Original Research Article

EffectofTobacco-SmokingonCognitiveFunctionamongyoung adults in a Tertiary Care Hospital of North India-A Pilot Study

Abstract

Introduction: Around 25% of the world's population uses tobacco, with smoking being the most common form. Smoking is linked to long-term health issues, respiratory, cardiovascular, malignancies, neuropsychological dysfunction, and increased risk of depression and cognitive decline.The study aimed to compare non-smokers and tobacco smokers to assess cognitive function impact, hypothesizing smokers have poorer cognitive function.

Methodology: This cross-sectional study involved 50 young adults, 25 smokers and 25 non-smokers, in a psychiatry outpatient department at AIIMS Bathinda, Punjab, India. Participants were healthy individuals, without serious medical conditions, drug dependence, or significant brain trauma. The study was approved by the Institutional Ethics Committee. Cognitive functions were assessed using Montreal cognitive assessment (MoCA) (7.1 version) and Fagerstrom Test was used to assess severity of Nicotine dependence among smokers. A p value <0.05 was considered statistically significant.

Results Sample consisted of 25 male smokers and 25 non-smokers, with 64% aged 22-24 years. Both groups were comparable in in terms of age, education and socioeconomic status. there was no statistically significant difference in cognitive function (MoCA) across demographic profile of subjects. In comparison to tobacco smokers, non-users had a higher mean MoCA score (22.12 vs. 22.08). Abstraction and recall were significantly impaired (p values 0.048 and 0.007, respectively) in tobacco smokers. There was a significant association between cognitive function (MoCA) and nicotine dependency severity (Fagerstorm Test; p=0.026) among tobacco users.

Conclusion: Tobacco smoking increases the risk of neurocognitive impairment, in young adults. The degree of smoking has an adverse effect on individuals' cognitive performance.

Implications

Young adults frequently use tobacco, especially in the form of smoking. Smoking tobacco is thought to enhance performance and attention. However, the current study discovered that it was linked to diminished cognitive function in the areas of recall and attention. Additionally, smokers' cognition is considerably impaired due to the severity of their nicotine dependence. The study implies that in order to understand the relationship between tobacco smoking and cognitive functions, large-scale, prospective investigations are necessary. Additionally, including radiological evaluation of brain functions using functional MRI may provide clearer evidence of the areas of the brain affected by tobacco use.

Keywords: Tobacco, Smoking, Nicotine Dependence, Cognitive Function, Cognitive Impairment, MoCA test ,Fagerstrom Test.

Abbreviations: MoCA- Montreal cognitive assessment,

INTRODUCTION-

According to the WHO, around a quarter (24.9%) of the world's population uses tobacco in some way, with smoking being the most common form of consumption (WHO,2021).[1]It is a global health issue that has been linked to detrimental long-term effects like a rise in respiratory illnesses, cardiovascular illnesses, and different types of malignancies. Additionally, smoking is associated to the pathophysiology of neuropsychological dysfunction and directly increases the risk of depression and cognitive decline(WHO, 2021, Richards et al., 2003 and Campos et al.,2016).[1-3]

The main psychoactive component of tobacco, nicotine, alters cognitive processes via acting on nicotinic acetyl cholinergic receptors found throughout the central nervous system (Chamberlain et al., 2012).[4] Tobacco smoking improves cognitive performance briefly by raising some components of attention and memory above normal levels, whereas nicotine abstinence causes cognitive disturbance, which supports its usage. These neurobiological consequences reinforce nicotine use and contribute to the development of nicotine dependence (Heishman et al., 2021).[5]

Prolonged nicotine use, on the other hand, may have a deleterious impact on cognitive performance (Campos et al.,2016).[3]The majority of research revealed that people who smoke regularly score worse on neuropsychological tests than people who don't, including in terms of general intellectual capacity, processing speed, attention, memory, cognitive flexibility, and executive functions (Campos et al.,2016, Conti et al., 2019 and Durazzo et al 2010).[3,6,7] Some studies, however, came to the conclusion that smoking may actually be good for cognitive processes. For instance, a 10-year longitudinal research on older persons found that smokers had a lower risk of cognitive impairment than non-smokers (Wang et

al.,2010) .[8]According to another study by Momtaz et al.(2015), smokers are less likely than non-smokers to experience cognitive impairment.[9]Additionally, several studiesfound that smoking had either no effect on smokers' cognitive performance or a favorable effect on certain areas of their cognitive function (Heishman et al., 2010, Pandey et al., 2017, Razani et al.,2004 and Caspers et al.,2010).[5,10-11] Most of the studies done among elderlypatients reported association between tobacco smoking and cognitive deficits, which may be due to cardiovascular changes caused by chronic smoking affecting withconsequenteffectsonbrainfunctionduetomicrovascular/macrovascularevents in elderpopulations as demonstrated by Campos et al.(2016).[3]

There is not enough evidence in the literature to definitively state how smoking affects cognitive function (Conti et al.,2019).[6]In numerous research, confounding factors such psychiatric problems, concurrent substance usage (alcohol, cannabis, etc.), and length of tobacco use were not included (Wagner et al.,2013).[12]The relationship between cognitive abilities and tobacco smoking in the young Indian population has received very little attention in published literature so far. Therefore, it is crucial to carry out further research into how smoking affects cognitive processes while accounting for potential confounding factors, especially in young individuals. The aim of the current cross-sectional study was to compare group-matched non-smokers to non-smokers in order to evaluate the impact of tobacco users on cognitive function. It was hypothesized that tobacco smokers have poorer cognitive functions in comparison to non-smokers.

Methods

Participants and procedure: This cross-sectional study was conducted in Psychiatry outpatient department in the, AIIMS Bathinda,Punjab India for a period of 2 months (August, 2022to September, 2022. The study included a total of 50 young adults, 25 Smokers and 25 Non-Smokers.Smokers group included patients who have been smoking for at least 1 years. The Non-smoker group included age and sex matched twenty-five healthy individuals and

wererecruitedfromamongstthehospitalstaffandpatients'attendants.

Theparticipantswhowerehavingseriousmedicalconditions, non-ambulatory,uncooperative,withhistoryofdrugdependenceotherthannicotine, significanthistoryofheadtraumaorbrainsurgery,patientwithorganicbrainsyndrome, psychotic disorder, major depressive disorder, and bipolar disorder which might cause cognitive impairment were excluded from both the groups. The study was done after the approval from Institutional Ethics Committee. Before the data was collected, each participant voluntarily agreed to take part in the study by signing a written consent form. An initial interview was used to gather data on smoking, health, and sociodemographic characteristics.

Montreal cognitive assessment (MoCA) (7.1 version)**,** abrief30-questionquestionnaire was used to Measure the cognitive function of both smokers and non-smokers.It is provided by the MoCA test organization (http://www.MoCAtest.org/).The MoCA is made up of 13 tasks that assess the eight cognitive domains of visuospatial/executive, naming, immediate memory (not scored), attention (3 different items with separate scoring), language (two different items with separate scoring), abstraction, delayed recall, and orientation. The results of the 13 challenges are added together to produce a final score. The highest possible score is 30 points. It is accessible in the public domain (Ewert et al.,2018).[13]

Fagerstrom Test for Nicotine Dependence (FTND) which is a standard tool for assessment of the intensity of physical addiction to nicotine, was used to measure the severity of nicotine dependence among smokers. Thetotalscorerangesfrom0-10.Scoresbetween0-2areassociatedwithvery lowdependence, scoresbetween3-4areassociatedwithlowdependence,scoreof5is represent with moderate dependence, score between 6-7 are associated with high dependence, and score between 8-10 tells very high dependence (Heatherton et al.,1991).[14]

The data were compiled in Micro Soft Excel and exported to SPSS version 28 for data analyses. The descriptive data is presented in terms of means, proportions and percentages.

The continuous data were compared by using unpaired t-test and categorical data were compared by using chi-square test. A 'p-value' of <0.05 was considered statistically significant.

Results

The final sample included 25 smokers and 25 non-smokers and all were males. The mean age of both the groups was 22 years. Majority (64%) of participantsin both the groups were in the age group 22-24 years.

Table 1 shows the socio-demographic profile of the study population.Chi-square test showed that both groups were comparable across socio-demographic characteristics. Table 2, depicts the relation of cognitive function with socio-demographic profile of the study participants Outof50subjectsincludedinthestudy,mildcognitiveimpairmentwasobservedin24(48%). Out of which 17(54.2%) were in age group 22-25 years, 83.3% were educated up to 12^{th} standard and majority (45.8%) belonged to lower middle followed by upper middle (25%) socio economic class. However there was no statistically significant difference in cognitive function (MoCA) across demographic profile of subjects(p>0.05).

Table 3 shows association between Cognitive function and tobacco use disorder, the mean MoCA score among non- tobacco users was 22.12 while it was 22.08 among tobacco users. The difference is non-significant statistically with P value 0.05. Abstraction and recall were significantly impaired among tobacco users as compared to non-tobacco users with p-value 0.048 and 0.007 respectively.

Table 4 shows the associationof severity of nicotine dependence (FagerstormTest)with Cognitive Function (MoCA) among tobacco smokers. Out of total 25 tobacco smokers, cognitive impairment was recorded among 14 (56%) subjects. The number subjects with cognitive impairment increase with severity of nicotine dependence, 6(42.9%) had High Fagerstorm test score followed by 3 (21.4%) with moderate score. Chi – square test showed a statistically significant association between severity of nicotine dependence (FagerstormTest)and Cognitive function (MoCA) among tobacco smokers(p value= 0.026).

Discussion

In the present study, we determined and compared the cognitive functions, using MoCA test, among tobacco smoker and non-smoker young adults in North India. The results supported the hypothesis that, in comparison to group-matched non-smokers, tobacco users significantly impaired their ability to abstract and recall information (p=0.048 and p=0.007, respectively). The difference, however, was not significant in the remaining MoCA test categories, including visual-spatial, naming, attention, language, and orientation. Our study's findings were broadly consistent with those of Chamberlain SR et al.(2012), who used the Cambridge Neuropsychological Test Automated Battery (CANTAB) for neurocognitive assessment. However, they found that nicotine users had significant cognitive impairments in the domain of sustained attention (p=.005), spatial working memory (p=.023), and executive planning (p=.002).[4] The variations in the results of our study could be due to the fact that the tool used for assessment of cognitive functions that is MoCA is a screening tool whereas CANTAB is a more detailed assessment tool. Some earlier investigations among young people produced findings that were comparable (Campos et al.,2016, Conti et al., 2019 and Durazzo et al., 2010).[3,6,7]

Spilich et al.(1992) demonstrated that smoking had no detrimental effects on performance for easy perceptual tasks, but measurable detrimental effects on performance for harder information processing tasks.[15]Similar results were obtained by Hill RD et al.(2003), who discovered that current smokers underperformed compared to never-smokers on the cognitively demanding tasks of block design and free recall.[16]Although Nadar MS et al.(2021) observed that smokers' performance on the Montreal Cognitive Assessment (MoCA) was not inferior to that of non-smokers, they also found that, despite the MoCA's "normal" results, more focused tests clearly showed that our smokers' group was performing below-averagely on neuropsychological tasks. [17]

In contrast to the current study findings, several investigations found that smoking had a favorable effect on cognitive performance; however, the studies included older participants.[8,9]Wang et al., 2010 found that cognitive impairment was less probable among previous and present smokers than non smokers throughout a 10-year follow-up using the Short Portable Mental Status Questionnaire (SPMSQ) in a prospective cohort research.[8]Similarly,

Momtaz et al.,2015 found that current smokers were 37% less likely to be cognitively impaired than never smokers in a cross-sectional study utilising Mini-MentalStateExamination (MMSE).[9]

According to our study, there is a statistically significant association (p value= 0.026) between tobacco users' cognitive function (measured by the MoCA) and the level of nicotine dependence (measured by the Fagerstorm Test). Similarly, Hill et al. (2003) found a significant negative correlation between number of cigarettes smoked and Block Design, $r=-0.16$, $P<0.05$, as well as the free recall task, $r=-0.18$, $P<0.05$. The direction of these relationships in both cases suggested that lower performance was linked to smoking more frequently and for longer periods of time.[16]In contrast, Wang et al. (2010) found no dose-response association between pack years and cognitive impairment in their study.[8]These findings indicate that the risk of cognitive impairment is more among young adults with higher frequency of smoking.

Our study's weaknesses include limited sample size and cross-sectional design. To fully understand the connections between smoking and neuropsychological impairment, large-scale prospective studies with more reliable, sensitive, and strong cognitive outcome assessments such as CANTAB are needed, along with radiological assessment of brain functions in the form of functional MRI among young population. Another limitation was lack female participation in the study, hence the gender variation in cognitive functions among tobacco users could not be commented. The study enrolled participants from outpatient department of a tertiary care hospital, a community-based study could have provided better insight.

Conclusion

Tobacco smoking seems to be a risk factor for neurocognitive impairment, as expressed in our data by impaired abstraction and recall of smokers compared to their group-matched non-smoker young adults. The degree of smoking has an adverse effect on individuals' cognitive performance.

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Tables

Table 1- Socio-demographicprofile of study participants. (N=50)

Characteristic	Tobacco Use disorder		p- value
	Present(n=25)	Absent (n=25)	
Age(inyears)			0.55
18-21(n=18)	10(40%)	8(32%)	
22-25(n=32)	15(60%)	17(68%)	
Education			0.47
Upto12thStandard(n=10)	4(16%)	6(24%)	
Graduation (n=40)	21(84%)	19(76%)	
SocioEconomicStatus			0.91
Lower (n=2)	1(4%)	1(4%)	
Uppelower (n=13)	6(24%)	7(28%)	
Lowermiddle(n=16)	9(36%)	7(28%)	
Uppermiddle(n=16)	7(28%)	9(36%)	
Upper(n=3)	2(8%)	1(4%)	

Table2: Cognitive function (MoCA) test among study participants. (N=50)

Characteristics	MoCA		p-value
	Normal(n=26)	Mildimpairment(n=24)	
Age(inyears)			
18-21(n=18)	7(26.9%)	11(45.8%)	0.16
22-25(n=32)	19(73.1%)	13(54.2%)	
Education			
Up to 12 (n=26)	6(23.1%)	20(83.3%)	0.57
Graduation(n=24)	20(76.9%)	4(16.7%)	
SES			
Lower (n=2)	0	2(8.3%)	0.11
Upper lower (n=13)	9(34.6%)	4(16.6%)	
Lowermiddle(n=16)	5(19.2%)	11(45.8%)	
Uppermiddle(n=16)	10(38.5%)	6(25%)	
Upper(n=3)	2(7.7%)	1(4.1%)	

Table 3- Association between Cognitive Function(MoCA Test) and Tobacco Use disorder (N=50)

Cognitive Function Test	**Tobacco Use Disorder**		**p-value**
	Present (n=25) Mean score	Absent (n=25) Mean score	
MoCA	**22.12**	**22.08**	**0.05**
Visuo-spatial	4.64	4.76	0.235
Naming	2.96	3.00	0.322
Attention	5.4	4.84	0.06
Language	1.80	1.72	0.761
Abstraction	1.64	1.88	**0.048**
Delayed recall	2.68	3.56	**0.007**
Orientation	5.96	6.00	0.322

*Unpaired t- test

Table4: Associationof severity of nicotine dependence (FagerstormTest)with Cognitive Function (MoCA) among tobacco smokers. (N=25)

FagerstormTest Scores	**MOCA (N=25)**		**p-value**
	Normal (n=11)	Mildimpairment (n=14)	
Verylow(n=2)	0	2(14.3%)	**0.026**
Low(n=9)	6(54.5%)	3(21.4%)	
Moderate(n=8)	5(45.5%)	3(21.4%)	
High(n=6)	0	6(42.9%)	