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Flavored Vapes and Youth Targeting: *An Influence on Adolescent Lives*

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ABSTRACT

The rise of flavored e-cigarette use among adolescents has emerged as a pressing public health concern, primarily driven by targeted marketing, appealing flavor varieties, and social normalization. Initially introduced as a harm-reduction tool for adult smokers, e-cigarettes have rapidly infiltrated youth culture, with flavors like fruit, candy, and menthol masking harmful nicotine content and reinforcing misconceptions about safety. This narrative review synthesizes current literature on how flavored vapes attract adolescent users, the neurological and respiratory risks associated with early nicotine exposure, and the role of social and peer influences in vaping initiation. Data shows that adolescents are more likely to try flavored products, view them as less harmful, and develop long-term use habits. Furthermore, nicotine and flavor additives have been linked to cognitive deficits and brain inflammation during critical developmental stages. Despite some progress in regulation, gaps in policy enforcement and online accessibility continue to fuel underage access. This review calls for comprehensive policy reform, increased educational outreach, and youth-centered cessation strategies to combat the vaping epidemic and protect developing adolescent brains.

KEYWORDS: *Smoking, Vaping, E-cigarettes, Adolescents, Teenagers, Lungs, Brain, Nicotine, Addiction, Cessation, Abstinence, JUUL*

INTRODUCTION

With the end of the cigarette era and the introduction of a safer alternative to smoking, electronic cigarettes entered the U.S. market in 2006 (Fadus et al., 2019). Electronic cigarettes are devices that allow the delivery of nicotine and other chemicals in an aerosolized form, bypassing combustion while maintaining the addictive properties of traditional cigarettes (Groom et al., 2020). Initially introduced as a safer alternative to conventional cigarettes and a way to wean off smoking for adults, e-cigarettes are being used among adolescents. The use of flavored electronic cigarettes, or vapes, has surged among adolescents, raising concerns among parents and public health officials.

In 2022, over 2.6 million Americans reported using e-cigarettes, and the United States accounted for 22.45 billion dollars in sales related to vaping (López-Ojeda & Hurley, 2024). The increase in use among the youth is due to marketing in a wide range of appealing flavors such as “Tutti Frutti”, “Blue Razz”, and “Strawberry Ice”, these products are often perceived by youth as less harmful than traditional tobacco, despite containing toxic levels of

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nicotine and other poisonous substances (Groom et al., 2020). Flavor additives play a central role in attracting younger users. Research has consistently shown that sweet, fruity, and minty flavors increase the appeal of nicotine products to adolescents, lowering their perception of harm and increasing the likelihood of experimentation and regular use (Chaffee et al., 2023).

Data from a 2019 study showed that over 70% of high school students and nearly 60% of middle school students use e-cigarettes with flavorings (Groom et al., 2020). Companies like JUUL have been targeting adolescents with their modern e-cigarettes by designing products with sleek designs, user-friendly functions, and flavors, as well as the ability to be used discreetly in places where smoking is forbidden, such as schools (Fadus et al., 2019). The attractive packaging, social media, advertising, and flavor options have drawn criticism for intentionally targeting a younger audience, leading to a rise in adolescent addiction to nicotine.

Marketing strategies have adapted to directly and indirectly target adolescents. Through the use of vibrant packaging, influencer marketing on social media, and flavors, e-cigarette companies have created a powerful social influence around vaping among adolescents. A 2023 study found that social media posts promoting flavored e-cigarettes frequently featured trendy language and aesthetics, with hundreds of new flavors introduced annually to sustain interest and novelty (Chaffee et al., 2023).

The rationale for this narrative review stems from the urgent need to understand how flavored vaping products have contributed to increased youth usage and the extent to which marketing, product design, and regulatory gaps have facilitated this trend. While vaping may present a safer alternative to traditional smoking for adult smokers, it is now clear that it poses a significant risk to the youth population. Young users are particularly vulnerable to nicotine addiction due to ongoing brain development, and exposure to nicotine during adolescence has been shown to alter cognitive function, impair impulse control, and increase susceptibility to future substance use (Fadus et al., 2019).

Moreover, the flavored vaping trend raises important questions about public health and prevention. Studies show that flavored product use is highest among young people who have never used other tobacco products, suggesting that vaping may serve as a gateway to long-term nicotine dependence rather than a safer substitute for smoking (CDC, 2024). Despite growing public awareness and some policy responses towards vaping, such as flavor bans and age restriction laws, many adolescents continue to access flavored vapes through online retailers, vape shops, and their peers, overlooking the effectiveness of current interventions.

This review aims to explore the relationship between flavored vape products and youth behavior through a narrative synthesis of current literature, public health data, and policies. By examining how flavors, design, and marketing intersect to influence adolescent behavior, the review seeks to provide insights into the public health implications of this trend and identify areas where stronger regulatory or educational interventions are necessary.

METHODS

This narrative review aims to understand the introduction of flavored vape products into teenagers' lives and their widespread impact on modern society. Through research literature review from a wide range of sources, including PubMed and Google Scholar, with search terms including ‘flavored vapes,’ ‘marketing,’ and ‘adolescents.’ Boolean operators such as AND/OR were used to combine search terms.

In this review, we included studies that focused on adolescents' relationships with flavored vapes and were published in peer-reviewed journals, all in English. Excluded from this review were studies that did not provide full access or did not relate to the topic of flavored vapes and youth targeting.

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Each study was reviewed by reviewers who examined the abstracts of the articles. This narrative review synthesized the selected literature using a thematic approach. In the articles, key themes were identified across studies that examined the role of flavored e-cigarettes among adolescents, marketing strategies, behavioral outcomes, and regulations related to e-cigarettes and youth.

This review has a couple of limitations. The articles were selected with a selection bias because they were chosen by the reviewers. This can result in some important studies being overlooked and not included. Finally, because the review is based on our narrative interpretation, some points may be discussed more thoroughly than others. We have developed this manuscript with the primary goal of shedding light on the harmful, addictive, and potentially life-altering consequences of vaping, particularly its impact on the health and well-being of children and adolescents.

RESULTS

This manuscript synthesizes existing literature to provide a comprehensive overview of e-cigarette use among youth, addressing the social influence of vaping, exploring the appeal of flavored products, discussing the policy and regulations, and highlighting the concerning impact of vaping on the developing brain and health.

The Rise of Vaping and Youth Appeal

As the use of vaping increases, the question of its influence and appeal to its audience has become a concerning topic among parents and health officials. The e-cigarette was initially introduced to help smokers end their addictive relationship with traditional cigarettes and as a tool for smoking cessation. However, a study conducted by Fadus et al. (2019) found that the emergence and rapid popularization of electronic cigarettes (e-cigarettes), particularly "pod-mod" devices like JUUL, have significantly altered the landscape of nicotine consumption, especially among youth.

This study offers a comprehensive review of e-cigarette usage trends among adolescents, relating to the JUUL pod. By the end of 2018, JUUL had become the most popular retail e-cigarette brand in the United States, accounting for 76% of the retail e-cigarette market. As a result, e-cigarette usage skyrocketed from 1.5% to 20.8% due to JUUL's influence. Companies like JUUL within the e-cigarette industry have adapted to target a younger audience through flavor variety featuring fruity and dessert-like options, social media, discreet designs of their devices, and functions, which accounts for the rise in usage among the youth.

The exponential growth of vaping and JUUL pods is related to the large number of adolescents exposed to their marketing and social media. From sweet and fruity vape flavors to sleek, concealable designs and widespread promotion through social media platforms, companies have created a kid-friendly image that masks these products. The appealing flavorings available, such as mango, fruit medley, and menthol, provided by JUUL, mask unwanted tastes and smells and are often cited as a reason for experimentation among young users (Fadus et al., 2019).

A relatively recent study, conducted by Chaffee et al. (2023), with a non-probability sample of United States adolescents, observed how flavors influence their willingness to try vaping products. The participants in this study ranged from 12 to 17 years old. They were shown pairings of random pairs of nicotine, just vapor, or cannabis vape products, each presented either in a flavored version, which included seven options. They were asked about their likelihood of trying each product and their perceptions of these products.

The results concluded that flavored vapes consistently evoked greater willingness to try compared to their unflavored counterparts. The

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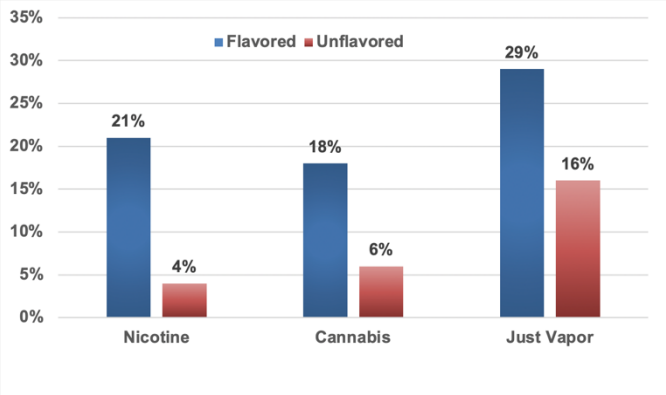
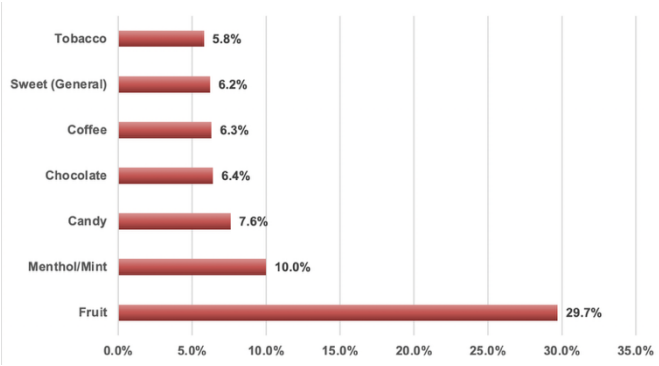
flavor combinations that had the highest willingness were candy, dessert, fruit, and ice combinations. Participants who did not use e-cigarettes or marijuana favored nicotine paired with fruit and sweet (21%), as opposed to tobacco unflavored (4%) (Figure 1). Marijuana, paired with fruit and sweet, was 18% and tobacco, unflavored, was 6%. Lastly, the vapor with fruit and sweet was 29%, while the tobacco unflavored was 16%. This trend was found in both the nicotine and cannabis options but was pronounced explicitly for products that combined nicotine with fruity or sweet-like flavors. Adolescents rated flavored options as more appealing and less harsh, and they had a misconception that these options were safer. The association of flavors with vaping led adolescents to view vaping as less risky, which leads to a heightened interest in vaping (Chaffee et al., 2023).

Figure 1: Willingness to Try Vape Products by Flavor



The study by Groom et al. (2020) examines the relationship between adolescents' preferences for flavored e-cigarettes and demographics, behavioral, and perceptual factors, highlighting the central role that flavors play in youth vaping initiation and continuation. Drawing from a large cross-sectional sample of U.S. youth, the study found that the vast majority of adolescent vapers prefer flavored products, with fruit and minty flavors being the most popular (Figure 2). Notably, of 1549 participants, adolescents aged 13-18 drawn from an online survey showed an even stronger preference for sweet flavors than older teens, and female users were significantly more likely to favor dessert and candy-like flavors compared to their male peers (32.7% vs. 27.4%).

Figure 2: Commonly Preferred Vape Flavors Among Adolescents



According to this study, fruit was the favorite flavor with 29.7% of the votes, followed by menthol or mint (10%), candy (7.6%), chocolate (6.4%), coffee (6.3%), sweet (6.2%), tobacco (5.8%), other (2.2%), alcohol (1.1%), spice (0.2%), and none of the above (6.0%). This points to a concerning trend in which flavor categories align closely with youth taste preference, especially among more impressionable or vulnerable subgroups. Data from 2016 shows that 71% of youth use tobacco products "because they come in flavors I like", which include fruit, menthol, candy, and desserts. Beyond initial experimentation, the study revealed that adolescents who began vaping with flavor products were significantly more likely to progress to regular use, suggesting that flavor preference is not only a recruitment tool but also a factor in sustained behavior. Notably, the data also shows that users of flavored e-liquids were more likely to believe that vaping was less harmful than smoking, reinforcing the idea that flavor marketing contributes to a misconception about health. Many participants reported vaping specifically "because it tastes good", emphasizing that taste and sensory experience play a primary role in vaping motivations (Groom et al., 2020).

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Together, these findings suggest the flavors are not merely passive product features but active components in shaping adolescent attitudes, risk perceptions, and usage patterns. When considered alongside industry marketing tactics such as candy-like packaging and social media promotions, the study underscores how flavor appeal interacts with targeted branding to attract and retain underage users. In the context of public health, this research strengthens calls for comprehensive regulations of flavored e-cigarette products as a core strategy to reduce adolescent vaping.

Brain Development and Health Risks

E-cigarettes were introduced into the U.S. market as a safer alternative to combustible cigarette smoking. However, e-cigarettes can lead to brain development and health risks among adolescents. Lopez-Ojeda and Hurley's (2024) study review explores the health risks associated with adolescent e-cigarette use, emphasizing that nicotine exposure during this critical stage of brain development can have long-lasting consequences. Adolescents' brains are still maturing, particularly in areas such as the prefrontal cortex and hippocampus, which are responsible for executive function, decision-making, and memory.

The study highlights that nicotine disrupts the normal development of nicotinic acetylcholine receptors, leading to potential structural and functional changes that impair impulse control and cognitive performance (Table 1). In addition to nicotine, vaping aerosols often contain toxic chemicals that include volatile organic compounds, heavy metals, and artificial flavoring agents (e.g., fruit, cotton candy, and menthol), which can ultimately cross the blood-brain barrier and induce neuroinflammation, oxidative stress, and synaptic dysfunction.

Table 1: Health Risks Associated with Adolescent Vaping

Risk Areas	Key Implications
Brain Development	Neuroinflammation; Cognitive Deficits; Disrupted Impulse Control
Addiction	Nicotine Dependence (Heightened by Flavor Enhancers, e.g., Farnesol)
Respiratory	Elevated Risk of Symptoms, e.g., Wheezing, Chronic Cough, Lung Damage, etc.
Social Behavior	Normalization via Social Media/Peers; Increased Likelihood of Lifelong Use
Misconception	Flavored Vapes are Perceived as Less Harmful due to Taste and Design

The flavoring agents used in e-cigarettes are not strictly regulated. Flavor additives like menthol have been linked to promoting smoking among the youth. Menthol promotes addiction through its pairing with nicotine, reinforcing a high sensory cue. E-cigarette additives like farnesol, commonly used as a flavor enhancer, have been shown to amplify nicotine's effects on brain reward pathways, potentially increasing addiction risk. These chemical exposures may result in damage to neural circuits involved in emotional regulation and learning. Vaping can also cause damage to the organs, nervous system, and respiratory system.

The authors also draw the spotlight to the role of nicotine salts, commonly used in devices like JUUL pods, which deliver higher doses of nicotine with reduced throat irritation, making it easier for adolescents to inhale dangerous levels without immediate discomfort. Popular brands in the vaping industry contain around 59.2-66.7 mg/mL of nicotine, which is equal to a pack of 20 traditional cigarettes. Many young users are unaware of how

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much nicotine they are consuming, which increases the risk of early dependence.

Animal studies reviewed in the article support these concerns, showing that even short-term nicotine exposure during adolescence can lead to long-term deficits in mood, attention, and addiction vulnerability. In nematodes, exposure to e-liquids stunted growth and development, resulting in abnormal behavior and learning. In mice, chronic exposure leads to metal buildup in the brain and neuroinflammation, while popular flavoring agents like caramel and butterscotch were found to be cytotoxic in stem cell models, indicating that flavoring chemicals pose serious neurodevelopmental risks.

Overall, the review underscores that vaping is not a harmless alternative for youth but a direct threat to brain health, with potentially irreversible outcomes on cognition and emotional development (López-Ojeda & Hurley, 2024).

Trends, Respiratory Effects, and the Need for Caution

Polosa et al. (2022) provide a critical overview of vaping trends among adolescents and young adults in the United States, highlighting both the pervasiveness of e-cigarette use and its potential health implications. Drawing from national surveys, the authors report that after peaking in 2019, adolescent e-cigarette use has fortunately declined, while youth smoking rates continued to fall. Data shows that a 58% reduction in high school vaping occurred from 27.4% to 11.2%.

This division suggests vaping may not function as a direct gateway to smoking as previously thought; however, most adolescent vapers are infrequent users, and a majority have already experimented with cigarettes before vaping. Despite these reassuring trends, the authors underscore limited evidence regarding vaping's long-term impact on the adolescent body and brain. They note that while e-cigarette vapor likely contains fewer toxins from traditional cigarettes, its effects on developing lungs and neurocognitive systems remain largely unknown.

Short-term studies observe only transient respiratory symptoms, often mild and reversible, but high-quality data are still lacking. The study stressed the need for practical guidance from healthcare providers when counseling youth, given the current uncertainty surrounding adolescent vaping. They emphasize that while e-cigarettes may pose fewer immediate risks compared to traditional smoking, they are not harmful, especially in younger populations whose respiratory and neurodevelopmental systems are still maturing.

In one study, researchers investigated the association between e-cigarettes and respiratory effects, focusing on individuals aged 18 to 24 years. Specifically, former users had an adjusted odds ratio of 1.20 for any respiratory symptoms and 1.41 for wheezing, while current users showed 1.32 for respiratory symptoms and 1.51 for wheezing. This study revealed that both former and current e-cigarette users had significantly higher odds of experiencing respiratory symptoms compared to non-users.

In the context of brain development and health risks, this study contributes several key considerations. First, it speaks to usage patterns, mostly infrequent but potentially escalating, highlighting a window of opportunity for early intervention. Second, it draws attention to the absence of long-term data on adolescent vaping's physiological impacts, signaling an urgent need for research that tracks cognitive, behavioral, and neurological outcomes. Third, it reinforces concern that adolescents, at a time of rapid brain maturation, could be especially vulnerable to toxic exposures from vaping, even if initial physical effects appear mild.

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By framing e-cigarette use among youth as a legitimate concern requiring thoughtful medical advice, the article encourages a balanced, precautionary approach. This aligns with broader thematic imperatives like regulating flavors, minimizing adolescent initiation, and prioritizing research into neurological and pulmonary outcomes. As such, the study bridges the gap between behavioral epidemiology and biological risk, underscoring that preventing youth vaping and protecting their developing brains must remain central to public health strategies (Polosa et al., 2022).

Social Influences and Normality of Vaping

Although the use of traditional combustible cigarettes has decreased among youth, the overall use of electronic nicotine products has increased. By normalizing e-cigarette use in everyday life among adolescents and aligning it with being trendy and cool, these companies have shifted the intended purpose of the e-cigarettes from cessation to pure entertainment.

A study from Groom et al (2021) explored the role of peer influence in adolescents' vaping through a mixed-methods design involving United States teens aged 13-18. Drawing from a nationally recruited online panel, the study analyzed quantitative data from 1,549 e-cigarette users who reported that friends played a dominant role in their vaping initiation, 60% first obtained a vaping device from a peer, and 54% took their inaugural puff “while hanging out with friends.”

This strong quantitative signal was enriched by qualitative follow-up interviews, where socializing emerged as the primary context for experimentation. Notably, exposure to e-cigarette advertising on social media doubled the likelihood that friends were the source of adolescents’ first vaping experience, and marketing and peer social networks operated together to fuel initiation.

Demographic factors provided further information that peer-driven initiation was especially pronounced among non-Hispanic White and Hispanic/Latino adolescents, those in urban settings or high-income households, individuals with higher self-esteem, and those predisposed to experimenting. These findings paint a clear picture that vaping is not solely an individual choice; it involves behavior rooted in shared identity, belonging, and peer acceptance. This study explains the social influence and peer normality theme relating to e-cigarettes and vaping. It highlights peer networks as the primary gateway to vaping, with social situations serving as launching points for experimentation. It also reveals how social media marketing reinforces these peer dynamics, making vaping not only accessible but also normal and trendy within friend groups. It shows that demographic and psychological factors shape how peer influence operates across different teen subgroups. Finally, these insights suggest prevention efforts should target not only individuals but peer clusters, combining social media literacy with peer education strategies to disrupt the reinforcing cycle between marketing visibility and peer uptake (Groom et al., 2021).

Policy and Regulation

As adolescent vaping grows, federal agencies and public health organizations are beginning to implement regulations and policies regarding vaping and e-cigarettes. Recognizing the role that flavored products and digital marketing play in influencing youth, policies are being implemented to limit sales, restrict flavors, and impose age restrictions.

A study by Park-Lee et al (2024) evaluates the project impact of various tobacco control policies on reducing youth e-cigarette use. Using data from the 2021 and 2022 National Youth Tobacco Survey, which included over 20,000 United States middle and high schoolers, the researchers modeled the potential reduction in adolescent vaping if three key interventions were implemented: a ban on flavored

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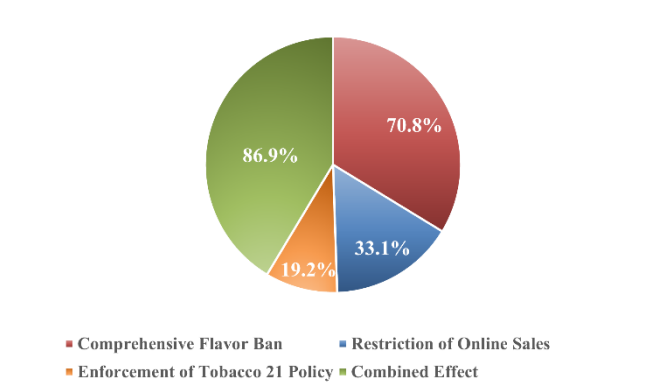
e-cigarettes, restriction of online sales, and enforcement of a minimum purchasing age of 21 across all retail outlets.

The most substantial policy effect was associated with a comprehensive flavor ban, which was projected to reduce youth vaping by up to 70.8% in high school students (Figure 3). Flavored products are a key factor in adolescent usage of vaping. In 2022, 85.5% of youth who used e-cigarettes reported using flavored varieties, with fruit, candy, and mint being the most popular. The authors argue that the partial bans have allowed the industry to adapt by shifting to exempted product categories, thus weakening the public health benefit. A total ban on all non-tobacco flavors would significantly reduce the appeal of vaping among adolescents.

Figure 3: Estimated Reduction in Youth Vaping from Policy Interventions



The restriction of online sales was estimated to result in a 33.1% reduction in youth vaping. Many adolescents obtain e-cigarettes via online websites, which often lack a strict age-verification process. This loophole has allowed widespread underage access to vaping products, especially those from newer brands that use synthetic nicotine or new flavorings. Shutting down or tightly regulating this channel could decrease accessibility.

Implementing the Tobacco 21 Policy raises the legal purchasing age to 21 nationwide, which is predicted to reduce adolescent vaping by 19.2%. This policy limits access among high schoolers, particularly those who depend on others for their products. Although the federal minimum age is already 21, inconsistent enforcement at the state and retailer levels undermines its effectiveness. Strengthening compliance and monitoring would increase the policy's impact. When all three interventions were modeled together, the estimated reduction in youth vaping was up to 86.9%, demonstrating the importance of policy and regulation. This study highlights the urgent need to restrict the vaping industry to help prevent adolescent vaping (Brouwer et al., 2024).

DISCUSSION

The findings of this review underscore the alarming influence that flavored e-cigarettes have on adolescent health and behavior, as well as the crucial need for public health strategies to mitigate this growing concern. While e-cigarettes were initially marketed as harm-reduction tools for adult smokers, evidence shows that these products have become gateways to nicotine addiction for adolescents due to appealing flavors, aggressive marketing, and social normalization of vaping.

Flavor additives such as fruit, candy, menthol, and dessert-like options play a significant role in attracting and sustaining adolescent users. Studies reviewed in this manuscript, including Chaffee et al. (2023) and Groom et al. (2020), demonstrate that flavors increase both willingness to try and misperceptions of safety. The sensory appeal masks the harmful contents of vape aerosols, including high concentrations of nicotine and chemicals capable of crossing the blood-brain barrier and inducing neuroinflammation. Moreover, flavorings like farnesol have been shown to potentiate nicotine's rewarding effects, increasing the risk of addiction.

The neurodevelopmental consequences of adolescent nicotine exposure are of particular concern. As López-Ojeda and Hurley (2024)

explain, nicotine disrupts key developmental processes in the brain, particularly in areas governing impulse control, memory, and learning. The adolescent brain is uniquely vulnerable, and long-term effects may include impaired cognitive function and increased susceptibility to other substance use. Additionally, toxicants in vape aerosols have been linked to lung disease and systemic inflammation, challenging the narrative of e-cigarettes as a "safer" alternative.

Beyond individual health risks, vaping's rise is deeply embedded in adolescent culture. As detailed by Groom et al. (2021), peer influence and social media are potent drivers of initiation. The normalization of vaping through friends and influencers increases the likelihood of experimentation and regular use, particularly in urban, higher-income, and non-Hispanic White and Latino populations. This indicates that vaping is not just a health issue, but a socio-behavioral trend reinforced by digital marketing and peer networks.

Policy interventions show promise but require more stringent enforcement. The study by Park-Lee et al. (2024) shows that a comprehensive ban on flavored products, stricter age verification, and robust online sale regulations could reduce adolescent vaping by nearly 87%. However, current partial restrictions allow companies to adapt and continue targeting youth. These findings support the implementation of nationwide, flavor-inclusive bans and consistent enforcement of the Tobacco 21 policy to limit access and appeal.

Overall, the review highlights a pressing need for coordinated public health responses, including policy reform, parent and school involvement, and youth-targeted cessation resources. Without decisive action, the widespread appeal of flavored e-cigarettes threatens to create a new generation addicted to nicotine, with long-term consequences for brain health, academic performance, and public well-being.

CONCLUSION

The widespread use of flavored e-cigarettes among adolescents poses a multifaceted threat to public health, particularly in the areas of neurodevelopment, addiction vulnerability, and respiratory health. What began as a cessation tool for adult smokers has been co-opted into youth culture, mainly due to the strategic use of flavor appeal, peer influence, and unregulated marketing. Studies demonstrate that adolescents are disproportionately drawn to flavored vape products and are at high risk for nicotine dependence, cognitive impairment, and long-term behavioral changes.

Despite existing policies such as flavor bans and Tobacco 21 laws, inconsistent enforcement and online loopholes continue to undermine their effectiveness. Prevention and intervention strategies must address the social and psychological drivers of youth vaping, integrate school and parental education, and implement more vigorous policy enforcement at both the federal and community levels. Ultimately, safeguarding the health and future of adolescents requires a united effort to dismantle the glamorization of vaping and restrict access to flavored nicotine products that endanger young lives.

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