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Assessment of the Effect of Smoking on Cognition in Young Adults

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Abstract

Smoking is an action in which the resultant smoke post-burning is breathed in to be gustated and released into the bloodstream. It causes many undesired effects in people. The main aim of the present investigation is to investigate the effect of smoking on cognition in young adults. For this, a questionnaire and some simple tests have been performed for the selected students. A total of 40 students were taken into study, out of which 20 were smokers and 20 were non-smokers. In the digit symbol substitution test, students were asked to draw a circle around even numbers and a triangle over odd numbers. In the digit vigilance test, the students were asked to cut off all 6 and 9 numbers. In the category fluency test, they were asked to list out the animal names in one minute. In attention switching task, a total of 30 slides were displayed and for each condition different sounding patterns should be made on the table. Smokers took more time to perform digit symbol substitution, digit vigilance and attention-switching tasks than non-smokers. Smokers could not write more animal names when compared to non-smokers. In all the tests, the number of errors performed by smokers is greater than that of non-smokers. This indicates reduced psychomotor and brain functioning in smokers when compared to non-smokers. All the results were statistically analyzed. Thus, from the current research, it was concluded that smoking in young adult students has declined cognitive functioning.

Keywords: Memory, Smoking, Students

1. Introduction

One of the most popular ways that people consume drugs recreationally is by smoking. Smoking tobacco is the most common type of tobacco use, with over a billion users worldwide, most of whom are in developing nations. The main source of smoking is Tobacco. It is the common name of several plants in the Nicotiana genus which belong to the Solanaceae family. More than 70 species of tobacco are known, but the chief commercial crop is *Nicotiana tabacum*. The stimulant alkaloid nicotine, which is extremely addictive, is found in tobacco. The principle usage for dried tobacco leaves is in pipes, shishas, cigarettes, and cigars. They are also used for chewing, dipping, and snuff tobacco. Nicotine is a drug that is addictive[1]. The most popular method of consuming tobacco, particularly among youth, is through cigarettes. Although it's a popular misconception that smoking hookah and shisha can be less harmful than smoking cigarettes, the truth is that one shisha is equal to 50–60 cigarettes, and two to three hours of shisha smoking is equal to 25 cigarettes[2]. One of the main causes of cancer of the lips, mouth, and throat is shisha smoking. It also causes cancer of the stomach, bladder, oesophagus, and lungs. Tobacco that has been chewed and is smoke-free is ingested orally. Without smoke, it is smoking. The tobacco juice is absorbed into the bloodstream and subsequently throughout the body when the user chews tobacco mixed with other items in their mouth for an extended amount

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of time. The body reacts to it similarly to how smoking does[3]. The 20th century saw a shift in the patterns of disease due to cigarette smoking, which increased rates of chronic obstructive pulmonary disease, lung cancer, and other cancers. It also increased the incidence of cardiovascular disease at a time when the death rate from infectious diseases was declining. Nicotine overdose is possible at high doses. This indicates that an individual has consumed more nicotine than their body can process[4]. Extremely high dosages can have more unpleasant side effects, such as dizziness, fainting, disorientation, sharp drops in blood pressure and respiration rate, convulsions, respiratory arrest, and even death[5].

Increased risk of stroke and brain damage, cataracts, macular degeneration, yellowing of the whites of the eyes, loss of taste and smell, yellow teeth, tooth decay, bad breath, cancers of the nose, lip, tongue, and mouth, potential hearing loss, laryngeal and pharyngeal cancers, osteoporosis, shortness of breath, chronic bronchitis, heart disease and high blood pressure (hypertension), blood vessel blockages that can result in a heart attack, and lung cancer are among the long-term effects of smoking[6].

The brain's ability to encode, store, and retrieve information when needed is known as memory. It retains data throughout time to influence decisions made in the future. Most people are aware of the negative effects smoking has on the heart and lungs, but fewer people are aware of the effects nicotine has on the brain[7]. Nicotine and smoking have been linked to several adverse effects on the brain, including increased risk of dementia, cognitive decline, brain volume loss, stroke, and cancer[8]. While nicotine mimics various neurotransmitters in the brain, such as acetylcholine, which has a similar structure, nicotine also has the beneficial effect of increasing brain signalling. Like dopamine, nicotine likewise activates the brain's pleasure regions. So, one's brain starts to associate use with feeling good[9]. Due to this diversity of effects of smoking and as young adults are highly prone to smoking addiction, the current research was focused on assessing the cognition ability of smokers compared with non-smokers.

2. Methods

2.1 Sampling and Participants

Young adult students at the Chebrolu Hanumaiah Institute of Pharmaceutical Sciences in Chandramoulipuram, Chowdavaram, Guntur district, provided the data. From October 2019 to February 2020, a total of five months were dedicated for conducting the study. All participants were made aware of the study's objectives before the commencement of the survey. They received guarantees of secrecy and anonymity, and their informed consent was acquired. The pupils were given explanations for each item on the questionnaire. The study only included participants who volunteered to be involved. Participants in the study were B. Pharmacy and Pharm. D. course students. Forty students in all have taken part in the survey.

2.1.1 Inclusion Criteria

The young adult male students of 19 to 21 years of age, smokers and non-smokers were selected for the study.

2.1.2 Exclusion Criteria

The female students were not included in the study because they felt that answering a questionnaire about smoking could be offensive to them and, they expressed no interest in participating when the study was announced. Along with them, students with ages of more than 21 years and students suffering from any psychological disorders were also excluded from the study. The research excluded participants who had psychological illnesses or were taking certain medications since these conditions could change the way the brain functions and impact the findings.

2.2 Procedure

The students were given and asked to fill out a questionnaire which contained their basic information and questions related to smoking. A comparative study was done among smokers and non-smokers of Chebrolu Hanumaiah Institute of Pharmaceutical Sciences, Chandramoulipuram, Chowdavaram, Guntur including 40 subjects of age group 19 to 21 years.

The Institution Ethics Committee (IEC) gave its approval to the research before the investigation. Based on the inclusion and exclusion criteria, subjects were chosen. Male, healthy participants who were willing to engage in the study and gave written informed consent were included in the investigation. Twenty smokers made up the study group, while twenty non-smokers in the control group had similar ages, sex, and educational attainment.

Written informed consent was obtained when subjects were briefed about the study's protocol. Caffeine had to be avoided by the subjects for at least three hours before to the trial, as caffeine is a CNS stimulant and makes the subject active which could alter the study result. A questionnaire on personal and other information was answered by the subjects. All the subjects in both groups underwent cognitive tests.

Various cognition domains were assessed like psychomotor speed, which was done by digit symbol substitution test, sustained attention by digit vigilance test, executive functions (fluency and working memory) by category fluency test and attention switching task test respectively[10].

2.2.1 Digit Symbol Substitution Test

This is an assessment for quick response times and sustained attention. To replace the symbols precisely and swiftly, information must be processed rapidly. On a piece of paper, one hundred numbers were printed at random from 1 to 100 without repetition of any number. For even numbers, the participants were instructed to draw a circle, and for odd numbers, a triangle. The amount of time (measured in seconds) needed to replace each of the 100 numbers with a symbol was recorded. The results are given in Table 1 and the relative errors performed by the subjects are indicated in Figure 1.

2.2.2 Digit Vigilance Test

Numbers from 1 to 9 were put in 50 rows, 30 digits per row, at random on the paper for this test. The numbers were all arranged closely. The target digits, which are 6 and 9, must be the subject's sole focus. They must be cancelled as quickly as possible without straying from the goals or cancelling the incorrect numbers. The score was calculated as the amount of time (in seconds) needed to finish the test. The results are given in Table 1 and the relative errors performed by the subjects are indicated in Figure 2.

2.2.3 Category Fluency Test

In this test, participants had one minute to list the names of as many animals as they could on a piece of paper. Birds, fish, and snakes were asked to be excluded from the list of names since they were simple to recall and did not contribute to the assessment of a person's cognitive abilities. The score was the total number of names that were generated. The results were given in Table 1 and the relative errors performed by the subjects were indicated in Figure 3.

2.2.4 Attention Switching Task (AST)

The attention-switching test assessed the participant's capacity to shift focus between an arrow's direction and where it is on the screen and to block out extraneous information when confronted with distracting or interfering occurrences. This exam was created to gauge prefrontal cortex-based top-down cognitive control mechanisms. This test is a sensitive indicator of "executive" and frontal lobe impairment. A total of 30 slides were displayed to the subjects and instructions were given to them such that for each condition different sounding patterns should be made on the table. An arrow that can point in either direction and appear on either side of the screen (left or right) was presented during the test. At the top of the screen during each trial, a cue tells the participant whether to click the button on the right or left depending on the "side on which the arrow appeared" or the "direction in which the arrow was pointing." The subjects were asked to finish the test within 30 seconds. A larger cognitive load was needed for incongruent stimuli (such as an arrow on the right side of the screen pointing to the left) in contrast to congruent stimuli (such as an arrow on the right side of the screen pointing to the right) in certain trials. The results were given in Table 1 and the relative errors performed by the subjects were indicated in Figure 4.

2.3 Statistical Analysis

The unpaired t-test was implemented using Graph Pad Prism software (version 8.4.3) to statistically analyze the data. A p-value of less than 0.05 in the result was deemed to be statistically significant.

3. Results

The effect of smoking on cognitive functioning was performed in young adult smoker students using non-smokers as control subjects. The control group consisted of 20 participants with a mean age of 20.66±0.34 years and the smoking group consisted of 20 participants with a mean age of 20.21±0.63 years. All subjects in both groups were successfully involved and completed the study

without any withdrawal. Age-wise, the subjects in both groups were well-matched.

This study matches in sample size to the past study conducted among smokers and non-smokers who took 22 to 25 as sample size[11].

Smokers performed poorly in all the tasks when compared to non-smokers which evaluated their cognitive functioning. These results are indicated in Table 1. They were strongly supported by the past studies' observations[12]. This study provides a way to detect cognitive damage early and helps to take measures to avoid further decline in cognitive performance.

3.1 Digit Symbol Substitution Test

Smokers took more time to perform digit symbol substitution tests when compared to non-smokers. This showed a high statistically significant difference in results ($p<0.0002^{**}$). This represents reduced psychomotor speed in smokers. The average number of errors performed during this test was also higher in smokers when compared to non-smokers which was indicated in Figure 1. This shows that smokers couldn't perform well in psychomotor assessment.

3.2 Digit Vigilance Test

Smokers took more time in performing the digit vigilance test which was indicated by a high average score when compared to non-smokers score. This showed a high statistically significant difference in results ($p<0.0001^{**}$). This shows the reduced psychomotor speed in smokers. The average number of errors performed during this test was also higher in smokers when compared to non-smokers as indicated in Figure 2. This shows that smokers couldn't perform well in psychomotor assessment.

3.3 Category Fluency Test

This test evaluated the memory of subjects along with avoidance of specific names. This test indirectly evaluates the thinking ability along with the quick and timely responses of subjects. Smokers couldn't write more animal names which was indicated by a lower average score when compared to non-smokers who showed more scores. This showed a statistically significant difference in results ($p<0.05^{*}$). The average number of errors i.e., writing the fish and birds names along with repetition of

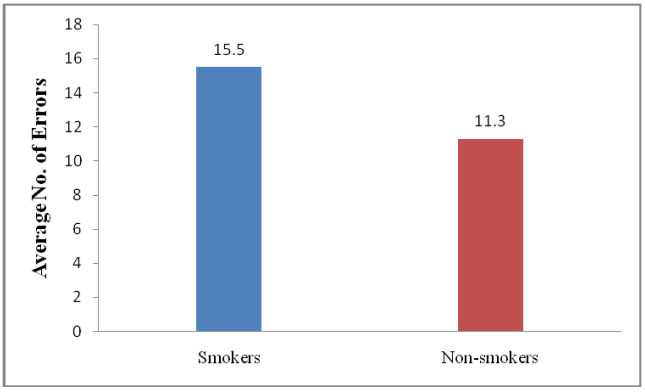

Figure 1. Average number of errors made in digit symbol substitution test.

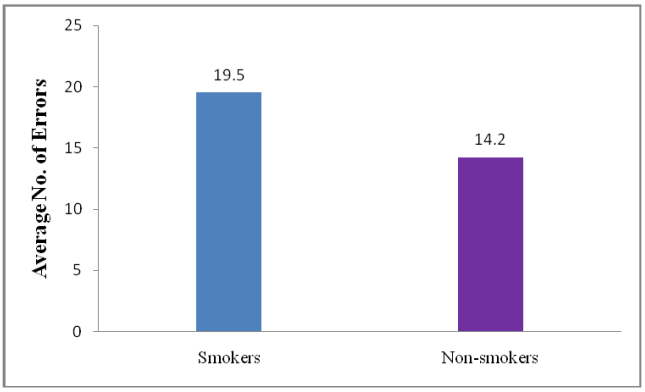

Figure 2. Average number of errors made in digit vigilance test.

Table 1. Comparison of cognitive functioning test scores of smokers and non-smokers

S. No	Cognitive Functioning Tests	Smokers (Mean ± S.D)	Non-Smokers (Mean ± S.D)	*P* – value
1	Digit symbol substitution test (sec)	416.50 ± 86.03	330.05 ± 40.26	<0.0002**
2	Digit vigilance test (sec)	155.10 ± 45.83	96.60 ± 22.06	<0.0001**
3	Category fluency test	10.75 ± 2.57	13.05 ± 3.13	<0.05*
4	Attention switching task (sec)	204.40 ± 37.24	175.50 ± 29.32	<0.05*

*S.D – standard deviation; N = 20 *P<0.05 – Significant; **P<0.0001 and **P<0.0002 – Highly significant*

animal names were also recorded and the average number of errors was shown in Figure 3. Smokers made more errors in this test when compared to non-smokers.

3.4 Attention Switching Task

This test evaluated the ability to switch attention between the functions. The reaction times of subjects along with errors performed were noted. Smokers took more time in performing attention-switching tasks which was indicated by a high average score when compared to non-smokers score. This showed a statistically significant difference in results ($p<0.05^*$). This showed a decrease in the psychomotor functioning of the brain in smokers. The average number of errors performed during this test was also higher in smokers when compared to non-smokers which is represented in Figure 4. This shows that smokers couldn't perform well in psychomotor assessment.

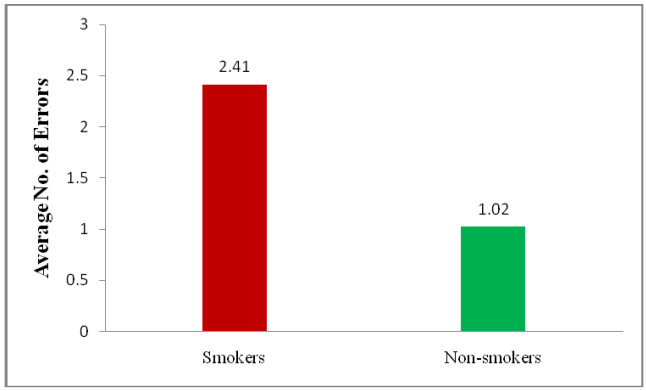

Figure 3. Average number of errors made in category fluency test.

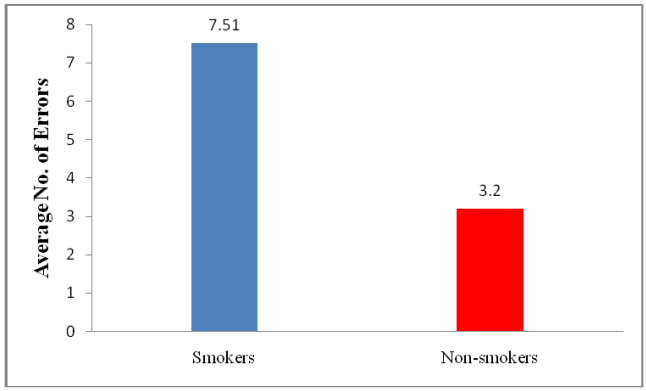

Figure 4. Average number of errors made in attention switching task.

4. Discussion

In the brain, smoking disrupts the blood-brain barrier, causes thrombotic injury, pro-inflammatory response, pro-atherosclerotic injury, oxidative damage, and disarrays cell-to-cell junctions[13]. Cigarette smoke also modifies the architecture of the brain, resulting in reduced functional connectivity between the orbitofrontal cortex, superior frontal gyrus, temporal lobe, and insula, as well as narrower frontal cortical areas and frontal grey matter abnormalities[14].

In addition, smoking lowers cerebral flow rates in the anterior, middle, and posterior cerebral arteries and alters blood counts[15]. Carbon monoxide, ketones, aldehydes, nitrosamines, and dihydroxybenzenes are among the cytotoxic chemicals found in cigarette smoke that can affect the cerebral hemisphere's ability to function as neurons and cellular membranes[16]. Furthermore, there are more free radical species in cigarette smoke, which encourage oxidative damage to the cellular architecture and function of neurons[17]. Smokers may be more susceptible to cognitive impairment due to all these variables. These people have a higher chance of developing dementia and cognitive decline as they age. Quitting smoking can enhance a smoker's functional outcomes[18].

The limitation of the current study pertains to the short duration of the study including a small sample size. Furthermore, it was impossible to determine whether every respondent provided accurate information because the personal history questions regarding cigarette smoking were entirely subjective.

5. Conclusion

Cognition plays an important role in the daily activities of humans. Especially in young adult students, it plays a crucial role in improving their working skills and day-to-day activities. Smokers took more time to complete all the tasks compared to non-smokers and they also committed more errors during the test. Thus, from the present study, it was concluded that smoking in young adult students has declined cognitive functioning.

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