

Early Nicotine Exposure and Opioid Abuse

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Abstract: Over the last few years, the number of opioid-related deaths has been skyrocketing across racial, age, and gender groups in the United States. Researchers have found that continuous exposure to nicotine-containing substances among teenagers increases the likelihood of opioid addiction during adulthood. Hence, exposure to nicotine remains an essential factor associated with opioid use. Early Nicotine Exposure and Opioid Abuse is the central theme of this study. The study yielded several noteworthy findings, including the following: Upon consumption, nicotine rapidly enters the bloodstream and binds to specific nicotinic acetylcholine receptors in the brain, resulting in the release of dopamine, a neurotransmitter responsible for the pleasurable and rewarding effects of nicotine use. Significantly, increased dependence on nicotine is strongly associated with heightened pain symptoms, which in turn exacerbate the likelihood of opioid use. To mitigate the risks of concurrent nicotine and opioid use, a comprehensive approach that addresses the root causes of addiction and prioritizes positive health outcomes for individuals and communities is needed. Hence, the importance of this study lies in its identification of key factors that inform the development of multifaceted interventions aimed at reducing the harms associated with nicotine and opioid use.

Keywords: nicotine, opioid abuse, chronic pain

1. Introduction

The opioid epidemic is increasing at a substantial rate despite enhanced public health awareness campaigns [1]. Over the last few years, the number of opioid-related deaths has been skyrocketing across racial, age, and gender groups in the United States. For instance, the total amount of deaths attributable to opioid overdose has grown by over 59,322 cases between 2010 and 2021 [2]. In most cases, one of the leading contributors is fentanyl, a synthetic pain reliever with 50-100 times more strength than any other opioid. In states like California, fentanyl-related overdose deaths accounted for about 5,722 of the 6,843 reported opioid-related deaths. Teenagers are at high risk of opioid-related deaths in the country [1]. Researchers have found that continuous exposure to nicotine-containing substances among teenagers increases the likelihood of opioid addiction during adulthood [1]. According to Ren and Lotfipour, nicotine may enhance the likelihood of opioid use disorders (OUDs) or exacerbate their seriousness by coming before illicit substance consumption behaviors.

Exposure to nicotine remains an important factor associated with opioid use. According to research, concurrent nicotine use among populations, regardless of gender or age, is linked to substance abuse of various drugs, including opioids [3]. At least 90% of those enrolled in the opioid treatment program

(OTP) are nicotine users, implying a link between nicotine use and the likelihood of opioid abuse. Evidence shows that the interaction between opioids and nicotinic receptor systems affects how the body reacts to opioid-related stimuli, increasing sensitivity to OUDs [4]. Early exposure to nicotine substances, especially among teenagers [1], is a substantial risk factor for opioid abuse in adulthood, especially fentanyl. People use fentanyl as a relaxer and pain reliever with a high chance of overdosing [2]. The potency level of the drug increases the risk of death.

In the United States, the use of nicotine and opioids has been associated with alarmingly high rates of mortality and morbidity worldwide. The co-occurrence of these two substances has a significant impact on the progression of diseases and the prognosis of treatment [5].

2. Neurobiological Alterations of the Brain by Nicotine

Nicotine is a psychoactive substance that activates the brain's reward centers, leading to feelings of pleasure and euphoria [6]. When nicotine is consumed, it enters the bloodstream and quickly reaches the brain, binding to specific nicotinic acetylcholine receptors (nAChRs) [6]. These receptors are distributed throughout the brain, and nicotine causes them to become active, releasing a number of neurotransmitters, including as dopamine, serotonin, and norepinephrine.

The pleasure and reward experienced after consuming nicotine are specifically brought on by the release of dopamine. This dopamine release reinforces the smoking behavior and creates a positive association with smoking, making it more likely for an individual to continue smoking. Over time, frequent nicotine consumption can change the brain's structure and function. These changes occur due to the neuroadaptation that occurs in response to repeated exposure to nicotine. Neuroadaptation is the brain's ability to adapt to environmental changes, including exposure to drugs such as nicotine. One of the most significant changes in the brain due to nicotine consumption is an increase in the number and sensitivity of nAChRs [6]. The upregulation of nicotine receptors in the brain leads to an increase in the release of neurotransmitters, notably dopamine. This heightened release reinforces the behavior of smoking and contributes to the difficulty of smoking cessation for individuals.

Another significant change in the brain due to nicotine consumption is a decrease in the density of certain brain regions, such as the prefrontal cortex and the hippocampus. These brain regions are responsible for decision-making, memory, and learning [6]. The decrease in density of these regions can lead to cognitive impairments and difficulty with memory and decision-making. Furthermore, nicotine consumption has been demonstrated to induce alterations in the brain's reward circuitry. Mahajan et al. have established that chronic nicotine exposure can diminish the sensitivity of dopamine receptors in the reward circuitry, resulting in a decreased ability to experience pleasure and reward. This attenuation in sensitivity can result in reduced motivation to participate in activities that typically induce pleasure, such as social interactions and exercise [6].

Additionally, continued nicotine use can activate stress circuits in the brain, leading to increased anxiety and depression symptoms. According to research, nicotine triggers the hypothalamic-pituitary-adrenal (HPA) axis, causing the production of stress hormones, including cortisol and adrenaline [6]. These stress hormones can trigger alterations in the brain's neuronal circuits, resulting in increased anxiety and depression symptoms.

Moreover, nicotine usage can lead to tolerance, meaning the user has to ingest more nicotine to attain the same results. This can lead to more significant nicotine usage, which can lead to additional alterations in the brain's neuronal circuits. These alterations can become persistent over time, resulting in addiction.

Apart from this, smoking during adolescence may pose significant harm to the developing brain. The adolescent brain is still undergoing structural and functional development, and nicotine use can result in long-term alterations to the brain. Research indicates that nicotine exposure throughout adolescence can lead to reduced grey matter volume in both the prefrontal cortex and hippocampus,

which can result in cognitive deficits and an increased susceptibility to addiction [6].

2.1. Diseases That Require Opioid Treatment Age Setup

Increased dependence on nicotine is highly linked to severe pain symptoms, which exacerbates the chances of using opioids [7]. Similarly, nicotine withdrawal symptoms are associated with a dampened stress response and severe pain. Among the smokers who report no pain, the chances of reporting pain are higher, while the chances of opting for opioid use increase by three times upon abstaining from smoking [5]. Pain-related anxiety increases the severity of smoking and is a barrier to abstaining, thereby enhancing the chances of opioid use.

One of the most common diseases that require opioid treatment is chronic pain. Chronic pain is a long-term condition caused by various factors, including injury, surgery, and disease [8]. Opioids are often prescribed to manage chronic pain, but long-term use can lead to dependence and addiction. Another disease that requires opioid treatment is cancer. Patients with cancer often experience severe pain, and opioids are frequently used to manage this pain. Unfortunately, Cancer patients may need large doses of opioids for extended periods of time, which increases the risk of addiction. Patients with HIV/AIDS may also require opioid treatment. Opioids can be used to manage pain caused by the disease or by the side effects of treatment [9]. However, like other patients who require opioid treatment, those with HIV/AIDS are at risk of addiction.

Patients who undergo surgery may also require opioid treatment. Opioids can manage pain during and after surgery, but long-term use can lead to addiction. Research has shown that up to 13% of patients prescribed opioids after surgery become addicted [9]. Patients with mental health conditions, such as depression and anxiety, may also require opioid treatment. Opioids can be used to manage pain associated with these conditions. Patients with mental health conditions may also be more vulnerable to addiction due to their illness.

2.2. Nicotine as a Gateway Drug to Opioid

Nicotine exposure has been identified as a potential gateway drug to opioid use. Animal model data clearly imply that adolescent nicotine usage amplifies the drug-reinforcing effects of other substances. Improved drug-related learning supports an addiction-like phenotype after short nicotine exposure in early adolescence [10]. Gateway drugs are substances believed to increase the likelihood of trying and becoming addicted to more potent drugs, such as opioids. Rajabi et al. suggests that while nicotine is not typically considered a “hard” drug like opioids, It could contribute to the emergence of opioid addiction [11]. The relationship between exposure to nicotine and opioid usage is complex. For one, nicotine has been shown to alter brain chemistry in ways that can increase the likelihood of addiction to other drugs, including opioids [11]. Specifically, nicotine increases the release of dopamine, a neurotransmitter linked to reward and pleasure. The reward system in the brain may change as a result, leaving a person more vulnerable to the addictive properties of other drugs. Another potential factor linking nicotine exposure and opioid use is the social environment in which these substances are used [11]. Individuals who smoke cigarettes are often exposed to peer groups that engage in other risky behaviors, including the use of opioids which can increase the likelihood of opioid experimentation and addiction.

Nicotine exposure may influence how the body reacts to pain, which may influence the development of opioid addiction and change brain chemistry and the social environment. Chronic nicotine use has been linked to studies suggesting changes in pain sensitivity and perception, which may increase the risk of people turning to opioids for relief [11]. Given the high rates of opioid abuse and overdose among people with chronic pain, this is especially worrisome.

Moreover, combining opioids and nicotine may make both drug addictions more likely. It has been

demonstrated that nicotine increases the pleasurable effects of opioids while simultaneously raising tolerance to those drugs' painkilling properties [11]. As a result, people may seek out more significant dosages of opioids to provide the same benefits, which can start a cycle of escalating consumption. It is crucial to remember that while exposure to nicotine may raise the likelihood of developing an opioid addiction, it is not the only element causing this complicated problem. Various other variables, including genetic predisposition, mental health issues, and social and environmental factors, influence opioid addiction.

As a result, the possible connection between nicotine exposure and opioid addiction emphasizes the need for thorough preventive and treatment efforts that address the root causes of drug use disorders. This might entail addressing social and environmental factors, granting access to evidence-based drug use disorder treatment, and promoting non-opioid pain management techniques to lessen dependency on them.

2.3. The Simultaneous Use of Nicotine and Opioids

Simultaneously using nicotine and opioids is a complex issue with potential health consequences. While nicotine and opioids are two different substances with distinct effects on the body, their combined use can lead to several adverse effects on physical and mental health [12]. The increased risk of addiction is one possible side effect of combining nicotine and opioids. Nicotine and opioids are addictive substances that can alter brain chemistry, increasing the likelihood of dependence and addiction. Furthermore, the combined use of these substances can lead to adverse effects of each substance, potentially leading to a greater risk of addiction.

Another potential risk of the simultaneous use of nicotine and opioids is the increased risk of overdose. Opioids and nicotine may interact with one another to increase the risk of respiratory depression, a potentially deadly illness in which breathing is greatly slowed or ceases entirely [12]. Overdose is a serious concern with opioids, and using other substances, including nicotine, can increase the risk of this potentially fatal outcome. The simultaneous use of nicotine and opioids can also negatively affect health. Both substances can affect mood and mental state, and the combined use can exacerbate symptoms of depression, anxiety, and other mental health disorders. Additionally, nicotine and opioids can lead to changes in brain chemistry that may increase the risk of mental health disorders over time.

Using nicotine and opioids at the same time is a complicated issue with potential health consequences. While both substances have therapeutic applications, their combined use can increase the risk of addiction, overdose, and negative mental health effects [13]. Healthcare professionals and individuals must be aware of the potential risks associated with the use of certain drugs concurrently and take precautions to reduce such risks. This includes promoting smoking cessation programs, educating people about the dangers of opioid use, and avoiding the use of both substances at the same time whenever possible. It is possible to promote better health outcomes for individuals and communities alike by lowering the risks associated with nicotine and opioid use.

3. Conclusions

Nicotine and opioids are two different substances with distinct effects on the body. Several potential risks are associated with substances, including addiction, overdose, and negative effects on mental health. Furthermore, nicotine use and addiction may be increased by nicotine exposure, making it a potential gateway drug. Healthcare professionals, policymakers, and individuals should be aware of the potential risks associated with nicotine and opioid use and take precautions to mitigate these risks. This includes promoting smoking cessation programs, providing education on the risks of opioid use, and avoiding the simultaneous use of these substances whenever possible. Reducing the risks

associated with nicotine and opioid use requires a multifaceted approach that addresses the underlying causes of addiction and promotes better health outcomes for individuals and communities. It is encouraged to lessen the prevalence of addiction and create healthier, more resilient communities by tackling these problems together.

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