorders. *J. Phys. Ther.* 28(2), 2016, 339-46.
- [3]. Lee J, Seo K. The comparison of cervical repositioning errors according to smartphone addiction grades. *J. Phys. Ther.* 26(4), 2014, 595-8.
- [4]. Kim MS. Influence of neck pain on cervical movement in the sagittal plane during smartphone use. *J. Phys. Ther.* 27(1), 2015, 15-7.
- [5]. Lee SY, Lee DH, Han SK. The effects of posture on neck flexion angle while using a smartphone according to duration. *Korean Society of Physical Medicine* 11(3), 2016, 35-9.
- [6]. Vate-U-Lan P. Text Neck Epidemic: a Growing Problem for Smart Phone Users in Thailand. *Int J Comput Internet Manag* 23(3), 2015, 55-1.
- [7]. Park J et al. A comparison of cervical flexion, pain, and clinical depression in frequency of smartphone use. *International Journal of Bio-Science and Bio-Technology* 7(3), 2015, 183-90.
- [8]. Kim HJ, Kim JS. The relationship between smartphone use and subjective musculoskeletal symptoms and university students. *J. Phys. Ther.* 27(3), 2015, 575-9.
- [9]. Neupane S, Ali U, Mathew A. Text Neck Syndrome-Systematic Review. *Imperial J Interdiscipl Res* 3(7), 2017, 141-8.
- [10]. Xie Y, Szeto G, Dai J. Prevalence and risk factors associated with musculoskeletal complaints among users of mobile handheld devices: A systematic review. *Applied ergonomics* 59, 2017, 132-42.
- [11]. Jung et al. The effect of smartphone usage time on posture and respiratory function. *J. Phys. Ther.* 28(1), 2016, 186-9.
- [12]. Kim GY, Ahn CS, Jeon HW, Lee CR. Effects of the use of smartphones on pain and muscle fatigue in the upper extremity. *J. Phys. Ther.* 24(12), 2012, 255-8.
- [13]. Kim SY, Koo SJ. Effect of duration of smartphone use on muscle fatigue and pain caused by forward head posture in adults. *J. Phys. Ther.* 28(6), 2016, 1669-72.
- [14]. Xie Y, Szeto GP, Dai J, Madeleine P. A comparison of muscle activity in using touch screen smartphone among young people with and without chronic neck-shoulder pain. *Ergonomics*. 59(1), 2016, 61-72.

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