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Effect of Mobile Phone Usage on Reaction Time in School Going Children Aged between 6-12 Years using a Ruler Drop Method - A Cross Sectional Study

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Abstract: ***Background: Increase in usage of cellphonization has increased massively in past 3 decades. Reaction time is very important for our everyday lives and needs intact sensory system, cognitive processing, and motor performance. Children under 6-12 years are the rich years filled with growth and more remarkable changes in executive attention. Objective: To assess the effect of mobile use on reaction time in school children aged 6-12 years by RULER DROP METHOD. Method: A total of 116 subjects aged 6- 12 years were selected and classified according to timing of mobile phone usage. Procedure was explained to all the participants. Reaction time was evaluated using ruler drop test and the data was statistically analysed. Result: The mean value and standard deviation for age was 9.05 ± 1.95 years, Height was 130.29 ± 10.776 cm, Weight was 26.93 ± 5.05 kg, BMI was 15.76 ± 1.68 kg/m2, Mobile phone usage was 5.57 ± 0.97 hours and Reaction time was 178.19 ± 26.12 ms. Conclusion: The study concludes that there is significant correlation between reaction time and mobile phone usage in children aged between 6-12 years.***

Keywords: Ruler drop method, reaction time, school children, mobile phone users

1. Introduction

REACTION TIME (RT) is simply defined as the time taken by individual to react to particular stimuli. Reaction Time is one of the important method to study a person's central information processing speed and fast coordinated peripheral movement response. It measures how quickly an individual reacts to a particular stimulus. Lesser the reaction time it multiplies one's achievements in many areas such as, sports, academics, music, dance, driving, defence. [1]

It measures the cognitive functioning of an individual and also how quickly an organism can respond to a particular stimulus. This reaction time mainly depends on the type, number and duration of possible stimuli. It varies with age, gender, physical fitness, hand dominance, fatigue, distraction, finger tremor, intelligence, learning disorder, accuracy in hearing and vision, etc.

Reliability of ruler drop method (RDM) in evaluating reaction time and it was established to have magnificent reliability between typically developing children (TDC). Hence, there is a definite need to validate a simple instrument to be used in schools like ruler. [2] In Simple Reaction time experiments, there is only one stimulus and one response. 'X' at a known location, 'spot the dot' and 'reaction to sound' all calculates simple reaction time. The simple reaction time task is a considerable task that aims mainly on speed of processing. Speed accompanying that a person can react to something, "Reaction Time" is the key determine the ability of an individual. When an individual reacts to something she/he hears, sees or feels, the total reaction time can be break up in a line of components. [3]

In the human life the age between 6-12 years are filled with growth and unusual changes in executive attention takes place from 6 and 8 years of ages where they make a move towards maturity from their period of being young. At the age of six years the kid shows noticeable shift in the cognitive abilities which incorporates perception memory, intuition, knowledge, reasoning, attention, judgment, and initiation and termination of activities. These cognitive changes transform the body and mind of a child along with biological and psychological changes. [4] So, if reaction time norms for children are supposed to be in these age duration, identifying the children diverting from these norms would be made simple.

Exposure to mobile phones prenatally and to a less amount postnatally has been affiliated with behavioural problems such as emotional and hyperactivity issues around the age of school entry.

2. Literature Survey

Previous researches and studies done were referred by using the key word Reaction time, ruler drop method and mobile phones. The databases searched were PubMed and Google Scholar. Articles included were randomized and non-randomized trials, quasi experimental trials, case studies and

systemic reviews.

3. Materials and methodology

The study was a cross sectional study conducted in home tuitions where a sample size of 116 school children aged between 6-12 years was collected using a convenient sampling method. The study utilized table and chair, measuring tape and ruler for the ruler drop method.

Inclusion criteria:
1) Children aged between 6-12 years.
2) Male and female genders.
3) Subjects with typical development and optimum health.
4) Children able to understand simple commands.
5) Children willing toparticipate. 6. Mobile phone users.

Exclusion criteria:
1) Uncooperative children
2) Open wounds
3) Recent fractures
4) Contracture or any nerve injury in the upper limb
5) Any other condition that prevents the children from performing the test.

Procedure: A sample of 116 children participated in this study with the prior parental assent from the parents/legal guardians. The ethical clearance was obtained from institutional research ethics committee prior to the study. The assent from children and consent from their parents/ legal guardians was obtained prior to the study. All anthropometric measurement was taken before the initiation of study. To measure Reaction time (RT) by ruler drop method (RDM) the child was made to sit with their dominant side elbow flexed at 90 degrees with mid-pronated forearm resting on a surface of flat table, and hand is kept open at the edge of the table. Ruler is dropped vertically by the therapist, in such a way that lower end of the ruler was aligned 5 cm between the web space (i.e. thumb and index finger) of the child's hand. Subject will be asked to catch the ruler as fast as possible once it dropped from the examiner's hand. Distance the ruler travelled was recorded from starting position. Then this distance will be converted into time by using following formula.

$$t = g \sqrt{d} /2$$

Where d is the distance travelled by ruler g is the gravitational constant (9.8m/s) Three trials were taken, then mean of this was used for the analysis and the test was repeated for next two sessions to estimate the intra-rater reliability.

4. Statistical Analysis

A total of 116 subjects were enrolled in this study. Data was collected on a data sheet and encoded for computerized analysis using SPSS version 28.0.0.0 for windows. Shapiro-wilk test was done to find out the normality distribution. As our data didn't cross the normality hence used a non-parametric test. Descriptive statistics was mention in terms of mean and standard deviation. Correlation of Reaction time with duration of mobile phone usage and age were done using Spearman's correlation test.

5. Result

From the 116 participants in the study, 62 were males and 54 were females. Age range was 6-12 years. **Table 1** shows mean and standard deviation for Demographic variables such as Reaction time, Age, Height, Weight, Mobile phone usage, BMI. The mean value and standard deviation for age was 9.05 ± 1.95 years, Height was 130.29 ± 10.776 cm, Weight was 26.93 ± 5.05 kg, BMI was 15.76 ± 1.68 kg/m^2, Mobile phone usage was 5.57 ± 0.97 hours and Reaction time was 178.19 ± 26.12 ms.

Table 1: Demographic data of participants recruited

Demographic Characteristics	N	Minimum	Maximum	Mean	Std. Deviation
Age	116	6	12	9.05	1.951
Height	116	101	152	130.29	10.776
Weight	116	18	40	26.93	5.054
BMI	116	11.0	19.6	15.763	1.6882
Mobile Usage	116	3	7	5.57	0.971
Reaction time	116	111	226	178.19	26.152
Valid N	116				

The Shapiro-Wilk test was done to assess whether the data was normally distributed. The test showed that the data was not normally distributed. Hence, a nonparametric test was used. (Table 2).

Table 2: (Test of Normality)

	Statistic	Df	Sig.
Age	.924	116	<.001
Height (in cm)	.984	116	.175
Weight (in kg)	.971	116	.012
BMI (kg/m2)	.992	116	.754

Table 3: Correlation between reaction time and mobile phone usage

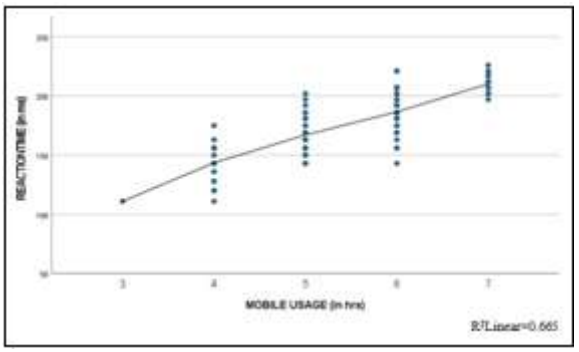
			Reaction time	Mobile Usage
Spearman's rho	Reaction time	Correlation Coefficient	1.000	.809**
		Sig. (2- tailed)	-	<.001
		N	116	116
	Mobile Usage	Correlation Coefficient	.809**	1.000
		Sig. (2- tailed)	<.001	-
		N	116	116

Table 3 shows the correlation between Reaction time and the mobile phone usage of 116 participants who participated in the study.

Table 4: Correlation between reaction time and age

			Reaction time	Age
Spearman's rho	Reaction time	Correlation Coefficient	1.000	0.183*
		Sig. (2- tailed)	-	.050
		N	116	116
	Age	Correlation Coefficient	.183*	1.000
		Sig. (2- tailed)	.050	-
		N	116	116

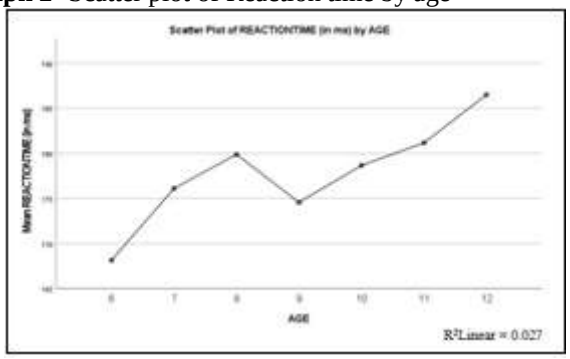
Table 4 Shows the correlation between Reaction time and the age of the participants.



Graph 1: Scatter plot of Reaction time by mobile usage

This Graph Depicts As The Duration Of Mobile Phone Usage Increases The Reaction Time Also Increases That Means Reaction Time Is Directly Proportional To Mobile Phone Usage.

Graph 2- Scatter plot of Reaction time by age



Graph 2: Depicts the correlation between the age and reaction time of the participants

6. Discussion

In this study we aimed to correlate Reaction time with mobile phone usage and age. In present study there were116 participants among which 62 were male participants and 54 were female participants in the study. The subjects were school children using mobile phones belonging in an age group of 6-12 years. Ruler drop method is used to assess the reaction time. Correlation was found using spearman's rho correlation formula.

According to GSMA the use of mobile phone last grown rapidly during last couple of decades. [5, 6] Misuse of cell phones is growing. Australia has been a world leader in the uptake of this technology with 20 million subscribers (or up to 94% of the population) now using a mobile phone. There is increasing use by children, with 23% of those between the ages of 6 and 13 owning a mobile phone. [10] There is now sufficient experimental evidence that mobile phone exposure does alter brain activity in young adults. [11] Greater mobile phone use was related to poorer accuracy on working memory and associative learning tasks, and greater reaction times on the simple and associative learning tasks. This depicts that rather than being related to a particular cognitive function, it may be related to a spontaneous response style of the child. In these circumstances, impulsive reaction or 'impulsive behaviour' refers to tend the children to react before they know the correct answer. Correlating to this, children who used mobile phones exist more fast but less correct on a number of tasks, suggesting that they may be more impulsive than other children, favouring a quick, and notaccurate, solution. [10]

As this study research was started before the COVID-19 pandemic. The data collection for the study was done during the lockdown when the schools were completely closed. Most of the children were attending online schools, this might become the reason for children using mobile phones for longer durations. Children have been using excessive phone depending upon their school hours, found to more than 5 hours per day according to the information on the consent form filled by their parents. Due to this there is increase in the screen time of the school children, which ultimately increased their time to react for the particular stimuli.

Previous studies show increase in mobile phone usage also increases the Reaction time value. The lesser the reaction time it affects the children's cognitive development. The most important finding of the present study was to assess the correlation of reaction time with mobile phone usage. The finding of the study revealed that the reaction time is prolonged with mobile use (graph 1). The results are statistically significant with p value of 0.0001 and is positively correlated. Previous study was done in the children aged between 6-10 years. There was a weak positive correlation between mobile phone usage and reaction time. [12] Present study was conducted on the age population between 6-12 years in which the mean value and standard deviations for age was 9.05 ± 1.95 years, mobile usage was 5.57 ± 0.97 hours, reaction time was 178.19 ± 26.12 ms. Differences were found in reaction time depending on different variables like age, height, weight and BMI values showing similarity with previous studies. Major differences were found in the weight of the children as compared to the previous study.

In this study the most important contributing factor for sudden dipping down of reaction time in age group of 9 years must be because of the weight of the children. There are few studies suggesting the association between cognitive function and both central and overall obesity among young children. Deng and others [11] advised that, waist circumference as a reliable sign of brain function in young, fully grown adult. Dore et al.[13] found that both waist circumference and WHtR (waist to hip ratio) were significantly associated with cognitive function. In present study the reaction time of children aged 9 years has decreased (graph 2). According to the belief of the Russian National Committee report to WHO, the following health risks are likely to be challenged by the children cellular phone users in the upcoming future: loss of memory, receding attention, vanishing learning and cognitive skills, sleep disorders, increase in stress sensitivity, and epilepsy. [11] Also decreased value of reaction time in this age might be because of the factors like less recognition to stimuli, differences in the lifestyle, reduce physical activity of children.

According to the previous study and the results of the present study, there is a need for further research to better understand the relationship between various cognitive functions, requiring lesser number of reaction time in the

specific age group associated with mobile phone usage and the weight in the young adults. The study was conducted on a sample population of 116 students in a region specific i.e., Mumbai; we need to compare the findings of the study conducted in different regions of India. The study was conducted at tuition classes in January 2021. Apart from this there are various factors like dominancy of the hand, weight, central obesity can be the factors affecting the reaction time which were not considered in this study.

7. Conclusion

The study concludes that there is significant correlation between reaction time and mobile phone usage in children aged between 6-12 years. Due to COVID-19 pandemic reaction time in the school children has increased that could also have affected our study results. All users of cellular phones should be advised not to engage in intense phone usage for the better improvement in reaction time, which is also a strong indicator for their cognitive abilities as the children grow older [13]. So we suggest there should be a limitedscreen time for children aged between 6 – 12 years.

8. Future Scope

Study can be obtained on larger sample size. Can be performed on dominant and non-dominant hand. Reaction time can be correlated with central obesity. Longer duration of phone usage (more than 8 hours) canbe studied to assess further insights on the effect of reaction time in comparison with variable factors.

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