

International Journal of Medical and Health Sciences

Journal Home Page: <u>http://www.ijmhs.net</u> ISSN:2277-4505

Original article

The study of auditory and visual reaction times in chronic smokers

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ABSTRACT

Audio-visual reaction time is a reliable indicator to assess the processing capability of central nervous system and sensory motor performance in response to an external stimulus. The present study was aimed to find out whether chronic smoking affects the processing capability of central nervous system. The audio-visual reaction times of 120 male subjects with age ranging from 25 to 55 years forming various groups as control and smoker were measured by a device "Response Analyzer". The auditory reaction time was recorded for high frequency sound and visual reaction time for red light. The observations revealed that both auditory and visual reaction times were significantly delayed in chronic smokers as compared to that in controls. The results indicated that alteration of the processing capability of central nervous system as reflected by the changes in auditory and visual reaction times might be due to impaired perceptual-motor coordination in chronic smokers.

KEYWORDS: Audio-Visual Reaction Time, Smoking

INTRODUCTION

Cigarette smoking is one of the major worldwide health problems and one of the largest preventable causes of disease and premature death. As per World health Organization (WHO), about a third of the male adult global population smokes and it is estimated that the global prevalence of smoking will be 22.7% by 2020 and 22.0% by 2030. [1] Cigarette smoke is a toxic mixture of more than 7000 different chemicals which includes hundreds of poisonous and carcinogenic compounds. [2] When inhaled, these chemicals affect the human body in multiple ways, none of which are beneficial. The immune system is compromised and the functioning of internal organs is also affected by these toxic chemicals. [3] Long term smoking is a prime factor in heart disease, stroke and chronic lung disease. [4] It can cause cancer of the lungs, larynx, esophagus, mouth and bladder, and contributes to cancer of the cervix, pancreas, and kidneys. [4]

Tobacco smoking has also been associated with negative effects on several types of cognitive functions. [5] Cognition involves brain's processing capability which can be assessed with various neurophysiological and or neuropsychological tests. Reaction time is an index of cortical arousal and has been recognized as a potentially powerful means to assess the integration of sensory, motor and coordination system of the body in response to an external stimulus. It is an interval between application of the stimulus and the initiation of the appropriate voluntary response by the subject as early as possible. [6] The delayed or fast reaction time indicates deteriorated or improved processing capability of central nervous system and or sensory motor performance.

Therefore, with the hypothesis that the reaction time of chronic smokers might be delayed than that of normal individuals, the present study was intended with objectives to determine auditory and visual reaction times of chronic smokers and to compare them with that of normal healthy controls.

MATERIAL AND METHODS

The present study was conducted in Indira Gandhi Government Medical College, Nagpur. The institutional ethics committee approved this study. After obtaining a written informed consent, subjects in the present study were divided into three groups based on their age. Group I was formed by the subjects with age between 25 to 35 years. Group II comprised subjects with age between 36-45 years whereas group III included subjects with age 46 to 55 years. Each group had a total of 60 subjects. These groups were then further subgrouped as control and smoker, according to the history of smoking.

Smokers had history of smoking filtered or unfiltered cigarettes at least 10 per day for last 5 years or more. Control group was selected from those who have never smoked tobacco. All the subjects were age and weight matched and having normal vision and hearing. None of the subjects had history of alcohol abuse or evidence of any major illness in the past. They belonged to same socio- economic status. Informed consent was obtained from them after explaining the study protocol. The readings of auditory and visual reaction times were taken by using a device "Response Analyzer" by Yantrashilpa system, Pune in a quiet room with good visibility conditions two hours after the light breakfast. Visual and auditory signals were given from the front side of the subject. They were instructed to use index finger of the dominant hand to press the response key. [7] The device "Response Analyzer" had display range of 0 to 9.999 sec. and accuracy of \pm 0.002 sec. After giving sufficient trails, three readings were noted and their average was considered as a single value for statistical analysis. [8] The data was analyzed by using unpaired t test and p value less than 0.05 was accepted as an indicator of significant difference between compared values.

RESULTS

Table 1, 2 and 3 depicts the mean and standard deviations of age, auditory reaction time and visual reaction time of Group I, II and III respectively. Also these tables show the p value and results of t test for comparison of control and smokers.

Age of control and smoker in the group I, II and III was found to be statistically nonsignificant. This finding suggests that the groups were age matched. (Table 1, 2, 3)

Auditory reaction time was found to be delayed in all age groups of smoker as compared to that of control. This delay was not statistically significant in group I whereas it was significant in both group II and III. (Table 1, 2, 3)

Similarly, visual reaction time was also delayed in all age groups of smoker as compared to that of control. The delay was not statistically significant in group 1 whereas it was significant in group 2 and 3 for both auditory and visual reaction times. (Table 1, 2, 3)

Table 1: Comparison and analysis of Group I controls and smokers for auditory and visual reaction times

VARIABLE	GROUP I			
	Controls I	Smokers I	Р	
	$(\text{mean} \pm \text{SD})$	(mean ±SD)	Value	
Age (years)	31.80 ± 2.06	32.45 ± 2.7	1.53 ^{NS}	
Auditory Reaction	n 0.15559 ± 0.0051	0.1592 ± 0.0054	1.11 ^{NS}	
Time (Sec)				
Visual Reaction	n 0.18884 ± 0.0088	0.1934 ± 0.0082	1.07 ^{NS}	
Time (Sec)				

(p < 0.005 was considered significant, ^{NS}: Statistically nonsignificant.)

Table 2: Comparison and analysis of Group II controls and smokers for auditory and visual reaction times.

VARIABLE	GROUP II			
	Controls II	Smokers II	P Value	
	$(\text{mean} \pm \text{SD})$	(mean ±SD)		
Age (years)	38.80 ± 3.17	39.50 ± 2.94	1.66 ^{NS}	
Auditory Reaction	0.1600 ± 0.0077	0.1653 ± 0.0048	< 0.005 *	
Time (Sec)				
Visual Reaction	0.1915 ± 0.0057	0.1968 ± 0.0070	< 0.005 *	
Time (Sec)				

 $(p < 0.005 \text{ was considered significant,}*: statistically significant, ^{NS}: Statistically nonsignificant.)$

Table 3: Comparison and analysis of Group III controls and smokers for auditory and visual reaction times.

VARIABLE	GROUP III		
	Controls III	Smokers III	P Value
	$(\text{mean} \pm \text{SD})$	(mean ±SD)	
Age (years)	50.90 ± 2.77	50.25 ± 2.33	1.05 ^{NS}
Auditory Reaction	0.1653 ± 0.0058	0.1694 ± 0.0068	< 0.005 *
Time (Sec)			
Visual Reaction	0.1973 ± 0.0053	0.2032 ± 0.0084	< 0.005 *
Time (Sec)			

 $(p < 0.005 \text{ was considered significant},*: statistically significant}, ^{NS}: Statistically nonsignificant.)$

DISCUSSION

The findings of the present study suggest that both auditory and visual reaction time was longer in smokers as compared to nonsmokers. This delayed response to auditory as well as visual stimuli by chronic smokers might be due to several patho-physiological changes in their body systems. One of the most important pathophysiological changes is probably the atherogenesis of arteries and arterioles supplying to cerebral hemispheres. This may be the result of long term tobacco smoking which leads to -

- i. Abnormal increase in blood total triglycerides, very low density lipoprotein (VLDL) and low density lipoprotein (LDL) cholesterol and decrease in HDL cholesterol. [9, 10]
- ii. Enhanced blood coagulability due to increased fibrinogen and other clotting factors. [11, 12]
- iii. Decreased synthesis of prostacyclin by vascular endothelium which has antiaggregation effect on platelets. [13]

Along with these atherogenic changes, there is also reduction in small airways function with low PaO₂ and PaCO₂ in smokers. [14] As CO₂ is most potent cerebral vasodilator, hypocapnia might lead to decreased cerebral blood flow.

Also, Carbon monoxide is one of the many harmful and neurotoxic constituents in cigarette smoke. Chronic smokers develop elevated carboxyhaemoglobin levels which might impair function of central nervous system by affecting oxygen transport and its utilization. [15] Thus reduced cerebral blood flow and hypoxic impairment of central nervous system might have lead to cognitive dysfunction and perceptualmotor delay in habitual smokers.

The present study findings also showed that delayed reaction time was more significant in higher age groups. That is, as age advances smoking related changes in the auditory and visual reaction time also go on increasing. The probable explanation for this finding is that, as the age increases various changes occur in nerves e.g. increased fibrosis, segmental demyelination and degeneration leading to slowing of conduction velocity in motor nerves. [16] These changes are more prominent beyond 50 years of age. With advancing age there is also an age related decline in psychomotor speed leading to delayed response in elderly individuals. [16] Thus age is another factor which might be additive to chronic smoking for delayed reaction time.

SUMMARY AND CONCLUSION

Addiction of smoking causes damage to health over time. As the auditory and visual reaction time is delayed, these addicts may have trouble in handling complex tasks. With long term exposure, even simpler tasks can be difficult for them because of impaired perception and reaction time. Thus, it is advisable to discourage the community from chronic cigarette smoking and health education to that effect is a need.

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