Impact of Smoking on Adolescents Development

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Abstract. This research investigates how smoking affects cognitive development in adolescents, emphasizing both the short-term and long-term consequences of nicotine on the brain. The research highlights the significant disruption caused by nicotine to critical brain regions such as the prefrontal cortex and hippocampus, which are essential for decision-making, impulse control, and memory retention. The incidence of smoking among adolescents, particularly the rise in e-cigarette use, is attributed to targeted marketing, affordability, and accessibility. These factors exacerbate the psychological and academic challenges faced by adolescents, linking smoking to issues such as depression, anxiety, and poor academic performance. The paper emphasizes the necessity of comprehensive educational programs, parental and community involvement, and stricter regulations to curb the use of tobacco products among young people. Future research directions include establishing a causal relationship between smoking and cognitive development, conducting longitudinal studies, and integrating mental health support with smoking prevention programs. By addressing these areas, the study aims to inform public health policies and promote healthier lifestyles among adolescents.

Keywords: Adolescent smoking; cognitive development; e-cigarettes; mental health; academic performance.

1. Introduction

Since tobacco use is the greatest preventable cause of death worldwide, smoking is a major public health concern [1]. According to health forecasts, smoking will claim the lives of one billion people by the twenty-first century—an extremely concerning statistic [1]. At the same time,the usage of electronic cigarettes, or "e-cigarettes," has sharply expanded in the US. A Monitoring the Future study from 2019 found that 25.4% of 12th graders had used e-cigarettes in the previous 30 days [2]. Comparing the survey findings from 2017 and 2018, there was a 131% rise [2]. A person's cognitive and emotional growth explodes throughout adolescence, making it a crucial period in their life. According to Gorounova and Mansvelder, adolescence is a period in a person's life, when creativity is at its peak and brave decisions are made [3]. Teenagers begin to face friendship, interpersonal problems and self-identity, and their prefrontal cortex is still developing, so teenagers are more susceptible to any form of influence, and it is difficult for them to make mature decisions. The combination of their erratic emotions and frequent incapacity to make wise choices puts children at risk for long-term behavioral issues. Smoking affects the cognitive development of adolescents.Leslie found that eighth graders in the US have increased their e-cigarette consumption by 157%, which is a cause for concern. Five million children in grades six through twelve have reportedly used e-cigarettes in the last thirty days, according to the National Youth Tobacco Survey. This is a rise from about 3.6 million users in 2018 [2].

Since the general incidence of active smoking among young school children is 8.9%, research from 131 countries has shown that adolescents are the group most at risk for starting to smoke [1]. According to Urrutia-Pereira et al, the prevalence is higher in the Americas and Europe, where it is 17.5% and 17.9%, respectively [1]. The National School-Based Health Survey carried out in Brazil reveals that thirty percent of young adults between the ages of 13 and 15 began smoking before turning twelve [1]. Smoking is a major public health risk and a global issue that requires attention since it affects the cognitive development of adolescents.

Therefore, understanding the relationship between smoking and cognitive development in adolescents is crucial due to the lasting impact of decisions made during this critical life stage. With

tobacco use being a major public health concern, this research aims to identify the prevalence of smoking among teenagers, aiding in better education and preventive measures. By addressing this issue, society can support young people in leading healthier lives and ensuring a brighter future.

2. Impact of Smoking on Adolescents

Smoking is a serious public societal issue, and smoking also affects the cognitive development of minors. Next, this study will specifically address the specific effects of smoking on the cognitive aspects of adolescents through the literature.

2.1. Neurodevelopmental Effects

The prefrontal cortex (PFC) is a crucial brain region situated behind the forehead that is in charge of cognitive processes like making decisions and controlling thoughts, emotions, impulses, and actions. Dopaminergic signals are released into the brain by nicotine, producing a euphoric feeling that frequently leads to addiction [3]. Nicotine impairs adolescents' cognitive development, inhibitory control, and executive functioning by causing increased degrees of dependence, which has an impact on the prefrontal cortex [3]. Adverse withdrawal symptoms from nicotine, such as anxiety, anger, and strong cravings for smoke, are also linked to the drug [2]. Adolescents have an extremely hard time quitting smoking due to these unpleasant effects. In the formative years, about 70% of American youths acknowledged smoking cigarettes at least once [3]. Adult brains are less sensitive to nicotine than adolescents' brains, according to Goriounova & Mansvelder. Essentially, even with low nicotine or cigarette consumption, adolescents experience indications of dependency[3]. After one or two days of tobacco use, the most vulnerable adolescents lose control over the substance. Adolescents who smoke face greater risks and potential injury to their developing brains and general health as a result. The component in tobacco, nicotine, is rapidly absorbed by the bloodstream and passes across the brain barrier once it reaches the body [3]. After inhaling tobacco, it takes ten to twenty seconds for the nicotine to enter the brain [3]. Following the chemical's arrival at the nicotinic acetylcholine receptors, a conformational shift occurs that either opens or closes the receptors' ion channels, altering how the body functions.Regular nicotine use makes the brain resistant to the drug, which makes addiction to it easier.

Leslie also researched the special and long-term effects of nicotine on the developing adolescent's brain. The brain's hippocampus is essential for both the creation and retrieval of memories. This important brain function is impacted when nicotine enters the hippocampus,which causes an increase in inattention . Smoking throughout early adolescence increases impulsivity and inattention, according to the Tobacco-Induced Neurotoxicity of Adolescent Cognitive Development (TINACD) theory. This is because nicotine use alters how the hippocampus and prefrontal cortex respond to memory and impulse control [2].

2.2. Academic Performance

Previous research has given particular attention to how students' conduct and attitudes are affected by their school environment. High school students who use tobacco and cannabis products had a higher likelihood of missing class. These students' poor academic performance was caused by significant turnover rates [2]. The social-control hypothesis holds that people act in specific ways because of their attachment to others and are influenced by those around them [4]. Zhou et al studied the relationship between nonsmoking adolescents' academic achievement and tobacco usage by their parents or peers.Individuals with strong social ties and commitments are less inclined to partake in any abnormal activity that could damage their reputation. Similarly, when adolescents have a closer relationship with their teachers or the school, they are less likely to participate in risky behaviors like smoking [4].

Academic success is typically linked to a strong sense of social connection to the institution. In essence, adolescents who excel academically and get acceptance from their classmates are less likely

to smoke and will focus better on class. Conversely, students with poor academic standing who are not accepted by their professors and peers feel less connected to the school and are more prone to disobey regulations and act in ways that are out of character. This also consistent with the findings of the study by Morin et al,they found that students with consistently high academic performance had a lower rate of smoking initiation (7.1%) compared to average achievers (15.1%) and unstable poor achievers (49.1%)[5].

Similarly, a study on adolescent smoking and academic performance was carried out in six European nations by Robert et al [6]. The research revealed that adolescents who perform poorly academically are more likely to smoke due to peers or the influence of parents and to make fewer attempts to quit smoking. In addition, there was a link between the ties and smoking as well as academic achievement. Essentially, adolescents who smoke every day have friends who smoke a lot, and adolescents who do poorly have friends who perform poorly as well [6]. The authors conclude that adolescents who shared the same smoking status and academic standing tended to be socially connected.

2.3. Psychological Impacts

Previous research has shown that smoking harms adolescents' psychological health. Adolescent smoking is a complicated activity linked to interpersonal aspects like motivation, self-esteem, and mental health [7]. According to research, adolescents who smoke frequently have worse self-images and worse levels of self-esteem than their non-smoking peers [7]. A 2017 study by Mathew et al. examined the connection between smoking cigarettes and depression. The study found a strong correlation between depression comorbidity and cigarette smoking. Compared to people without depression, those with a diagnosis of depression are more likely to smoke more cigarettes daily and are less likely to give up the habit [8]. Additionally, studies show that the rate of smoking among people with severe depression is twice as high as that of the general population [8]. Unfortunately, early adolescence is when depressive symptoms tend to flare up, making this group more susceptible.

Current Trends and Gaps: Globalization and technological growth have also led to the modernization of smoking. In recent years, there has been research on the prevalence of e-cigarette use among adolescents. More studies are currently concentrating on the causes of the rise in e-cigarette use among adolescents, particularly in the United States. Leslie reports that although the United States has seen a decrease in tobacco cigarette consumption in recent years, there has been a significant surge in the use of electronic cigarettes. Since its introduction to the US market in 2007, electronic cigarettes have become the most widely used tobacco product among adolescents [2]. The growth in adolescent e-cigarette use in the US is currently being studied by more researchers. For instance, a study conducted in 2020 by Sapru et al. found that e-cigarettes are more enticing than traditional cigarettes because they are easier to use, come in a variety of flavors, are less expensive, and are widely promoted on social media[9].

3. Findings and Discussion

3.1. Neurodevelopmental Impacts

Dopaminergic signals are released into the brain by nicotine, producing a euphoric feeling that frequently leads to addiction[3]. Regular nicotine use makes the brain resistant to the drug, which makes addiction to it easier. Adverse withdrawal symptoms from nicotine, such as anxiety, anger, and strong cravings for smoke, are also linked to the drug [2]. Adolescents have an extremely hard time quitting smoking due to these unpleasant effects. In the formative years, about 70% of American youths acknowledged smoking cigarettes at least once [3].

3.2. Cognitive Performance

According to Morin et al, the brain is more malleable throughout developmental phases such as adolescence, making it more vulnerable to the harmful consequences of nicotine use[5]. Individuals'

conduct is determined by the development and functioning of their brains. Adolescents who are exposed to nicotine have impaired executive function, learning and memory, reward-related circuitry, and cardiorespiratory function [3]. Nicotine from tobacco use affects the prefrontal cortex, which is in charge of executive functions like decision-making and attention span [2]. Adolescents who smoke cigarettes are therefore more inclined to partake in dangerous activities. Teens who smoke not only engage in dangerous activity but also jeopardize their academic performance since they are unable to make the best decisions for themselves.

According to Zhou et al, smoking and academic performance are tightly related[4]. In essence, students who excel academically and create strong social relationships at school are less likely to smoke than students who do not. The hippocampal region, which is in charge of memory, is also impacted, which may have an impact on the academic performance of adolescents [2]. Furthermore, according to Morin et al, the hippocampus is important for contextual information and spatial learning. All these functions are impacted if nicotine has a deleterious effect on the hippocampus[5].

The study conducted by Matthew et al, Fithria , Urrutia-Pereira , and Ranaei et al examines the connection between adolescent smoking and psychological health[1][7][8][10]. People with a diagnosis of depression are more likely to smoke cigarettes than people without a diagnosis, according to Matthew et al[8]. Furthermore, the smoking rate among the population classified as clinically depressed is twice that of the general population. According to Fithria et al. (2018), there is a connection between adolescent smoking and psychological problems like low self-esteem and low self-love. Compared to their classmates, adolescents who have lower levels of self-love and self-esteem are more likely to smoke. Additional elements including peer and parental impact are brought up by Urrutia-Pereira and Ranaei et al[1][10]. These two studies show that adolescents who have smoking parents and classmates are more prone to smoke than other adolescents.

4. Conclusion

The various studies reviewed for this research consistently demonstrate that smoking adversely affects adolescent cognitive development. Nicotine impacts critical brain regions responsible for cognitive functions, such as the prefrontal cortex and the hippocampus. This disruption affects adolescents' ability to make sound decisions, control impulses, and retain memory. Furthermore, smoking is associated with an increased likelihood of engaging in risky behaviors due to the addictive nature of nicotine, which triggers dopamine release and subsequent cravings. The rise in e-cigarette use among adolescents is particularly concerning, driven by targeted marketing, affordability, and accessibility. This trend underscores the need for heightened awareness and preventative measures to curb the use of tobacco products among young people. Smoking also has significant psychological impacts, contributing to issues such as depression and anxiety. Additionally, it correlates with poorer academic performance and overall well-being, further highlighting the comprehensive negative effects of smoking on adolescents.

Future research should prioritize establishing a causal relationship between smoking and cognitive development in adolescents to uncover the specific mechanisms at play. Conducting more longitudinal studies will provide more reliable and conclusive findings about the long-term effects of smoking on adolescent brain development and overall health. Insights from existing research should inform public health policies aimed at reducing smoking prevalence among adolescents. This could involve stricter regulations on the marketing of tobacco products and improved access to smoking cessation programs. Comprehensive educational programs are essential to inform adolescents about the risks of smoking and provide them with strategies to resist peer pressure and make healthier choices. Encouraging greater involvement from parents and the community in anti-smoking campaigns can create a supportive environment that discourages smoking and promotes healthy behaviors among adolescents.

Developing targeted interventions that consider the unique vulnerabilities of the adolescent brain and the social contexts that influence smoking behavior can significantly reduce the prevalence of

smoking among adolescents. Given the rise in e-cigarette use, it is crucial to monitor and regulate these products more stringently to prevent their appeal and accessibility to adolescents. Providing mental health support to adolescents can address underlying issues such as depression and anxiety that may contribute to smoking behavior. Integrating smoking prevention programs with mental health services could be particularly effective. By addressing these areas, future research and policy initiatives can help mitigate the adverse effects of smoking on adolescent cognitive development and overall well-being, paving the way for a healthier future generation.

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