

Received : 10/08/2024
 Received in revised form : 25/09/2024
 Accepted : 11/10/2024

Keywords:
 Smoking, Pack years, Visual Reaction time.

Corresponding Author:
Dr Sindhuja A
 Email: drkavyashreehm@gmail.com

DOI: 10.47009/jamp.2024.6.5.132

Source of Support: Nil,
 Conflict of Interest: None declared

Int J Acad Med Pharm
 2024; 6 (5); 700-704



Kavyashree H M¹, Umadevi B², Tejashwini V B³, Sindhuja A⁴, Sendil Kumaran D⁵

¹Associate Professor, Department of Physiology, Sri Madhusudan Sai Institute of Medical Sciences & Research, Chikkaballapur, Karnataka, India

²Professor & HOD, Department of Physiology, The Oxford Medical College, Hospital & Research Centre, Bangalore, Karnataka India

³Assistant Professor, Department of Physiology, Haveri Institute of Medical Sciences, Haveri, Karnataka, India

⁴ Associate Professor, Department of Physiology, Annai Medical College & Hospital, Sriperumbudur, Chennai, Tamilnadu, India

⁵ Professor & HOD, Department of Physiology, Sri Madhusudan Sai Institute of Medical Sciences & Research, Chikkaballapur, Karnataka, India

Abstract

Background: The relationship of smoking with visual reaction time is debated. Cigarette smoke contains cytotoxic compounds which directly or indirectly cause damage to neuronal cells. Smoking is also associated with deficiencies in auditory-verbal learning or memory, visual search speeds, processing speed and executive functions. Smokers develop elevated carboxyhaemoglobin levels which might impair function of central nervous system by affecting oxygen transport and its utilization leading to perceptual-motor delay in smokers. To record the visual reaction time in smokers and non-smokers aged 20-40years and to compare between two groups for any changes in reaction time for different colours. **Materials and Methods:** Age matched 100 male smokers and 100 male non-smokers in the age group of 20-40 years were studied visual reaction time. Smoking in terms of pack years was noted. Data was statistically analyzed. **Result:** Visual reaction time to red, blue, green and yellow colours was also increased in smokers when compared with non-smokers and the difference is statistically highly significant. **Conclusion:** Smoking increases visual reaction time leading to impaired perceptual-motor coordination.

INTRODUCTION

Tobacco smoking is the most important preventable cause of death and disease among adults. World Health Organization estimates that worldwide 5 million deaths are caused prematurely by smoking every year.^[1] In India, over 6, 00,000 people in the age group of 25-69 years die due to smoking every year.^[2] Currently in India there are about 120 million people who either smoke cigarette or bidi.^[3] Current percentage of male tobacco smokers are 24.3% in India and 23.2% in Karnataka according to Global Adult Tobacco Survey 2010.^[4] Smoking affects almost every system in the human body. Smoking is also associated with many eye diseases like tobacco-toxic optic neuropathy, thyroid ophthalmopathy, cataract, strabismus and colour vision defects as shown by various studies.^[5] Chronic cigarette smoking appears to be associated with deficiencies in executive functions, cognitive flexibility, general intellectual abilities, learning and/or memory processing speed, and working memory.^[6]

As smoking affects visual system as found by many studies, we have taken up this study to know the association of ill effects of smoking with visual reaction time.

A study done on smokers 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.^[7]

Therefore, the present study was taken up to observe the effects of smoking on visual reaction time for different colours.

The hypothesis being tested is that “there is effect of smoking on visual reaction time in Davangere population”

Objectives

To evaluate whether there are significant changes in visual reaction time in smokers for different colours when compared to non-smokers.

Review Of Literature

Reaction time (RT) is the time interval between the onset of stimulus and the initiation of response under the condition that the subject has been instructed to respond rapidly as possible. RT is considered to be an index of speed of processing.^[8] RT provides an indirect index of the processing capability of CNS and a simple means of determining co-ordination between the sensory and motor systems.^[9] Cognition involves brain's processing capability which can be assessed with various neurophysiological and or neuropsychological tests. The delayed or fast reaction time indicates deteriorated or improved processing capability of central nervous system and or sensory motor performance.

A study by **Pravin Jadhao et al.** on audio-visual reaction times of 120 male subjects aged between 25-55 years was done. The observations revealed that both auditory and visual reaction time were significantly delayed in chronic smokers as compared to that in controls. They indicated that alteration of the processing capability of central nervous system as reflected by changes in auditory and visual reaction time might be due to impaired perceptual-motor coordination in chronic smokers.^[7]

Afshan A et al., studied the effect of chronic cigarette smoking on intraocular pressure and audio-visual reaction time on 50 smokers and 50 nonsmokers. They observed a significant effect of cigarette smoking on intraocular pressure which had increased in both eyes, suggesting that it could be an important risk factor in occurrence of glaucoma, cataract, macular degeneration and amblyopia. Reaction time to green and red colour was decreased in study group.^[10]

Ichaporia RB et al., in their study of reaction time in smokers found there is a statistically significant decrease in the visual and auditory reaction times in 50 smokers as compared to healthy controls of same age group. Decrease in VRT and ART after cigarette smoking could be due to stimulant action of nicotine on the nervous system.^[11]

MATERIALS AND METHODS

Source of data

The present study was carried out on 100 smoking and non-smoking male population from residential areas of Davangere in the age group of 20-40 years. The subjects selected as study and controls were age matched. Smokers were divided into three groups depending on their smoking history in terms of pack-years. Female subjects were excluded from the study because many use smokeless form of tobacco and acceptance rate is very low.

Study Group

100 male smokers from Davangere in the age group of 20-40 years.

Control Group

100 normal healthy males' non-smokers from Davangere in the age group of 20-40 years.

Inclusion Criteria

Study Group

1. Male smokers aged between 20-40 years as study group.
2. Subjects with normal vision 6/6 with or without correction.
3. Subjects who have given written consent

Control Group

1. Male non-smokers aged between 20-40 years as control group.
2. Healthy subjects from residential area as evaluated by general physical, systemic and ophthalmological examination.
3. Subjects with normal vision 6/6 with or without correction
4. Subjects who have given written consent.

Exclusion Criteria

1. Age below 20 years and above 40 years.
2. History of alcohol consumption.
3. Subjects with history of diabetes mellitus and hypertension.
4. Subjects having cataract, anisocoria, extreme pupil size, colour vision defect and optic neuritis.
5. Subjects with systemic illness.

Protocol

1. All subjects were given a questionnaire to answer
2. Written consent was obtained from the subjects after explaining the procedure.
3. A general physical and systemic examination was conducted on all the subjects.
4. A thorough eye checkup was done; visual acuity and colour vision were tested.
5. Taking into consideration the predetermined inclusion and exclusion criteria, subjects were selected and assigned into case or control groups.
6. VRT was recorded using Portable Reaction Time Response Apparatus.

Methods

The smoking history of each subject of the test group was expressed in terms of pack-years. Pack-years of smoking is defined as the number of packs (one pack is equal to 20 cigarettes) smoked per day multiplied by the duration of smoking (in years). Subjects were instructed to restrain from smoking one hour before the tests. Study was conducted in Research laboratory, Department of Physiology, SS Institute of Medical Sciences and Research Centre, Davangere. Research Laboratory is a noise proof room with equipments. Visual Reaction Time (VRT) of control and study groups was measured using the Portable Reaction Time Response Apparatus by Inco Instrumentation (Ambala).

Before measuring VRT subjects were made familiar with the apparatus. All the readings were taken during morning in a quiet room.

While performing the test, subjects were made to sit comfortably on a chair and were motivated for better results.

Visual stimulus consisted of shooting red, blue, green and yellow light which were given randomly.

As soon as stimuli were perceived the subject responds by pressing the response switch by the index finger of the dominant hand.

The display indicates response time in seconds.

- 5 trials were given and after repeated practice, readings were taken for each colour
- Lowest of readings was taken as the value for reaction time for that colour.

Statistical Analysis

- Data analysis was done using 'T' test to compare the mean of two groups.
- Differences were considered significant at $p < 0.05$ level.
- 'F' test (ANOVA) was used to compare means of more than to two groups.

RESULTS

The present study is a case-control study comparing VRT in male smokers and nonsmokers aged between 20-40 years. Out of 240 subjects examined, 100 were selected as controls, i.e. non-smokers and 100 subjects were selected as cases i.e. smokers, after satisfying all the inclusion criteria.

The parameters studied are VRT for different colours like red, blue, green and yellow with respect to smoking history expressed in terms of pack-years. The data was analyzed using appropriate statistical tests. The following are the statistical methods applied in this study.

Statistical Methods

Student's unpaired t test has been used to find out the significance of homogeneity of study characteristics between two groups of subjects. Student's unpaired t test has been used to find the significance of VRT between two groups. Simultaneous comparison of all 3 groups of cases is carried out by oneway ANOVA test which was followed by Tukey's post hoc test for pairwise comparison. Spearman's coefficient of correlation test was applied to find the correlation among 3 groups of cases with respect to pack years.

Statistical software: The data has been analyzed by using SPSS 18 (Trial Version) USA, Chicago. Microsoft word and Excel have been used to generate graphs, tables etc.

Study design: Case-control study with 100 male smokers and matched controls of 100 male non-smokers is taken to study the effect of smoking on VRT.

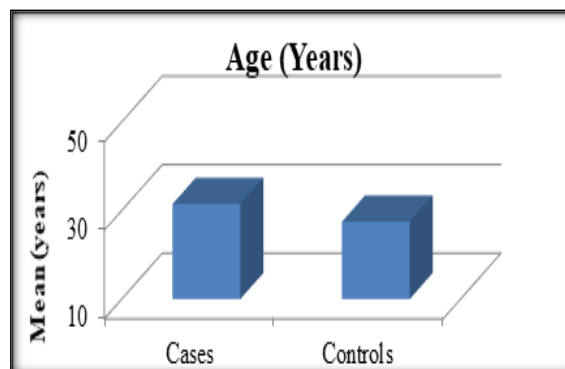


Figure 1: Age distribution of subjects studied

The age distribution of subjects included in the study is shown in [Table 1 and Figure 1]. The study groups are age matched as the p value is 0.06.

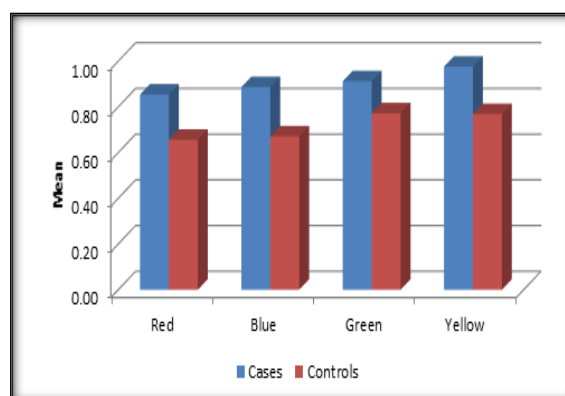


Figure 2: Comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers and non-smokers

[Table 2 and Figure 2] shows the Comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers and non-smokers. The difference is statistically highly significant.

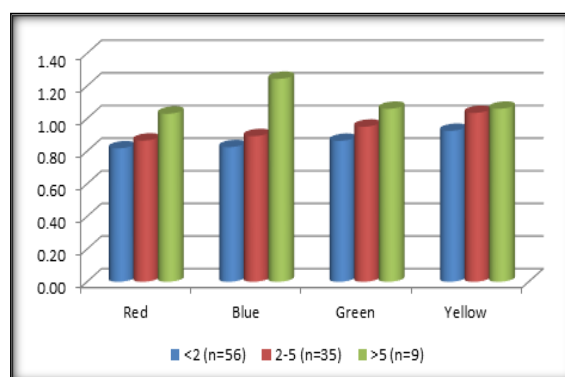


Figure 3: Comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers with relation to pack years

[Table 3 and Figure 3] depicts comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers with relation to pack years. Reaction time for blue colour is increased in comparison to other colors. It is affected in subjects

of group II (2-5 pack years) and the value is statistically significant.

Table 1: Age distribution of subjects studied

Age (Years)	Cases	Controls	Total No.	Total %
20-24	7	14	21	10.5
25-29	30	32	62	31
30-34	34	31	65	32.5
35-40	29	23	52	26
Total	100	100	200	100
Mean \pm -SD	31.5 \pm - 5.1	30.16 \pm -5.04		

* Student's unpaired t test, Samples are age matched with P= 0.06

Table 2: Comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers and non-smokers

	Case	Control		
Visual reaction time (msec)	Mean \pm SD	Mean \pm SD	Mean Difference	P* value, sig
Red	0.85 \pm 0.34	0.66 \pm 0.15	0.20	<0.001 HS
Blue	0.89 \pm 0.37	0.67 \pm 0.17	0.22	<0.001 HS
Green	0.91 \pm 0.29	0.77 \pm 0.23	0.14	<0.001 HS
Yellow	0.98 \pm 0.41	0.77 \pm 0.18	0.21	<0.001 HS

* Student's unpaired t test, HS – Highly significant

Table 3: Comparison of Visual Reaction Time for red, blue, green, yellow colours between smokers with relation to pack years

	< 2 (n=56)	2-5 (n=35)	>5 (n=9)	P value	Significant pairs
Visual reaction time (msec)	Mean \pm SD	Mean \pm SD	Mean \pm SD		
Red	0.82 \pm 0.28	0.87 \pm 0.36	1.03 \pm 0.53	0.21	
Blue	0.83 \pm 0.34	0.89 \pm 0.37	1.24 \pm 0.44	0.007 S	I&III, II&III
Green	0.86 \pm 0.24	0.95 \pm 0.27	1.06 \pm 0.54	0.10	
Yellow	0.93 \pm 0.38	1.03 \pm 0.46	1.06 \pm 0.38	0.38	

*Oneway ANOVA test, S- Significant

**Tukey's post hoc test

Table 4: Spearman's correlation of pack years with VRT of smokers

Visual reaction time (msec)	ρ	P value
Red	0.105	0.29 NS
Blue	0.24	0.02 S
Green	0.14	0.17 NS
Yellow	0.104	0.30 NS

[Table 4] shows Spearman's correlation of pack years with different colours of VRT of smokers. There is positive correlation for blue colour with a significant P value.

DISCUSSION

Cigarette smoking affects almost every system in the human body and it is accepted as a risk factor for various cancers, heart diseases, strokes, emphysema and many eye diseases as shown by various studies. This study was taken up to study the effects of cigarette smoking on vision and by measuring visual reaction time. VRT were compared in smokers and non-smokers. History of smoking in terms of pack years was noted to compare among smokers.

Study by Rose FC, on smokers with optic neuritis found that there was high incidence of colour vision defects in smokers when compared with non-smokers. Vascular effects of smoking may be due to a direct effect of nicotine which could act either by depressing retinal ganglion cell function, block transmission in demyelinating nerve fibers, blocking synaptic transmission at lateral geniculate body or depressing receptor cells in striate cortex.^[12]

Our Analysis showed that VRT to red, blue, green and yellow colours were increased in smokers when

compared with non-smokers and the difference is statistically highly significant. When compared among smokers VRT for blue colour increased and the difference is statistically significant.

Cigarette smoke contains many cytotoxic compounds like carbonmonoxide, free radicals etc which directly or indirectly cause damage to neuronal cells, promote oxidative damage. Smoking is also associated with deficiencies in auditory-verbal learning or memory, general intellectual abilities, visual search speeds, processing speed and executive functions.^[13]

The delayed response to visual stimuli in smokers might be due to various patho-physiological changes probably like atherosclerosis of arteries and arterioles supplying cerebral hemisphere. This may be the result of tobacco smoking which leads to abnormal increase in total blood triglycerides, enhanced blood coagulability due to increased fibrinogen. There is reduction in small airways function with low levels of PaO₂ and PaCO₂ which might lead to decreased cerebral blood flow. Smokers develop elevated carboxyhaemoglobin levels which might impair

function of central nervous system by affecting oxygen transport and its utilization leading to cognitive dysfunction and perceptual-motor delay in smokers.^[7]

This study matches with the results of Pravin Jadhao et.al,^[7] stating that there is increase in VRT in smokers. Though there are different opinions regarding effects of smoking on VRT, studies suggest that immediately after smoking reaction time becomes faster than baseline,^[10,11] Reversed effects like increased reaction time,^[11] increased latency, decreased amplitude of P100 is seen after few hours of abstinence of smoking as seen in present study as subjects were instructed to avoid smoking atleast 1 hour before the tests.

CONCLUSION

In this study the visual reaction time on male smokers and non-smokers were studied. The data was statistically analyzed which revealed that smokers had delayed visual reaction time, which was significant for all the colours tested.

REFERENCES

1. Gupta PC. Tobacco control in India. *Ind J Med Res* 2006;123:579-82.
2. Reddy KS, Gupta PC. Report on tobacco control in India. New Delhi : Ministry of Health and Family Welfare, Government of India;2004.
3. Rani M, Bonu S, Jha P, Nguyen SN, Jamjoum L. Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional house-hold survey. *Tob Control* 2003;12(4):e4.
4. Government of India. Ministry of Health and Family Welfare. Global Adult Tobacco Survey, India Report, 2009-2010.
5. Erb C, Nicaeus, Adler M, Isensee J, Zrenner E, Thiel HJ. Colour vision disturbances in chronic smokers. *Graefe's Arch Clin Exp Ophthalmol* 1999;237:377-380.
6. Durazzo TC, Meyerhoff DJ, Nixon SJ. Chronic cigarette smoking: Implications for neurocognition and brain neurobiology. *Int J Environ Res Public Health* 2010;7,3760-3791;doi:10.3390/ijerph7103760
7. Jadhao P, Kamble P, Deshpande VK, Phatak MS. The study of auditory and visual reaction times in chronic smokers. *Int J Med Health Sci* 2013;2(1):18-22.
8. Jensen A. Clocking the mind. Mental chronometry and individual differences. Amsterdam: Elsevier 2006.
9. Venkatesh D, Rmamaachandra DL, Baboo NS, Rajan BK. Impact of psychological stress, gender and color on visual response latency. *Indian J Physiol Pharmacol* 2002;46(3):333-337.
10. Afshan A, Bhutkar MV, Reddy R, Patil RB. Effect of chronic smoking on intraocular pressure and audio-visual reaction time. *Int J Biol Med Res* 2012;3(2):1760-1763.
11. Ichaporia RB, Kulkarni SP, Malathi A, Parulkar VG. Study of reaction time in smokers. *J Postgrad Med* 1991;3:209-10.
12. Rose FC. Smoking and optic neuritis. *Postgraduate Medical J* 1975;51:382-385.
13. Mostafa S, Kamal S. Cognitive function and electroencephalogram in chronic tobacco smokers. *Egypt J Neurol Psychiat Neurosurg* 2009;46(2):377-383