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CORRELATION OF ERGONOMIC RISKS AND UPPER EXTREMITY MUSCULOSKELETAL DISORDERS AMONG SMARTPHONE USER MEDICAL STUDENTS.

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Conflicts of Interest: Nil

Abstract:

Background: The number of smartphone users is increasing globally. Smartphone users adopt awkward postures and they have high ergonomic risk levels when using their smartphones. Rapid Upper Limb Assessment Scale (RULA) is a screening tool based on observation, used to assess exposure to load factors due to posture of neck, trunk and upper limb along with muscle use and forces. The smartphone users have highest prevalence of upper extremity musculoskeletal disorders. Standard Nordic Questionnaire is self-reported questionnaire is used to survey musculoskeletal disorders.

Objective: To study correlation between ergonomic risks and upper extremity musculoskeletal disorders among smartphone user medical students.

Material and Method: 50 participants from Rural Medical College, Loni were selected according to the inclusion and exclusion criteria. They were asked to fill Standard Nordic Questionnaire which is used to assess upper extremity musculoskeletal disorders and then they were given a smartphone texting task for 5 minutes and were video recorded during the task. The video recording was further evaluated by two investigators to assess the ergonomic risks using RULA.

Result: Smartphone users in the current study adopted awkward postures, and they all had high ergonomic risk levels when using their smartphones. There was correlation between RULA Score and Standard Nordic Questionnaire using Karl Pearson's correlation coefficient test in which r value is 0.09860 and p value is 0.0264; which indicated significant.

Conclusion: It can be concluded that there was significant correlation between ergonomic risks and upper extremity musculoskeletal disorders among smartphone user medical students.

Keywords: Ergonomic risks, Upper extremity musculoskeletal disorders, Smartphone users, Rapid Upper Limb Assessment Scale (RULA), Standard Nordic Questionnaire.

I. Introduction

The term ergonomics is derived from "Greek" words "Ergon" signifying Work and "Nomos" signifying Natural laws. Ergonomics is the systematic study of people and their work. It is highly relevant and occupational medicine, management of musculoskeletal injuries and rehabilitation. It helps people understand their abilities and limitations and teaches them how to perform safely, effectively, and comfortably within the environment. [1]

In our digital world, the use of smartphones has increased rapidly. Smartphones are popular devices capable of processing more information than other phones; they include many features such as games, access to the internet and social networks, messaging, videos, multimedia, and navigation, in addition to their use for communication. A study concluded that behavioral changes like depression, anxiety and sleep quality may be associated with overuse of smartphones.[2] Presently smartphones are being used everywhere because these devices do not use physical cable that is demanded for communication purposes. Their demand for electromagnetic radiation for receiving and transferring the data in the air; either it is a

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network or a sound data. These smartphone devices give off harmful radiations which effects to the human health because such type of radiation is available everywhere and their existence cannot be felt.[3]

There are 3.4 billion smartphone users worldwide. There were 291.6 million smartphone users in India by the end of year 2017. The number of smartphone users in India is estimated to hit 337 million till the end of 2018. Smartphone users vary in age, ranging from students to workers to senior citizens.[4] Coincident with growing smartphone use concerns of musculoskeletal problems associated with intensive smartphone use have increased. An epidemiological study of smartphone users conducted in the Republic of Korea found that 18.8% of smartphone users experienced musculoskeletal symptoms in the neck, upper trunk and upper extremity. Previous studies show that physical risk factors which are related to neck and upper extremity musculoskeletal disorders in workers include awkward posture. Smartphone use can encourage awkward postures.[5] Prolonged smartphone usage causes faulty slouched posture, forward neck posture and sustained forward neck posture can cause injury to the structure of the cervical and lumbar spine, as well as ligaments. These structural problems caused by faulty posture can also lead to respiratory dysfunction.[6] Several studies have suggested that smartphone addiction has negative effects on mental health and well-being.[7] Smartphone addiction may cause risks ranging from self-reported problems such as headache, difficulties in concentration, dizziness, depressive symptoms, sleep disturbances, to radiation and oxidative stress, etc.[8] A previous study in Thailand found majority of smartphone users who reported musculoskeletal disorder adopted positions in upper body of: neck flexion 82.74%, shoulder protraction 56.61%, elbow flexion 65.16%, wrist and hand flexion during keying 22.40%, and wrist and hand supination to support the device 21.62%. These awkward postures can affect soft tissues leading to musculoskeletal discomfort.[5]

Smartphone habit may increase ergonomic risks of posture and muscle use, as well as psychological strain, which can lead to musculoskeletal complaints. Various methods have been reported to assess ergonomic risks when using Information Technology devices including using the RULA tool.

Rapid Upper Limb Assessment (RULA) method, which was presented in 1993, assesses static muscle activity and the force exerted on the upper limbs.[9] It was developed to investigate the exposure of the individual workers to risk factors associated with work-related upper limb disorders.[10] It is a screening tool based on observation, which is used to assess exposure to load factors due to posture of neck, trunk and upper limb along with muscle use and forces. Using the RULA tool comprises assigning a numerical rating to the posture of the upper arms, lower arms and wrist (Score A) together with posture of the neck, trunk and legs (Score B), and then assigning another numerical rating for additional factors that stress the musculoskeletal system, such as repetitive action, static loading and force exertion so they become (Score C) Previous ergonomic studies have used the RULA tool to estimate the posture of children when conducting academic tasks at computer workstations in the classroom setting. To date, no reported studies have been used the RULA tool to implement ergonomic risk assessment on smartphone users. Currently, there are no risk assessment tools developed to evaluate the specific ergonomic risks of smartphone use. While using a smart phone, static postures include head, neck, trunk, upper arms, lower arms, wrists and leg posture. These postures provide a stable base for some part of body performing in repetitive manners for example, thumb or other fingers.[1]

Various studies reported smartphone users to have highest prevalence of musculoskeletal disorders of neck. Musculoskeletal disorders (MSDs) are injuries or pain in the human musculoskeletal system, which includes the joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck and back. Musculoskeletal disorders can arise from a

sudden exertion (e.g., lifting a heavy object), or they can arise from making the same motions repeatedly repetitive strain, or from repeated exposure to force, vibration, or awkward posture. MSDs can also arise from the interaction of physical factors with ergonomic, psychological, social, and occupational factors. In this case, RULA is an appropriate scale for assessment. Hence this study is done to evaluate ergonomic risk assessment of smartphone users using Rapid Upper Limb Assessment (RULA) tool in medical students.[1]

Self-reported musculoskeletal disorders can be assessed by various questionnaires, the Standard Nordic Questionnaire (SNQ) is the common questionnaire to assess the prevalence of musculoskeletal discomfort within the last 7 days, last 12 months and trouble preventing normal work within last 12 months. The Standard Nordic Questionnaire is used to survey musculoskeletal disorders in the neck, shoulder, elbow, wrist and hand, upper back, lower back, hip and thigh, knee, ankle and foot. All the answers are noted as YES or NO. The Standard Nordic Questionnaire comprises high validity, good test-retest reliability and sensitivity in the measurement of the prevalence of musculoskeletal disorders.

The objective of the study is to determine any correlation between musculoskeletal disorders and ergonomic risk levels.

II. Materials and Methodology

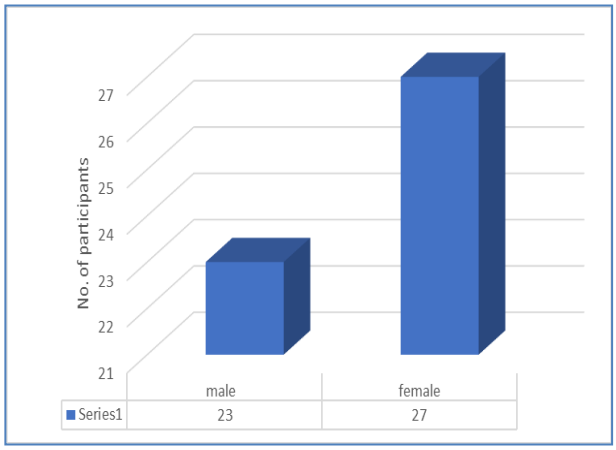
The study received Ethical approval from Institutional Ethical Committee of reference no. PIMS/CPT/IEC/2018/564**.**

Fifty medical students of age group 18-25 years were taken as the participants from Rural Medical College, Loni. The participants were screened according to the inclusion and exclusion criteria. The written informed consent was taken from all participants regarding the procedure prior to the study. All participants were asked to complete the Standard Nordic Questionnaires. Then all participants were asked to use their smartphone while a video recording will be taken for 5 mins. Then the two investigators viewed each participant's entire video clip together and inspect which part of the video showed the most sustained posture. The RULA tool was used to assess the sustained posture and determine a grand score for each side of the body.

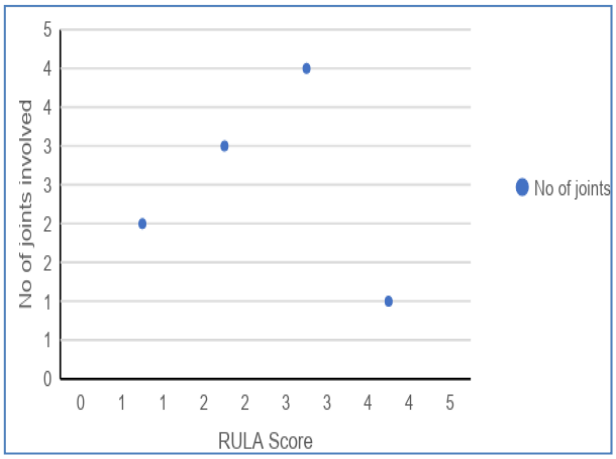
III. Data Analysis

Demographic Characteristics	
AGE	18-25 years
NO. OF PARTICIPANTS	50
MALES	23
FEMALES	27

Outcome measures	**MEAN±SD**
RULA Score	4.28± 1.183891887
Standard Nordic Questionnaire	2.16±1.332066064

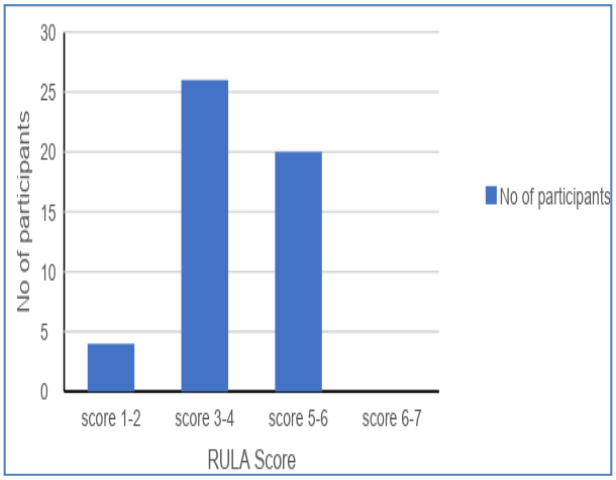


Graph no. 1 shows that there were 50 participants in which 23 were males and 27 were females.

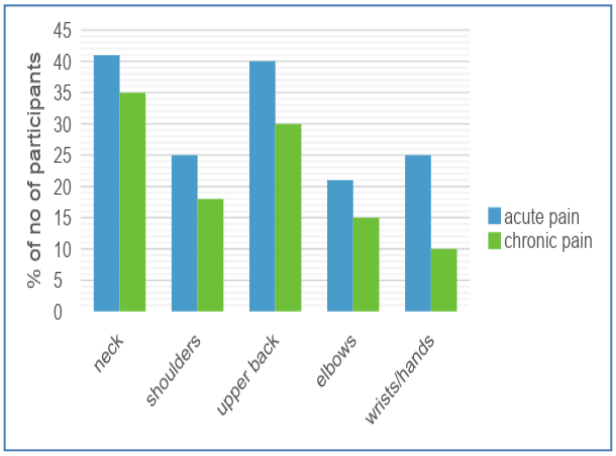


Graph no.2 There is positive correlation between RULA Score and Upper Extremity

Musculoskeletal disorders as the graph shows that the ergonomic risks increases when more joints are involved.



Graph no.3 Shows RULA Scale scorings which indicates the ergonomic risks increasing in smartphone users.



Graph no. 4 shows the self-reported musculoskeletal disorders in smartphone users. Acute pain indicates the pain aggravated previous last 7 days. Chronic pain indicates the pain aggravated previous last 12 months.

IV. Result

There was correlation between RULA Score and Standard Nordic Questionnaire using Karl Pearson's correlation coefficient test in which r value is 0.09860 and p value is 0.0264; which indicated significant. The Mean±SD value of RULA score was 4.28±1.183891887 and for Standard Nordic Questionnaire 2.16±1.332066064. From the 50 participants ranging from age group of 18-25 years there were 23 males and 27 females. The Standard Nordic Questionnaire shows the self-reported musculoskeletal pain in the participants were higher in past 7 days then past 12 months.

V. Discussion

The present study "Correlation between ergonomic risks and upper extremity musculoskeletal disorder among smartphone users in medical students." was conducted in Rural Medical College, Loni. Medical students with age group of 18-25 years were included who had at least six months experience in using smartphone and a daily smartphone user for at least 2 hours per day. The level of ergonomic risk among smartphone users was assessed using RULA tool. Most of the smartphone users had Grand Score of 4 which indicates further investigations and low risk level but change may be needed. There was a significant correlation between RULA score and musculoskeletal disorder most commonly of neck and upper back. The Standard Nordic Questionnaire concludes that the self-reported musculoskeletal pain was aggravated in past 7 days then when the pain started in past 12 months particularly in neck and upper back region. We now consider the possible reasons why smartphone users had high ergonomic risk when they were using their smartphone.

The three components of RULA assessment, shows the risk levels including posture, muscle use and force scores. Observation of posture of the body part revealed that while using the smartphone most participants held their neck in more than 20 degrees flexion or with neck side bent. The upper arms were held in flexed posture with or without raised shoulders or leaned or supported their upper too.

The lower arms were in flexion position while their wrist postures in both flexion and extension positions. A trunk flexion posture of some participants was ranging between 20 to 60 degrees also some had their trunk twisted or side bent. Some participant's leg posture was not well supported where as some of them supported one leg and some of them supported both the legs.

These postures correspond that the smartphone users held their neck flexion, shoulder protraction, elbow flexion, wrist and hand flexion during texting, with wrist and hand supinated to support the device while their back flexed and legs in neutral position. It was clear that each of these postures adopted by the smartphone users is awkward.

The muscle use score of the participants was score1 as they held the smartphone for longer than one minute and less 5 minutes. The force score of the participants was zero as the average weight of the smartphones were less than 2 kilograms.

From the above study, it shows there is high level of ergonomic risks in smartphone users who use the smartphone for a longer duration. The results showed that neck pain was the musculoskeletal disorder with highest prevalence in smartphone users. The smartphone users had high ergonomic risk levels which were mainly due to awkward posture and excessive muscle use.

The study was done first in Thailand to utilize an observation-based screening tool to demonstrate the ergonomic risk level among smartphone users in. As number of smartphone users in India was estimated to hit 337 million population. The previous researches had found the ergonomic risk assessment in Information Technology professionals in India. But there was hardly any study who investigated the correlation between ergonomic risks and musculoskeletal disorders in smartphone users in India. The study concluded that there was positive correlation between ergonomic risk levels and musculoskeletal disorders among the smartphone users in medical students.

VI. Conclusion

The study concluded there is significant correlation between ergonomic risks and upper extremity musculoskeletal disorders among smartphone user medical students. Hence, to minimize the risks and musculoskeletal disorders we can give them ergonomic advice.

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