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# 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 addictors & non-addictors **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 addictors & 50 addictors . 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 addictors compared to nonaddictors (U=0.500, n1=n2=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 addictors & addictors 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 addictors compared to the non-addictors.

***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 technology[1]. Though it has many uses like social, interactions, information retrival & 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 skype[2]. 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 stress[3].

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 friends[4]. 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 devices[5]. 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 & dexterity[6]. 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 coordination[7].

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 hands[8].

Repetitive flexing and extending of tendons in hands & wrists particularly when done forcefully and for prolonged periods without rest also can increase pressure in carpel tunnel. Injury to wrist can cause swelling that exerts pressure on median nerves and causes carpel tunnel syndrome[9].

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 addictors & non-addictors .

## 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 addictors 57.8% . By using the formula calculated by G* power

$n = (Z_{\alpha/2}+Z_{\beta})^2 * (p_1(1-p_1)+p_2(1-p_2)) / (p_1-p_2)^2$, n1 (smartphone Addictors)=50,n2(Smartphone non-addictors)=50

where $Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2 (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96), $Z_{\beta}$ 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 questionairre given to young adults to know whether they are smartphone addictors or non-addictors[10].

Bimanual coordination of upperlimbs of smartphone adductors & non-addictors 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) commited during completion of task was noted in seconds[11].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, emailusage, education purpose,facebook, games, text messages, webusage & 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.

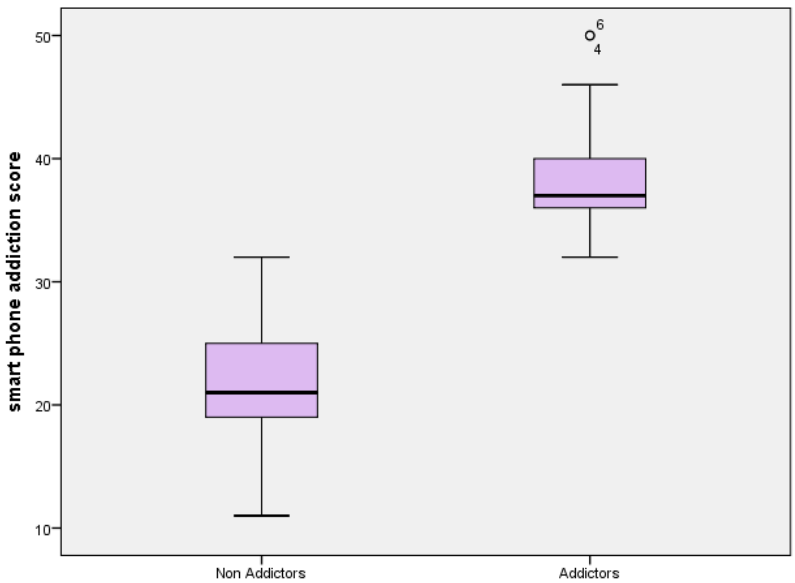
**Table-1: Comparison of efficiency index in smartphone addictors & nonaddictors in young adults**

| 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 addictors & nonaddictors. There was a significant reduction of efficiency index among the smartphone addictors as compared to nonaddictors (p<0.001)

Mann Whitney U test indicated that smartphone addiction score was significantly higher in adductors(median-37) than for nonaddictors(median-27) U=0.500, n1=n2=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 ,inturn 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 months[12]. 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 addictors & nonaddictors was significantly higher ($p<0.001$).(Fig-1)Time spent on smartphone /day was significantly more in addictors 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 etal,where the students were spending more than 3 hours on using smartphone for various purposes[13]. One more study showed a major component of daily smartphone usage time among students was 4-6 hours (40.1%) per day[14].

The present study also showed a significant relationship where smartphone addictors 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 addictors spent almost daily compared to nonaddictors. 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 showedThe primary purpose of smartphone use was to access social networking services (56.8%), such as Facebook, Twitter, WhatsApp, and Instagram[14]. 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 smartphone for various activities almost daily which was statistically significant. The efficiency index assessed by bimanual coordination is significantly decreased in smartphone addictors compared to the non addictors ($p<0.001$),(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 addictors 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 homologus 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 delayed[15]. 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 etal[13].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 arthritis[16].

## Conclusion

In the present study in smartphone addictors efficiency index of bimanual coordination has significantly decreased compared to nonaddictors. As time spent on smartphone usage was more in smartphone addictors 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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