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Effect of Dipping Tobacco and Smoking on Auditory and Visual Reaction Time in Males

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Abstract: ***Background:*** In India smoking and tobacco dipping are major health problems and one of the largest preventable causes of disease and premature death. Nicotine has been reported to improve attention, learning, reaction time (RT), problem solving, and stimulus evaluation and discrimination. Previous research has established that cholinergic systems are important for cognitive functioning and nicotine is a potent cholinergic stimulant that affects many central nervous system (CNS) pathways, including the auditory pathway. It is a measure of function of sensory motor association and performance of an individual. It involves stimulus processing, decision making, and response programming. ***Material and Methods:*** This is a Prospective, observational, comparative study was conducted in the Departments of Physiology at Index Medical College. Audio-visual reaction time – Measurement of reaction time is a simple test which is measured by 'audiovisual reaction time apparatus' (Anand agency, Pune). Reaction time is a commonly used parameter for measuring implicit learning. In measurement of reaction time subject was asked to respond by pressing the button as soon as he had received the stimulus in the form of sound or light. The apparatus provides both auditory (low and high pitched sounds) and visual (red and green) stimuli. The arrangement consists of a source of stimulus, response key and the time recording device. The response is given by the subject by pressing a key with his index finger. ***Results:*** In the present study, in age groups ART values were significantly different (Graph-1) in all three groups, ART and VRT values increase in control, smokers and dipping tobacco users as age advances. As regards ART values, age group 31-40 years differs significantly from age group 11-20 years and 21-30 years ($p<0.05$), similarly age group 41-50 years differs significantly from age groups 11-20 years, 21-30 years and 31-40 years. As regards, VRT values age groups differ from each other but age group 41-50 years differ significantly from age group 11-20 years and age group 21-30 years. ***Conclusion:*** Significant difference was also observed after smoking and after 12 hours of abstinence in study group subjects. This indicated increased reaction time required for integration process in CNS and delayed conduction in reflex arc after abstinence. Thus, the evidence presented in this article supports that temporary abstinence from nicotine has adverse effect on reaction time which may force them to smoke again. Health education and nicotine replacement therapy may help them to achieve the ultimate goal of complete cessation from smoking.

Keywords: Dipping Tobacco, Smoking, Auditory Reaction Time, Visual Reaction Time

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INTRODUCTION

In India smoking and tobacco dipping are major health problems and one of the largest preventable causes of disease and premature death. Nicotine has been reported to improve attention, learning, reaction time (RT), problem solving, and stimulus evaluation and discrimination. [1] Previous research has established that cholinergic systems are important for cognitive functioning and nicotine is a potent cholinergic stimulant that affects many central nervous system (CNS) pathways, including the auditory pathway. [2]

According to World Health Organization the death penalty due to smoking may exceed 1.5 million annually. In India prevalence of smoking in school and college going students is increasing day by day. [3,4] Nicotine is one of the ingredients of cigarette smoke. Cigarette smoking has stimulant effect on nervous system and nicotine causes decrease in reaction time due to its stimulant property on the nicotinic receptors. [5] Smokers claim that they are able to concentrate to

perform and complete the given tasks immediately after cigarette smoking. [6] In chronic cigarette smokers abstinence impairs attention and cognitive abilities. The effects can be reversed by cigarette smoking to pre deprivation baseline levels. [7]

Nicotine reinforces self-administration. Initial application of nicotine can increase the activity of the dopamine neurons, which could mediate the rewarding aspects of tobacco use. [8] Prolonged exposure to low concentrations of nicotine, however, can cause desensitization of the nicotinic receptors, which helps to explain acute tolerance to nicotine's effects. [9]

It has been observed that nicotine activates and desensitizes nicotinic acetyl choline receptors. Major effect of these receptors is modulation rather than processing of fast synaptic transmission. These events contribute to the cellular events that underlie nicotine addiction. [10] The reports suggest that the first cigarette of the day gives more pleasure, whereas the effect of subsequent cigarettes decreases. It may depend on the interplay between activation and desensitization of multiple nicotinic receptors. [11]

Recent research indicates chronic cigarette smoking is associated with increased risk for numerous biomedical conditions that may directly or indirectly compromise brain neuro-biology and neuro-cognition. [12] Compared to the substantial volume of research on the general health consequences associated with chronic smoking, little research has been specifically devoted to understanding effects after abstinence for twelve hours on audio-visual reaction time. [13]

It is a measure of function of sensory motor association and performance of an individual. It involves stimulus processing, decision making, and response programming. Reaction time studies have been documented in both sexes for visual and auditory stimuli. It has physiological significance and is a simple and non-invasive test for peripheral as well as central neural structures. [14]

MATERIALS AND METHODS

This is a Prospective, observational, comparative study was conducted in the Departments of Physiology at Index Medical College.

Inclusion Criteria

1. Male between the age group of 19-25 years.
2. Cigarette smokers consuming at least 10-19 cigarettes per day for more than 2-3 years.

Exclusion Criteria

1. Smokers suffering from any acute or chronic illness.
2. Smokers with any physical deformity.
3. Smokers consuming alcohol.

Control group – Consisted of age matched non-smoker males, not suffering from any illness and without any physical deformity.

Audio-visual reaction time – Measurement of reaction time is a simple test which is measured by 'audiovisual reaction time apparatus' (Anand agency, Pune). Reaction time is a commonly used parameter for measuring implicit learning. In measurement of reaction time subject was asked to respond by pressing the button as soon as he had received the stimulus in the form of sound or light.

The apparatus provides both auditory (low and high pitched sounds) and visual (red and green) stimuli. The arrangement consists of a source of stimulus, response key and the time recording device. The response is given by the subject by pressing a key with his index finger. Time taken by the subject to give a response is displayed with an accuracy of one millisecond and is recorded as his auditory or visual reaction time. [15]

The reaction time was recorded in a well illuminated and noise free room in the Department of Physiology. The location and direction of the instrument and position of subject was kept constant throughout the study period. The test subject was allowed to relax before commencing with recording of reaction time. Reaction time was measured for two varieties

of auditory stimuli (low and high pitch) and two varieties of visual stimuli (red and green) provided in the instrument. The sequence of application of stimuli was kept constant. Procedure was demonstrated to all the subjects individually. [16]

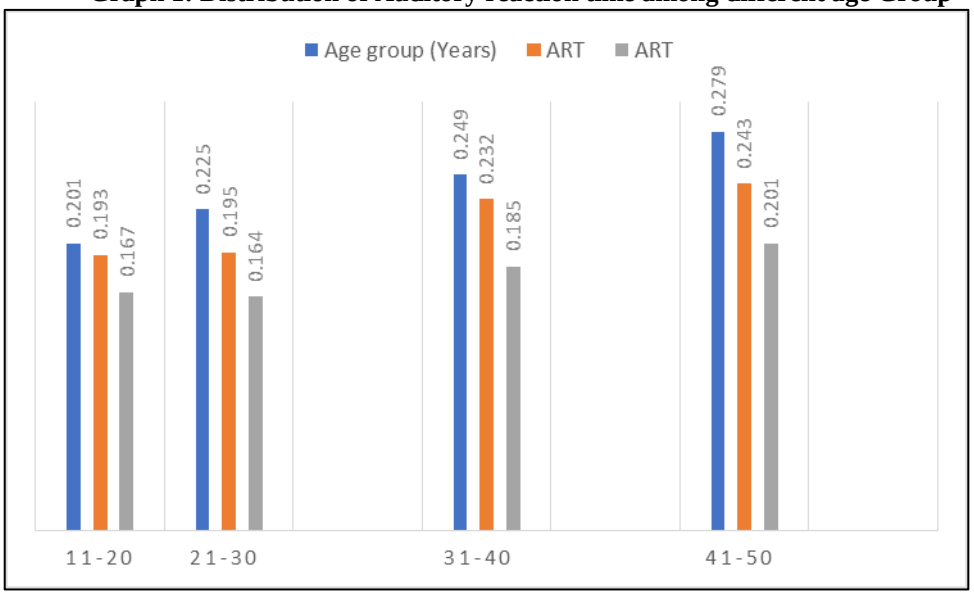
Statistical Analysis

The observations in the two groups were compared. The data was analysed by using Student's t-test and p-value less than 0.05 was accepted as an indicator of significant difference between compared values.

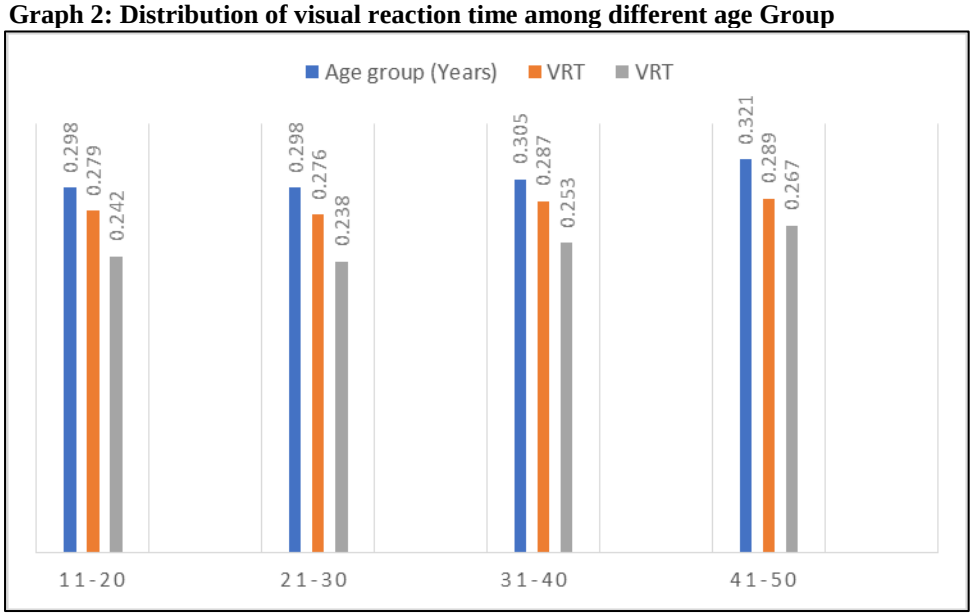
RESULTS

In the present study, in age groups ART values were significantly different (Graph-1) in all three groups, However a decreasing trend was there in ART values from control to smokers and dipping. Control group is having the highest mean value while dipping has lowest mean value. Post-hoc analysis found that in age groups 31-40 years and 41-50 years ART values are significantly different in dippers as compared to control but do not differ significantly from smokers group. Over the age groups, smokers and dipping tobacco users differ significantly from control. ART and VRT values increase in control, smokers and dipping tobacco users as age advances.

Graph 1: Distribution of Auditory reaction time among different age Group



Graph 2: Distribution of visual reaction time among different age Group



As regards ART values, age group 31-40 years differs significantly from age group 11-20 years and 21-30 years ($p<0.05$), similarly age group 41-50 years differs significantly from age groups 11-20 years, 21-30 years and 31-40 years.

As regards, VRT values age groups differ from each other but age group 41-50 years differ significantly from age group 11-20 years and age group 21-30 years.

DISCUSSION

In our study there is a statistically significant decrease in the basal VRT and ART of smokers as compared to healthy controls. Myrsten *et a* [15] have claimed that cigarette smoking tends to shorten reaction time. Hauser *et al*[66] studied EEG changes in healthy adults and showed an increase in dominant ? frequency, which probably demonstrates that smoking in some way affects central nervous system.

Surwillo[17] found definite relationship between EEG measures of arousal and reaction time and has shown close correlation between reaction time and frequency of ? rhythm indicating increase arossal.

In our study also the shorter VRT and ART in smokers could be due to increased arousal. After smoking one cigarette a significant decrease in VRT and ART has been noticed. Literature suggests that nicotine in the quantities taken by human smoker can be a central nervous system stimulant drug. [18] The stimulating action of nicotine on the human nervous system has also been accepted by RG Bell. [19] Chessick put forward suggestion that smoker may experience lessening of tension and anxiety thereby enabling him to work at an increased level of efficiency.

Thus in our study the decrease in VRT and ART after one cigarette could be due to the stimulant action of nicotine on the nervous system. This study found a longer reaction time among lead-exposed smokers than non- smokers. Our findings could add further support to previous studies reporting detrimental effects of occupational lead exposure captured in the recent systematic reviews. [20] While their overall metanalysis result was inconclusive, Goodman et al. suggested a significant difference of cognitive function examined by the digit symbol test, a more sensitive test than the simple reaction time, to detect a change in cognitive function. [70] Our results call for workplace intervention to protect smokers from chronic lead exposure considering their contribution to cultural heritage.

The mechanism of chronic lead toxicity during adulthood in the cognitive domain has just started to be explored in detail. [21] Several previous studies have demonstrated the effect of occupational lead exposure with executive functions decline, slowed decision-making abilities, and reaction times. [22] A recent animal study found detrimental effects of chronic lead exposure on neurotransmitters in adult rats' prefrontal cortex, representing chronic lead exposure during adulthood. [23] Lead can substitute for calcium in several regulatory events that involve calmodulin, interfering with energy metabolism and calcium release from mitochondria, resulting in priming activation of programmed cell death process. [24] More pronounced effect of lead exposure on reaction time among female workers than male workers might be assumed. Mansouri et al. also found different behavioral effects of chronic lead exposure between male and female rats. [25] Distinct hippocampus development and the differences in lead concentration and metabolism between male and female was suggested to be responsible for the sex-dependent effect of chronic lead toxicity on cognitive function. [26] On the contrary, a previous study found that men experienced a higher blood lead level than females in a similar occupational context. [27] While our study supports the gender-specific threshold of occupational lead exposure, the sex-dependent effect of chronic lead toxicity on reaction time needs further investigation.

Several studies suggested that musculoskeletal problems and complaints such as leg pain, low back pain, upper limb pain, and neck pain could result in delayed reaction time, but our study could not find a correlation between musculoskeletal complaints and reaction time. [29]

CONCLUSION

Significant difference was also observed after smoking and after 12 hours of abstinence in study group subjects. This indicated increased reaction time required for integration process in CNS and delayed conduction in reflex arc after abstinence. Thus, the evidence presented in this article supports that temporary abstinence from nicotine has adverse effect on reaction time which may force them to smoke again. Health education and nicotine replacement therapy may help them to achieve the ultimate goal of complete cessation from smoking.

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