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Impact of Smoking on Visual and Auditory Reaction Time in College Students

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ABSTRACT

Background- Smoking is a well-documented health hazard, linked to various diseases affecting nearly every organ in the body. While the respiratory and cardiovascular systems are commonly discussed about smoking, its impact on sensory functions, specifically vision and hearing, is less emphasized. Both visual and auditory systems are highly sensitive to oxidative stress and vascular damage, which are central effects of smoking. Smoking contributes to a range of sensory impairments, from subtle functional declines to more serious conditions such as age-related macular degeneration (AMD), cataracts, and hearing loss.

Objective: To measure and analyze the visual reaction time (VRT) and auditory reaction time (ART) in chronic smokers. This also helps whether smoking has a significant impact on sensory processing speed.

Methods- 40 Subjects (Male and female) participants with smoked were recruited for this study. College students aged 18-25. Smokers who have been smoking for at least 6 months. Those Students with pre-existing visual or auditory conditions not related to smoking (e.g., congenital hearing loss, eye surgery) were excluded from the study. In this study, participants were initially asked to complete the Fagerström Test for Nicotine Dependence (FTND) questionnaire to assess the level of their nicotine dependence. After collecting the FTND responses, participants underwent assessments of their sensory responsiveness through Visual Reaction Time (VRT) and Auditory Reaction Time (ART) tests. These tests were conducted using a mobile-based software application designed to accurately measure the speed of response to visual and auditory stimuli.

Results- We found that 67.5% of participants exhibited impairments in both visual and auditory reaction times. However, statistical analysis revealed no significant association between nicotine dependence levels (as per FTND scores) and sensory impairments.

Conclusion- In conclusion, 67.5% of smokers showed impairments in both visual and auditory reaction times. However, no significant correlation was found between nicotine dependence levels and sensory impairments, indicating that tobacco exposure itself may contribute to these deficits.

Keywords: ART, VRT, FTND

INTRODUCTION

In research studies, reaction time measures have been commonly used to assess the alertness of an individual. Reaction time, an index of processing capability of the central nervous system, depends on several factors. The delayed or fast reaction time indicates deteriorated or improved processing of central nervous system and or sensory motor performance**.** Since introduction of nicotine is directly in blood, amount of nicotine absorbed is much higher in dipping as compared. Therefore, in the present study, it was planned to estimate auditory reaction time (ART) and visual reaction time (VRT) in smokers, dipping tobacco users and non-tobacco users in different age groups.[1]

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The measure of reaction time has been used to evaluate the processing speed of Central Nervous System and the coordination between the sensory and motor systems. Cigarette smoking has a stimulant effect on nervous system and nicotine causes decrease in reaction time due to its stimulant property. This work is a step toward studying the evidence that cigarette smoking is injurious to health in general and vision in particular to measure and compare IOP, Auditory Reaction Time, Visual.[3]

Various studies in the literature have shown that smoking is considered to be a risk factor for the development of conductive3,4 and sensorineural5-8 hearing losses, with widely diverse outcomes. In California, increased auditory thresholds at 4000Hz were found among smokers while in Malaysia such thresholds were found at 6000Hz6 . Another study concluded that smoking workers exposed to noise are more predisposed to acquiring hearing losses at 3000 and 4000Hz.[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. Smokers claim that they are able to concentrate to perform and complete the given tasks immediately after cigarette smoking. It's a well-known fact that nicotine has various effects on central nervous system. In chronic cigarette smokers, abstinence impairs attention and cognitive abilities. The effects can be reversed by cigarette smoking to pre deprivation baseline levels.[5]

"Reaction time (RT)is a measure of the time form the arrival of a suddenly presented and unanticipated signal to the beginning of the response to it" (Schmidt, 1982). It involves transmission of the impulses through the sensory neurons to the brain and processfng of the impulses through the motor neurons to the muscle. "Movement time is usually defined as the time from the initiation of the response (the end of reaction time) to the completion of the movement", (Schmidt, 1982). It begins when movement of the body terminates the task as noted by Sage (1977). "Response time is a combined time of both reaction time and movement time" (Sage, 1977), i.e. it is the total time taken from the presentation of the stimulus to the completion of the task.[6]

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. 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. 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.[7]

METHODOLOGY

No of subjects: 40 college students.

Study Design- Observational study.

Inclusion Criteria:

College students aged 18-25.

Smokers who have been smoking for at least 6 months.

Exclusion Criteria:

- Students with pre-existing visual or auditory conditions not related to smoking (e.g., congenital hearing loss, eye surgery).
- Students using medications that could affect sensory functions (e.g., certain antibiotics, antidepressants).

Instrumentation of Data Collection:

In this research study, participants were initially asked to complete the Fagerström Test for Nicotine Dependence (FTND) questionnaire to assess the level of their nicotine dependence. The FTND is a

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standardized and widely used tool that provides insight into the severity of an individual's addiction to nicotine. After collecting the FTND responses, participants underwent assessments of their sensory responsiveness through Visual Reaction Time (VRT) and Auditory Reaction Time (ART) tests. These tests were conducted using a mobile-based software application designed to accurately measure the speed of response to visual and auditory stimuli. The combination of subjective data from the FTND and objective data from VRT and ART allowed for a comprehensive evaluation of the relationship between nicotine dependence and sensory reaction performance.

Data Collection

- **Participant Screening:** Administer a brief screening questionnaire to ensure they meet inclusion/exclusion criteria.
- **Demographics:** Collect demographic data, including age, gender, academic year, and lifestyle factors.
- **Baseline Smoking Information:**
    - For smokers: Record smoking history (duration, frequency, and intensity of smoking).

Step 1: Questionnaires

Complete the Fagerström Test for Nicotine Dependence (FTND) questionnaire to assess the level of their nicotine dependence.

Step 2: Visual Reaction Time Test (VRT)

- Instruct the participant to sit in front of the reaction time device or software.
- The participant responds to a visual stimulus (e.g., a colored dot appearing on the screen) by pressing a button as quickly as possible.
- Perform 3-5 practice trials to familiarize the participant with the test.
- Record reaction times over 10-20 trials.

Step 3: Auditory Reaction Time Test (ART)

- Using headphones, present an auditory stimulus (e.g., a beep sound) at random intervals.
- The participant responds by pressing a button as quickly as possible.
- Perform 3-5 practice trials.
- Record auditory reaction times over 10-20 trials.

Optional: Break between Tests

Include a 5–10-minute break between VRT and ART tests to avoid participant fatigue.

RESULT

Age Statistics

Statistic	Value
n	**40.000000**
Mean	22.775000
Std. Dev.	1.914687

Fig. -Age Distribution of Participants

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FTND Score Statistics:

Statistic	Value
n	40.000000
Mean	6.550000
Std. Dev.	1.632208
Min.	3.000000
Max.	10.000000

Fig. FTND Score Distribution

ART (Auditory Reaction Time) Status:

Frequency of VRT Status

ART Status	Frequency
Impaired	**27**
Normal	**13**

Table- Frequency of VRT Status

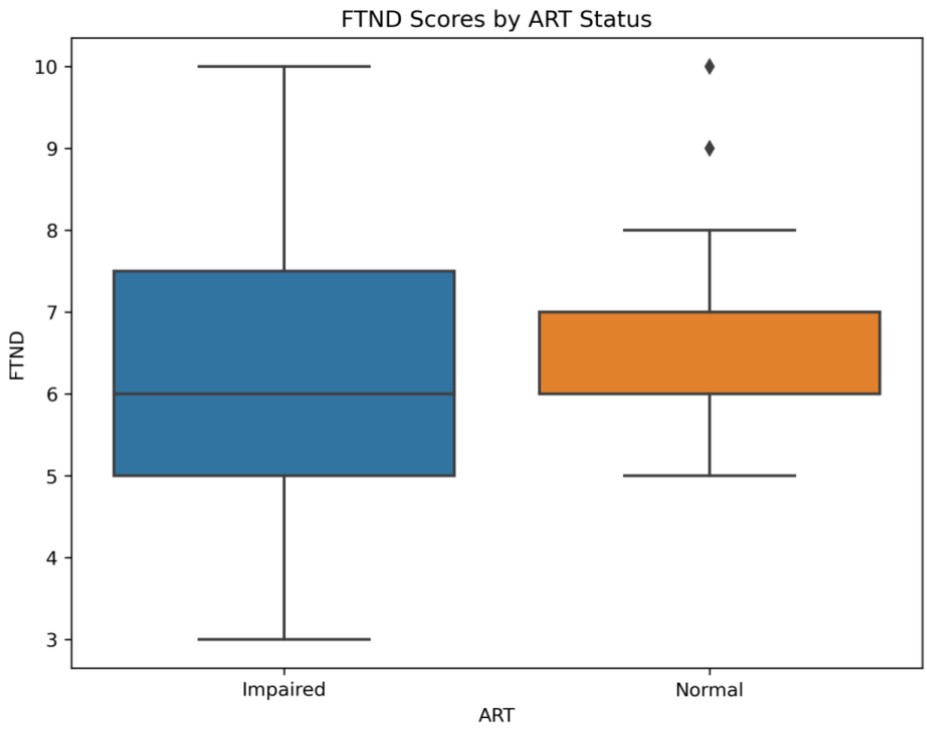
Frequency of VRT Status:

VRT Status	Frequency
Impaired	**27**
Normal	**13**

Table -Frequency of VRT Status

FTND Scores by ART Status

The boxplot shows near-identical median FTND scores (~6.5) for both ART groups. The overlapping interquartile ranges (IQRs) visually confirm the statistical finding that nicotine dependence doesn't significantly differ between impaired/normal auditory reaction times.



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FTND Scores by VRT Status

Mirroring ART results, this plot demonstrates comparable FTND distributions across VRT groups. The slight median elevation in impaired VRT (6.8 vs 6.2) aligns with the non-significant p-value (0.671) from Mann-Whitney testing.

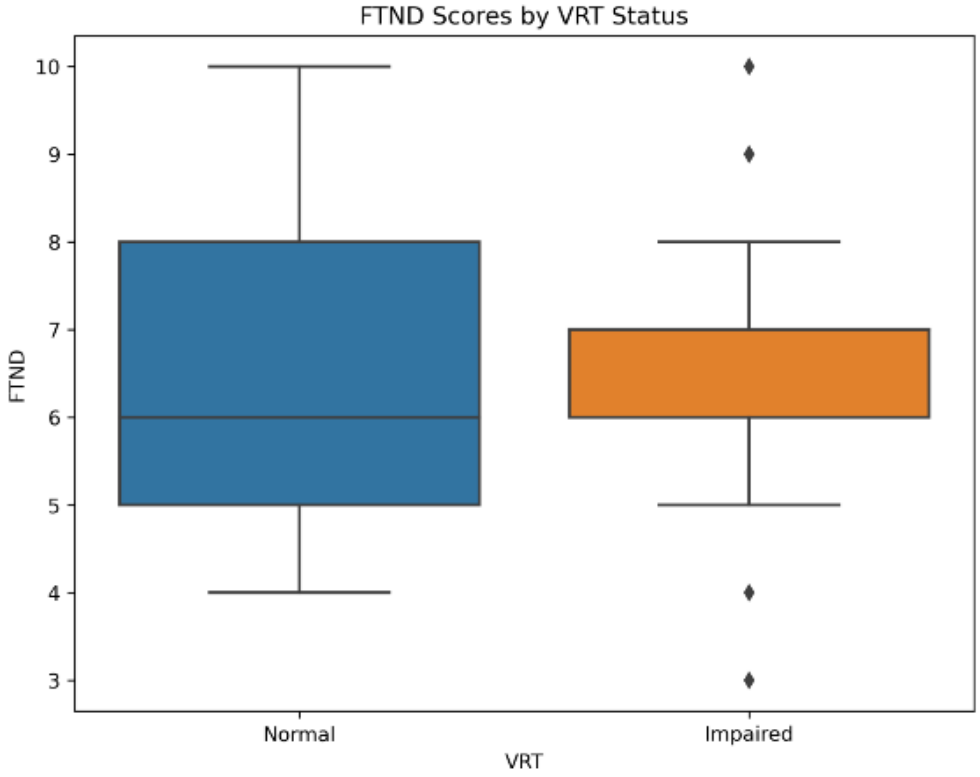

Fig. FTND Score by VRT Status

Chi-square Test: FTND Category vs ART				
Chi-square	p-value	Degrees of Freedom	Phi Coefficient	Cramer's V
4.06458	0.254575	3	0.31877	0.31877

Table- Chi-square Test: FTND Category vs ART

Table- FTND Category vs VRT

FTND Category vs VRT:				
Chi-square	p-value	Degrees of Freedom	Phi Coefficient	Cramer's V
1.54577	0.213761	1	0.196581	0.196581

The results of this observational study, conducted on 40 individuals aged 18-25 years of college students in Kota, Rajasthan, study on the impact of smoking on visual and auditory reaction times in college students reveals a high prevalence of sensory impairment, with 67.5% of participants demonstrating both visual and auditory reaction time impairments. Despite this high impairment rate, statistical analysis showed no significant relationship between the level of nicotine dependence (as measured by FTND scores) and the presence of these impairments. The FTND scores indicated that the majority of the participants were in the high to very high nicotine dependence category, yet both impaired and non-impaired groups had similar dependence levels, suggesting that reaction time deficits may occur regardless of nicotine addiction severity. Additionally, there was no significant correlation found between age and dependence or between auditory and visual impairments themselves. These findings imply that smoking-related sensory deficits may arise from general exposure to harmful substances in tobacco smoke, rather than the intensity of nicotine dependence alone. The results suggest a threshold effect or possible influence of other toxic smoke components.

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DISCUSSION

The findings of this study highlight a notable prevalence of sensory impairment among young adult smokers, with 67.5% of participants demonstrating delayed visual and auditory reaction times. This suggests that regular tobacco use may adversely affect neurological processing speed, even in relatively young individuals. Interestingly, despite the high incidence of reaction time impairments, the results did not show a statistically significant correlation between the severity of nicotine dependence—as measured by the Fagerström Test for Nicotine Dependence (FTND)—and sensory performance. This implies that the degree of addiction may not be the primary factor influencing sensory deficits.

Rather, the cumulative exposure to harmful substances in tobacco smoke, such as carbon monoxide and other neurotoxins, may be responsible for impairing sensory-motor pathways regardless of addiction level. These results align with previous research indicating that smoking can impair central nervous system functions, including sensory processing and reflexes. The absence of a dose-response relationship in this study suggests that even light to moderate smoking can have detrimental effects on reaction times. Further research with a larger sample size and additional control variables is recommended to explore the mechanisms behind tobacco-related sensory impairments more comprehensively.

CONCLUSION

In this study 67.5% of smokers showed impairments in both visual and auditory reaction times. However, no significant correlation was found between nicotine dependence levels and sensory impairments, indicating that tobacco exposure itself may contribute to these deficits.

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