Acute Effects of Earphone Usage on simple Reaction Time

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ABSTRACT- Reaction time test is the measure of the time taken by an individual to respond to a given stimulus which in succession tell about a person's central information processing speed and ascertain the integrity of the CNS. Straight away there has been a considerable increase in earphone usage, along with exposure of oneself towards loud music; as a rule was convinced to cause functional aberrations in the long run. However in this study we would like to manifest that hearing soft music even at an average volume for short time have an acute effect on reaction time; Thereby bring out toil in aforth livelihood of an individual both in one's personal as well as work life.

***Keywords-*SRT, ART, soft music, Decibel, Earphone, BMI**

I. INTRODUCTION

Reaction time (RT) is the time between onset of a stimulus and a response to it. RT is of three main types that include simple, recognition as well as choice reaction time. Simple reaction time (SRT) applies when there is only one possible stimulus requiring only one type of response. SRT is the most basic measures of processing speed where subjects simply respond to a stimulus as fast as possible. It is a parameter that measures the cognitive functioning of an individual, first measured by Francis Galton in the 19th century. [1]-[3]

In its working, the auditory stimulus activates the receptors in the inner ear. Information then travels to the central nervous system via the vestibulocochlear nerve. Conscious as well as unconscious processing of [auditory] information in the auditory cortex results in the generation of motor outputs which then travels via the descending pathway to various locations in the body. Here the motor response is the movement of finger tips in response to auditory stimulus [4].
Many varied factors like age, gender, physical fitness, fatigue, alcohol, weather, ethnicity etc. have shown to have an effect on reaction time [5]-[6].

It was disclosed in a study conducted by DD Waard et al. that listening to music has an effect on auditory perception and the intensity of which increases with usage of earbuds in particular [7]. Ronak Rathod et.al has affirmed in an investigation carried out by them on 96 medical students that there has been a significant increase in auditory reaction time in earphone users compared to non-users, which in turn notify that earphones act as a distractor and have its effect on rapid decision making task such as driving[8]. To add more, Jane farrel has uncovered the impact of music volume on reaction time, which turned out to have a significant increase in SRT with increased music volume and concludes that louder music have its impacts on an individual's capacity to respond to a stimulus[9]. This finite number of studies has shown beyond doubt the effects of gadgets on a person's ability to respond and in active functioning of one's biological system especially the CNS.

However, there are limited number of studies on reaction time and record of no studies done till date on their acute effects. Further as new technologies are being invented and holding its place with more adaptable features replacing the previous ones, one's dependence towards contact devices like bluetooth earphones have been increased and lack of substantial number of studies on their side effects has paved a way in coming forth with this investigation to look over on the short term effects of earphone usage on one's response time in a norm.

II. MATERIALS AND METHODS

A. *SAMPLE SIZE CALCULATION*

A pilot study of 5 subjects reported the auditory reaction time (ART) before and after exposure to soft music to be 0.18±0.047ms and 0.272 ± 0.077 ms respectively. Expecting a difference in reaction time of 0.092 ms, as reported by the pilot study, with a power of 80%, a confidence level of 95% and an alpha level of 5% with an expected SD of the difference to be 0.07, a sample size of 30 subjects were studied.

This cross sectional study was conducted on a total of 30 subjects in the age group of 17 - 30 years, randomly selected from JSS Medical College Mysore. The UG and PG students of JSS Medical College has been included in the study. The total available subjects (accessible population)was 343. A random sample of 30 subjects using simple random sampling method, with a random number table generated with the help of software(MS Excel), has been selected into the study. Healthy adult subjects of both gender with normal hearing were included and subjects with any history of diabetes, hypertension, previous/present ear diseases or deafness, any ear problems like discharge, ear surgery, related medication or any systemic disease that would affect hearing, Smokers and Alcoholics; were excluded from the study.

B. *ETHICAL CONSIDERATION*

Ethical clearance was obtained from the institutional ethical committee. Further Participation in the study was voluntary and informed consent was taken from every participants.

C. *METHODLOGY*

Demographic characteristics of individual participants were documented. The height was measured in cm using a stadiometer and weight in Kg using a weighing machine. The participants were allowed to rest in a calm and composed state and were instructed about the procedure. This was followed by the recording of simple auditory reaction time using INCO Reaction Time Test Apparatus, model No. 651. SRT is the time taken by the subject to respond to a stimulus. The total time taken from the starting of stimulus (by pressing any of the stimulus keys on the operators panel), till the time the subject responds (by releasing both the keys). This time, displayed in seconds, indicates SRT. The auditory SRT was recorded by asking the subjects to press the two hand keys on the RT test apparatus with the fingers of their dominant hand and simultaneously release both hand keys as soon as they perceive the sound stimulus. The subjects were exposed to two different sound stimuli of varying frequencies, S1 and S2 respectively and SRT was recorded separately for each stimuli. By putting the switches above S1 and S2 to S position the particular stimulus can be configured for simple reaction. In simple reaction mode the display will stop as soon as both hand keys are released and the time can be noted from the display. Then the subsequent reading was taken after exposure to soft music of an average 60 decibel (dB) for about 30 minutes, using Bluetooth earphones. The reaction values were directly read from the digital display of the testing apparatus. All the readings were recorded in a quiet secluded room.

D. *STATISTICAL ANALYSIS*

The demographic characteristics such as Gender, BMI etc. are being represented in percentage. The comparison of the Reaction Time measured in milliseconds before and after exposure has been compared using a paired sample T test. The comparison of the reaction time (S1 Post) between male and female participants and among different categories of BMI has been done using an independent sample T test and ANOVA respectively. P Value < 0.05 has been considered statistically significant. The statistical analysis has been performed using SPSS Version 22 after checking the Normality of data using Kolmogorov Smirnov test.

III. RESULTS

The present study was undertaken on 30 subjects (n = 30) which includes 13 male and 17 female participants belonging to the age group of 17-30 years. The average age of subjects being 21.69 years and average BMI being 23.32 kg/m^2 respectively. The statistical analysis of the result shows that there is a highly significant difference between the pre and post exposure to soft music for both the stimulus, with RT being increased after exposure to music through earphone.(Table 1)

Table I : Comparison Between Auditory SRT Before and After Exposure to Soft Music

Stimulus	Pre (Mean±SD) ms	Post (Mean±SD) ms	P Value
S1	0.1623±0.0331	0.2140±0.0593	<0.001
S2	0.1716±0.0499	0.2142±0.0578	<0.001

There has been a statistically significant difference in the reaction time of S1 and S2 before and after the exposure (P Value < 0.001)

Table I : Comparison of Reaction Time (S1 Post Exposure) Between Male and Female Participants

	Male (Mean±SD) ms	Female (Mean±SD) ms	P Value
S1 (POST)	0.2146±0.0701	0.2133±0.0486	0.952

There was no statistically significant difference in Reaction time (S1 post exposure) between male and female (P Value 0.952)

Table III : Comaprison of Reaction Time (S1 Post) Among the BMI Categories

Classes of BMI	S1 (post) (Mean±SD) ms	F Value	P Value
Severe Thinness	0.203±0.03535	0.554	0.650
Mild Thinness	0.14800±0.0		
Normal	0.2124±0.0622		
Overweight	0.2268±0.06009		

There was no significant difference in reaction time (Post S1) among different categories of BMI (P Value 0.650)

IV. Discussion

The study was conducted on healthy adult subjects to analyze the acute effects of earphone usage on simple reaction time. In this study prolongation in reaction time has been seen after exposure to soft music at an average of 60 dB for 30 minutes. Few of the examinations carried out till date divulges that earphone usage has a negative effect on reaction time. In a study executed by J Farrel, an increase in average reaction time was noted with a rise in music volume from 0 dB to 75 dB [9]. This clearly depicts the harmful effects of hearing music in loud volume. Further as reported in an article by H. baeon, usage of earphones for prolonged time has shown to give out a far greater chance of hearing loss, severity of which increases with increased background noise [10]. Exposure to even soft music with an average decibel for short time has led to an increase in reaction time in our study which in turn throw light to the fact that exposure to discotheque music or increasing volume will further deteriorate it, bring about arduous out turns on one's life; inclusive of physical as well as mental disturbances counting difficulty in execution of quotidian activities.

From an investigation carried out by A Jain et al. a significant difference was found in RT of male and female as well as between sedentary and regularly exercising students which once again open up and enlist the various factors that affect the reaction time. RT was set down to be more in an exerciser compared to an idle person which highpoint that healthy lifestyle help in improvement of one's response time. It was exemplified in previous studies that any variation in BMI from the normal state outfocus an increase in reaction time, on the same hand further analysis has delineated the other side where no apparent analogy was seen between BMI and RT. In a study done on relation between BMI and SRT by A. S. Nene et al. the reaction time was found to be longer in subjects having a higher and lower BMI which therein shows that BMI has an effect on the sensory motor association [11]. Alternatively Esmaeilzadeh S et al. in their study held no significant relationship between reaction time and BMI [3],[12]. However in our study no significant citable association was discerned on this aspect.

Alike gender has also shown to have an effect on RT, where few of the studies showed an increase in reaction time in female while other investigation repotted an increased RT in male respective to the gender. Moreover it has been documented that gender does not affect the speed of body language reading. However, the existing difference is due to the stronger motor response in male and hormonal influences [13]. Withal in this study no significant difference in RT between male and female was noted.

Certain other factors both external as well as internal, at molecular level; might lay its influence on RT which therein indirectly cause an increase in response time. This can be hormonal, lifestyle and diet, exercise, environmental factors, mental well-being etc. Further we would foreground on few areas, we didn't take the focus of our studies into like extent of damages caused by different hearing devices like head phone, earphones, Bluetooth devices etc. In addition the comparison can be done on recognition or choice RT as well in future studies.

V. Conclusion

The current study highpoint on the acute effects of using earphone in our day to day life, from hearing music to having daily conversations with our dear and near ones, if not reduced and averted will have a damaging effect on once performance, neurocognitive changes including slow response and poor working of systems in the body. In addition to this it is not advised to use headphones prior to and during significant decision making activities thereupon to intensify and aid in a better deliberation, active functioning and execution of divergent tasks.

VI. REFERENCES

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