Original Article

Association between Smartphone Addiction and Breathing Pattern in Sedentary Young College-Going Students – A Cross-Sectional Study

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ABSTRACT

Background: The number of smartphone users has progressively increased worldwide. Altered biomechanics of the cervicothoracic spine and ribcage could limit the chest wall function that affects the respiratory muscles strength, reducing diaphragm function in smartphone users. This study aimed to compare breathing patterns between smartphone-addicted and -nonaddicted user groups. **Objective:** To find the association between excessive smartphone use and breathing pattern in sedentary young college-going students. **Materials and Methods:** This cross-sectional study includes 230 participants. The participants were screened for the inclusion and exclusion criteria and were asked to fill out a Smartphone Addiction Scale questionnaire. These breathing patterns were then assessed by self-evaluation of breathing questionnaire (SEBQ), manual assessment of respiratory motion (MARM), breath-holding test, and capnography. **Results:** The correlation of smartphone-addicted and -nonaddicted groups with breathing patterns was performed by Spearman rank correlation. Results show no significant association between the smartphone-nonaddicted and -addicted users. **Conclusion:** This study concluded that excessive smartphone use and breathing patterns are not associated.

KEYWORDS: *Breathing pattern, smartphone addiction, young adults*

INTRODUCTION

A smartphone is a handheld tool that can perform the characteristics of a personal computer/laptop and a hand cell phone. Although small, it can perform numerous tasks, including net browsing, cell mail, video games, media players, phone calls, and texting. Therefore, its usage is now important in everyday lifestyles.[1] Prevalence of smartphone usage worldwide is 2.1 billion people, and in India, smartphone usage is 349 million people.[2] India has become the second most extensive wireless network in the world, overtaking United States and second only to China.[3] In present-day society, smartphone penetration and the number of smartphone users are growing hastily. Modern people use a smartphone in most areas of their lives, such as occupational and leisure activities, which means their duration of smartphone utilization is likewise increasing.[4] According to a previous study, university students spend an average of more than 3.5 hours/day texting, emailing, scheduling, and internet browsing on their mobile phones.[5] Smartphone use has doubled by 26 hours during the COVID-19 pandemic. A widespread lifestyle style shift during the COVID-19 pandemic has become entirely reliant on the internet and smart devices, like tablets, laptops, and mobiles.[6]

Excessive smartphone usage may lead to bad posture consisting of a forward neck posture, slouched back, and rounded shoulder. It has been reported that, because of this increased smartphone usage, there is an increased sedentary time in kids and adolescents, which could afflict their musculoskeletal health, decreased pulmonary function, obesity, and

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bad posture.[7,8] Text neck syndrome has become a worldwide epidemic, affecting people of all ages who use smartphones and causing harmful effects on the cervical spine, supporting musculature, ligaments, nerves, tendons, and bony segments, eventually reversing the natural curvature of the spine, disc degeneration, headaches, and a 30% reduction in lung capacity.[9] Prolonged computer use, handheld mobile device use, and even mouth breathing have all been associated with forward head posture.[10] Previous studies measured physiological adjustments during mobile telephone textual content messaging. They had to determine that people tended to stabilize their breath or shallow breaths once they entered data and/or studied the liquid crystal display screen.[11] Breathing pattern disorders (BPD), defined as disturbances in breathing functionality that are chronic enough to cause signs without an apparent organic motive, are present in a variety of individuals with musculoskeletal dysfunction.[12] Breathing mechanics are influenced directly by biomechanical, biochemical, and psychosocial factors.[13]

According to a previous study, the posture assumed while using a smartphone led to reduced respiratory function.[14] Thoracic breathing could have an acute impact on respiratory chemistry; a decrease in carbon dioxide causes the pH of the blood to increase, and respiratory alkalosis results. Respiratory alkalosis can cause modifications in the body's physiological, psychological, and neuronal states that may negatively affect fitness performance and musculoskeletal system.[12] Continuous forward neck flexion could affect pulmonary function and respiratory muscle strength.[8] As per existing evidence, changes in the biomechanics of the cervicothoracic spine and ribcage could limit the chest wall's function and affect the respiratory strength, including the diaphragm. As a result, the ability of the chest wall to normally expand during inhalation and return to its resting position during exhalation could be affected.[8,15,16]

The adverse effects of prolonged sitting and a sedentary lifestyle on our health are well known. Similarly, we should understand the effect of prolonged smartphone usage on our breathing pattern. Previous literature suggests that although smartphone usage could affect breathing patterns, no objective could find the association between excessive smartphone use and breathing pattern. Hence, this study aimed to find an association between excessive smartphone use and breathing patterns in sedentary young college-going students. If the association is found, it will help to design an appropriate exercise plan of care and restore normal breathing in sedentary young college-going students.

Materials and Methods

This study was an observational study in accordance with the guidelines set out in the Declaration of Helsinki, approved by the Institutional Ethical Committee. All the participants were recruited for the study from a musculoskeletal physiotherapy OPD. G power was used to calculate the sample size, and the level of significance was set as $P < 0.005$. Participants were included based on specific inclusion and exclusion criteria. Subjects aged between 18 and 25 years, both genders, sedentary lifestyles, using a smartphone for more than 4 hours a day, able to read, write, and understand English, and having a normal body mass index (BMI) were included in the study. Prior consent was obtained from the participants. Subjects with unstable angina, if they had become nonsmokers within the last five years, congenital postural deformities, pregnancy, diagnosed cases of restrictive or obstructive respiratory conditions, known case of neck pain and back pain in the previous 1 year, undergone thoracic or abdominal surgery in last five years, diabetes mellitus, hypertension, peripheral vascular disease, chest wall deformities like pectus excavatum, pectus carinatum, and elite athletes were excluded. The included subjects were asked to fill out the smartphone addiction scale-short version. Based on the score, participants were divided into smartphone-addicted group ($n = 115$) and smartphone-nonaddicted group ($n = 115$). They were examined for breathing pattern using the self-evaluation of breathing questionnaire (SEBQ).

Procedure

The self-evaluation of breathing questionnaire (SEBQ), comprised of 25 questions, was distributed to the subjects to determine self-perception of breathing dysfunction.[17]

The MARM was performed while the subject was seated, and the tester placed their hands on the posterior and lateral aspects of the lower ribs. While the subject did tidal breath, the tester looked for the vertical motion relative to the overall lateral motion of the thoracic cage [Figure 1]. And, then based on the observation, two lines were drawn to form a pie chart for each event. Finally, drew the graphic notion and calculated the variables by measuring the angles formed by the two lines. The vertical line's top end was considered 180, and the bottom 0 [Figure 2].[18]

Breath-holding time test—subjects were asked to sit quietly and breathe normally. At the end of the normal exhalation, they had to pinch their nose and hold their breath. Subjects were instructed to stop when they felt a sense of inhalation. A stopwatch was used to record the breath-holding time. A rest of one minute was given between the trails. The average of the three trials was noted.[19]

End-tidal carbon dioxide measurement (capnometer)—A portable Emergency Mainstream Analyzer capnometer machine was used to assess end-tidal carbon dioxide [Figure 3]. Subjects were instructed to sit quietly and to exhale maximally at the end of expiration through an airway adapter [Figure 4].

Data analysis

The data analysis was conducted using IBM Statistical Package for the Social Sciences version 20.0 in Windows. The Kolmogorov–Smirnov test evaluated the normality of data. The Mann–Whitney *U* test was used to calculate the median and interquartile range for descriptive data, as the data did not follow the normal distribution. The association was examined using Spearman's rank correlation.

Result

Among the total of 230 participants, 134 were females and 96 were males, and as the data were not normally distributed, the age of the participants was expressed in the median and interquartile age range. Participants were divided into smartphone-addicted group (n = 115), in which 42 males and 73 females were present, and smartphone-nonaddicted group (n = 115), 54 males and 61 females were present. The median age was 23 years (IQR21-25) for smartphone-nonaddicted subjects and 22 years (IQR20-23) for smartphone-addicted subjects. The median and interquartile range of BMI was 21.3 kg/m^2 (IQR 20.2-23.4) for smartphone-nonaddicted subjects and 21.5 kg/m^2 (IQR 20.3-24) for smartphone-addicted subjects.

Correlation analysis values of SEBQ (rho =0.136, P = 0.148), manual assessment of respiratory motion (MARM) was (rho =0.117, P = 0.213), MARM was (percentage rib cage motion-rho =0.124, P = 0.185), breath-holding time (rho =0.083, P = 0.380), and end-tidal carbon dioxide value (capnometer-rho =0.083, P = 0.388) no association was seen among the participants without smartphone addiction [see Table 1].

Correlation analysis of SEBQ (rho = -0.086, P = 0.362), MARM (balance) (rho = -0.050, P = 0.597), MARM (percentage rib cage motion) (rho =0.009, P = 0.925), breath-holding time (rho = -0.086, P = 0.359), and end-tidal carbon dioxide (capnometer) (rho = -0.017, P = 0.857) among subjects with smartphone addicted showed no association [see Table 1].

Figure 1: Shows the test position for MARM

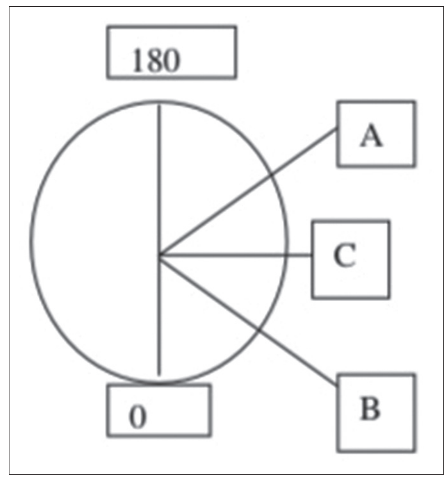

Figure 2: Shows a pictorial representation of MARM

Figure 3: Emergency Mainstream Analyzer capnometer

Table 1: Correlation of variables with smartphone-addicted and -nonaddicted subjects

Spearman rank correlation (ρ)	Smartphone-nonaddicted (*n*=115)	Smartphone-addicted (*n*=115)
Self-evaluation of breathing questionnaire	0.136 (*P*=0.148)	-0.086 (*P*=0.362)
Manual assessment of respiratory motion (balance)	0.117 (*P*=0.213)	-0.050 (*P*=0.597)
Manual assessment of respiratory motion (percentage rib cage motion)	0.124 (*P*=0.185)	0.009 (*P*=0.925)
End-tidal carbon dioxide (capnometer)	-0.083 (*P*=0.388)	-0.017 (*P*=0.857)

Figure 4: Shows the use of capnometer

Discussion

The present study is aimed to find the association between smartphone addiction and breathing pattern in young college-going students. We found that there is no association between smartphone addiction and breathing pattern.

BPD is an evolving process, and numerous disciplines impart clear views that give a multi-dimensional understanding of the multifaceted function that is breathing. Clifton *et al*. have suggested that dysfunctional breathing affects up to 10% of the general adult population with BPD.[20] Recently, sedentary behavior has been identified as an independent risk factor for coronary artery disease, type 2 diabetes, and certain types of cancer.[21]

BPD is recognized within the specialty of musculoskeletal and sports physiotherapy.[8] Breathing is a central aspect of our entire being and one of our most vital functions. An irregular breathing pattern, whether it is a mechanical, physiological, or psychological dysfunction, can be the first sign that all is not well.[12]

In the present study, we aimed to find the association between smartphone usage and BPD.

We assessed the rib cage and abdominal motion during breathing in MARM assessment and found an insubstantial association with smartphone addiction. Studies have reported gender differences in thoracic-abdominal dimensions and configuration with disproportionately smaller rib cage dimensions and shorter diaphragm in females compared to males.[22] Comparing to present study there were no gender difference being considered there could be lack of association which was obtained.

In the present study, we utilized a SEBQ to determine self-perception of breathing dysfunction and end-tidal CO_2 by using a capnometer and did not observe a significant association between breathing patterns and smartphone usage. Studies conducted by Alonazi *et al*. and Kang *et al*. found similar results reporting that there was no significant association between smartphone addiction and peak expiratory flow and maximum voluntary ventilation.[23,24] Tease findings can partially be explained by observations made by Well *et al.* in their study of age-related changes in thoracic structure and function. Their study observed an increase in lung function in subjects of 18-25 years. This continued increase in lung function is primarily the result of an increase in both the anterior-posterior and left-right dimensions of the thoracic cage. There is an increase in stature and muscle mass, enhancing lung functions by increasing respiratory muscle strength and endurance.[25] However, this finding did not support the results of Jung *et al*., who reported that the PEF values in young adult smartphone users were significantly lower than among young adults who were not users.[7] These changes in peak expiratory flow values could be due to the results of head positioning, flexion, or/and extension, as it affects the size of the airway.

In the present study, we assessed if the subjects were suffering from problematic smartphone use by using a smartphone addiction scale (short version), but the intensity of the problem was not considered. Poor posture is one of the predictors of BPD. Also, previous studies mentioned that poor posture in the form of forward head posture and rounded shoulders were the primary risk factors for the development of BPD. However, in the current study, we have not assessed the presence of any of these postures.

This study has some limitations. The number of subjects' age criteria and we did not investigate the subjects' posture. Therefore, future studies should further extend this study to evaluate the missing insights and determine possible solutions to the problems caused by prolonged smartphone usage.

Conclusion

The present study concludes that there is no association between smartphone addiction and breathing patterns in sedentary young college-going students.

Declaration of patient consent

The authors certify that Participants have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts were made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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