

Effect of Smartphone Addiction on Motor Efficiency in Upper Limb Assessed by Bimanual Coordination in Young Adults

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Abstract

Objectives: To compare efficiency index by bimanual coordination in smartphone addicts & non-addicts
Materials & Method: Cross sectional observational data was collected from Professional students in the age group 18-25 years who uses smartphone more than 6 months. Smartphone addiction was assessed using scale-SV questionnaire. Among them 50 smartphone non addicts & 50 addicts . Bimanual coordination of upperlimbs was done by using two hand coordination test apparatus with electric chronoscope & efficiency index was calculated. **Results:** A Mann Whitney U test was conducted to determine whether there was a difference in the score of addiction & nonaddiction. From this data it can be concluded that there was a significantly higher score in smartphone addicts compared to nonaddicts ($U=0.500$, $n_1=n_2=50$, $P < 0.001$) The effect of smartphone addiction on efficiency index assessed by bimanual coordination were compared using an independent t test .Mean of efficiency index in smart phone non addicts & addicts was 78.90 ± 17.04 & 53.70 ± 18.06 ($t=-7.17$ $p < 0.001$), which is statistically significant.

Conclusion: Motor efficiency in upper limb assessed by bimanual coordination in young adults is significantly decreased in smart phone addicts compared to the non-addicts.

Keywords: Smartphone addiction, bimanual coordination, efficiency index, young adults.

Introduction

Smart phone usage among the general population is increasing widely. According to online surveys, almost 30 billion messages were sent per day using whatsapp and 20 billion SMS messages in 2015. Literature reports an adverse impact on the physical and psychological health of the users of mobile and other information technology¹. Though it has many uses like social, interactions, information retrieval & entertainment, but loss of control over smartphone use might lead to negative impacts on our daily life. Among the smartphone users, young adults are widely using the smartphone & getting addicted to the same. Most of the times students stress on usage of smartphone is hidden & its addiction is not

known. The use of these hand-held devices is on the rise. Mobile phone users can able to communicate other than voice by a wide range of text button usage by means of SMS (short message service), whats app, viber, line in, and social networking applications like facebook, twitter and skype². Survey-based research has shown that many respondents would give up brushing their teeth, exercising, wearing shoes, showering, and eating chocolate instead of living without their smartphones for the same period of time . A study conducted by South Korea's university students have also proven the relationship of smartphone addiction to mental health, campus life, personal relations, self-control and life stress³.

It is a wellknown fact that many young adults suffer from smartphone addiction, which is almost similar to narcomania or alcoholism. Smartphone addiction is defined as a behavior addiction, loss of control by excessive immersion and obsessions to smartphone use, consequent daily disorder by nervousness and

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anxiety, and inclination toward virtual world that feels more enjoyable with smartphone than with friends⁴. As with heavy smartphone usage, the incidence of musculoskeletal disorders of hand, wrist, forearm, arm and neck has been increasing all over the world due to prolonged, forceful, low amplitude, repetitive use of hand held devices⁵. Sustained and gripping and repetitive movements with the thumb and fingers have all been identified as risk factors which may lead to disorders of the thumb and thumb musculature in the forearm. In day to day activities two hands are used together for a number of activities. To achieve this goals our hand movements, have to be finely coordinated & this functional ability depends on the muscle strength, sensation and coordination of the muscles & dexterity⁶. Bimanual movements has to have intralimb coordination, & integration and sequencing of actions between limbs (i.e., interlimb coordination). It is a complex self-organizing system that is subject to both internal (biopsychological) and contextual (task) constraints. corpus callosum of the brain that connects the left and right sides of the brain facilitates communication between the two hemispheres—a process that is essential to interlimb coordination⁷.

In an individual various of bimanual coordination is observed, & most research task items have focused on the patterns of coordination that appear in cyclic movements: like, continuous finger tapping with index fingers of both hands, finger tapping with one hand while tracing a circle with the other hand, or circle drawing with both hands⁸.

Repetitive flexing and extending of tendons in hands & wrists particularly when done forcefully and for prolonged periods without rest also can increase pressure in carpal tunnel. Injury to wrist can cause swelling that exerts pressure on median nerves and causes carpal tunnel syndrome⁹.

The present study aims to study the effect of smartphone addiction on efficiency index assessed by bimanual hand coordination in young adults.

Objectives

- To assess smart-phone addiction in young adults by smartphone addiction scale questionnaire
- To determine efficiency index by bimanual coordination in young adults(18-25 years)

- To compare efficiency index by bimanual coordination in smartphone addicts & non-addicts.

Materials & method

Design: Cross sectional observational data was collected from Professional students in the age group 18-25 years who uses smartphone more than 6 months. Institute ethical clearance & Written Informed consent was obtained.

Sample size: Sample size was estimated based on the previous study of smartphone addiction at 24.8% & non addicts 57.8%. By using the formula calculated by G* power

$$n = (Z_{\alpha/2} + Z_{\beta})^2 * (p_1(1-p_1) + p_2(1-p_2)) / (p_1 - p_2)^2, \quad n_1 \text{ (smartphone Addicts)} = 50, n_2 \text{ (Smartphone non-addicts)} = 50$$

where $Z_{\alpha/2}$ is the critical value of the Normal distribution at $\alpha/2$ (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), Z_{β} is the critical value of the Normal distribution at β (e.g. for a power of 90%) and p_1 -24.8% and p_2 - 57.8% are the expected sample proportions of the two groups.

Interventions: none

The data was collected by self-administering the questionnaire to the students which consisted of two parts. First part recorded the demographic information including age, sex, education, type of phone used and time spent on smartphone per day & per week. Second part was smartphone addiction scale-SV questionnaire given to young adults to know whether they are smartphone addicts or non-addicts¹⁰.

Bimanual coordination of upperlimbs of smartphone addicts & non-addicts was done by using two hand coordination test apparatus with electric chronoscope (Anand agencies, Pune). The subjects traced the figure on the apparatus with the help of the pointer from start to end using two handles with both hands simultaneously. If the pointer touches the walls of figure on the apparatus it was noted as error (e) committed & was digitally recorded by chronoscope in seconds. They were given trial twice before the actual task to be performed. Time required for completion of the test (T) & error (e) committed during completion of task was noted in seconds¹¹. Known history of

motor, behavioural, orthopaedic, reported history of learning or neurologic deficits & participants with primary uncorrected visual defect or medical condition that might interfere with ability to carry out motor task were excluded from the study.

Statistical Analysis: Descriptive statistics, Independent t test was done to analyze the quantitative data & Mann Whitney U test was conducted to determine whether there was a difference in the score of addiction & nonaddiction. & chi square test was done to analyze categorical variables & $P < 0.05$ was considered statistically significant.

Results

Relationship of smartphone addiction with time spent on smartphone per day, apps installed, apps uninstalled, email usage, education purpose, facebook, games, text messages, web usage & whatsapp usage. The following sections details the results of cross-tabulations that have established a Significant relationship through Chi-square tests & significant relationship was found with the time spent on using smartphone /day & smartphone addiction ($\chi^2 = 24.74, p < 0.001$). Significant relationship was also found between for apps installed, email usage, facebook usage, games text messages. There was no significant relationship on apps uninstalled, education purpose & whats-app usage.

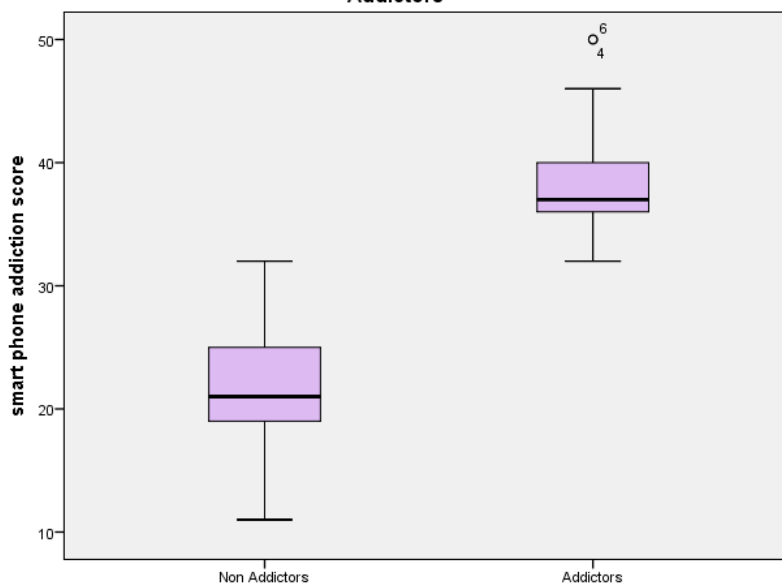
Table-1: Comparison of efficiency index in smartphone addicts & nonaddicts in young adults

Variable	Nonaddictors	Addictors	t value	P value
Age (years)	19.20+1.01	19.62+1.19	1.90	0.061
Efficiency index	78.90+17.04	53.70+18.06	-7.17	0.001

There was no significant difference for age among smartphone addicts & nonaddicts. There was a significant reduction of efficiency index among the smartphone addicts as compared to nonaddicts ($p < 0.001$)

Mann Whitney U test indicated that smartphone addiction score was significantly higher in addicts (median-37) than for nonaddicts (median-27) $U = 0.500, n_1 = n_2 = 50, P < 0.001$.

Fig-1: Comparison of smartphone addiction score between Nonaddictors & Addictors



Discussion

In the current day of events, the younger generation are becoming vulnerable to lucrative information technology devices which makes them addicted. Hand held devices such as Smartphones have become increasingly popular and more advanced over the last decade. Its use compels the user to use both hands simultaneously to perform the tasks like texting, gaming, browsing internet etc, in turn spending more time using both hands continuously. Thus the current study has focussed to assess functional evaluation of smartphone addiction on bimanual coordination in young adults.

Regular user is defined as those who use smartphone at least 6 or more times in 6 months¹². In the present study the data was collected in the age group 18-25 years which is age matched who were using smartphone >6 months. Smartphone addiction score between addicts & nonaddicts was significantly higher ($p < 0.001$). (Fig-1) Time spent on smartphone /day was significantly more in addicts i.e 81.5% & 71.4% were spending their time was between 4-6 hours & >6hrs. similar results was found in a study done by Inal et al, where the students were spending more than 3 hours on using smartphone for various purposes¹³. One more study showed a major component of daily smartphone usage time among students was 4-6 hours (40.1%) per day¹⁴.

The present study also showed a significant relationship where smartphone addicts were spending >once/week for app installation, but both the groups once the apps were installed spent less time on uninstalling. For emailing, facebook usage, games, texting messages, web usage smartphone addicts spent almost daily compared to nonaddicts. Similar results are found where the facebook users considered their Facebook dependency, are known as salience, tolerance, and conflict. But an interesting fact is that most of them in both the groups spent > 3-4 times daily for education purpose which is statistically not significant. Another study showed the primary purpose of smartphone use was to access social networking services (56.8%), such as Facebook, Twitter, WhatsApp, and Instagram¹⁴. In the present study both the groups most of them used Whatsapp daily, but showed no statistical significance.

Smartphone usage in day to daily activities requires bimanual coordination of hands. Bimanual coordination neurophysiology studies are very few. The present study showed most of them were using the smart-

phone for various activities almost daily which was statistically significant. The efficiency index assessed by bimanual coordination is significantly decreased in smartphone addicts compared to the non addicts ($p < 0.001$), (Table-1) thus indicating delay & also increase in error committed for the completion of the task. Increase in smartphone usage in young adults in the present study has decreased the rhythmicity of movements and the ability to synchronize limbs. Due to this there is decreased interlimb coordination, which is occurring at a slower pace & the individual is not aware of the damage occurring by using the gadget for a longer time.

When using Hand held devices the user is compelled to engage both the hands simultaneously where on repeated use it decreases the efficiency index of bimanual coordination. Possible explanation for the decrease in efficiency index might be due to chronic usage of smartphone in the hands there occurs fatigue in the distal muscles & the smartphone addicts demonstrated errors while performing the task. As distal muscles of the hand are primarily under the control of contralateral primary motor cortex. The corpus callosum which allows reciprocal information exchange between homologous cortical areas in the 2 hemisphere has been a source of neural cross-talk. This suggests that the corpus callosum plays a crucial role in exchanging sensory information about both limb motions to accomplish goal-directed task integration, which might be delayed¹⁵. The synchronisation of motor output will be decreased when there is repetitive flexing & extending of tendons in hands & fingers for prolonged period without rest. Our results corroborate in a study done by Inal et al¹³. Another study showed that Smartphone overuse assessed by ultrasound examination was found to be linked with higher signs of inflammation of musculoskeletal structures of hands joints in both psoriasis and controls, indicating its overuse may be a factor which speed up the possible development of psoriatic arthritis¹⁶.

Conclusion

In the present study in smartphone addicts efficiency index of bimanual coordination has significantly decreased compared to nonaddicts. As time spent on smartphone usage was more in smartphone addicts for various purposes, thus the best approach in them will be to attain self control & achieve level of balance while using smartphone, which might prevent

problems with interlimb coordination.

Conflicts of Interest---NIL

Source of Funding ----Self

Ethical Clearance---taken from Institute ethics committee (order No.DMC/KLR/IEC/08/2016-17 from SDUMC.

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