



Trends and impacts of e-cigarette use among medical students at a private university in São Paulo, analysis of influencing factors and long-term health implications: A systematic review

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ABSTRACT

This article investigates the perception and use of e-cigarettes among medical students at a private university in São Paulo, exploring the influencing factors and associated long-term consequences. The objective is to carry out a critical synthesis of the available literature on the subject, identifying gaps and suggesting areas for future research. Using a systematic review, recent articles and studies were selected from academic databases such as PubMed, Scielo and Lilacs. The inclusion criteria included studies investigating the use of e-cigarettes among medical students, the factors that influence this use, and the health impacts. The results indicate that the popularity of e-cigarettes among medical students is driven by the perception that they are less harmful than conventional cigarettes, the diversity of flavors, and targeted marketing. However, the short- and long-term adverse health effects are significant, including respiratory problems, cardiovascular problems, and the risk of nicotine dependence. Peer influence, the availability of devices, and the lack of strict regulation all contribute to the increased use of these devices among medical students. The review highlights the need to implement effective educational campaigns and robust public policies to mitigate the risks associated with the use of e-cigarettes

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among medical students in São Paulo.

Keywords: Electronic cigarettes, Medical students, Influencing factors, São Paulo.

INTRODUCTION

In recent years, the use of electronic cigarettes, also known as e-cigarettes or vapes, has grown significantly, especially among teenagers and young adults. Initially promoted as a less harmful alternative to conventional smoking and as a smoking cessation tool, e-cigarettes quickly became popular due to their modern design, variety of flavors, and the perception that they are less harmful than traditional cigarettes (Rotta; Birth; Dal Prá, 2024). This phenomenon is concerning because youth represents a critical phase for physical and psychological development, where exposure to nicotine and other chemical components of e-cigarettes can have severe long-term impacts on health (Santos, 2020).

The choice of this topic is justified by the urgent need to better understand the specific impact of e-cigarettes on young people. Despite the growing popularity of these devices, there is a significant gap in the literature regarding their long-term effects and the factors that motivate young people to use them. Most existing studies focus on adults, leaving a limited understanding of the specific dynamics involving adolescents and young adults.

In addition to direct physical health impacts, such as respiratory and cardiovascular problems, there are growing concerns about the role of e-cigarettes as a gateway to conventional smoking. Studies indicate that young people who try e-cigarettes are more likely to start using conventional cigarettes later, which contradicts the initial purpose of these devices as a harm reduction alternative (Jones et al., 2023).

The complexity of the phenomenon is magnified by the influence of social factors, such as peer influence and aggressive marketing directed at young people. The widespread availability of the devices and the variety of attractive flavors also play a crucial role in their popularity among young people.

This study aims not only to investigate the prevalence and patterns of e-cigarette use among young people, but also to specifically identify the influencing factors that lead young people to initiate and continue the use of these devices. It is also intended to assess young people's perceptions of the risks and benefits of e-cigarettes compared to conventional cigarettes, as well as to examine the possible long-term consequences of e-cigarette use on young people's physical and mental health.



In addition to contributing to scientific knowledge on the subject, this study seeks to provide empirical data that can guide the formulation of more effective public policies and educational interventions aimed at mitigating the risks associated with the use of electronic cigarettes among young people.

HISTORY AND EVOLUTION OF ELECTRONIC CIGARETTES

E-cigarettes, also known as e-cigarettes or vapes, have emerged as an alternative to conventional cigarettes, promising a smoke-like experience with potentially less health harm. Although the history of electronic cigarettes is recent, its evolution has been rapid and impactful (Cerqueira, 2023).

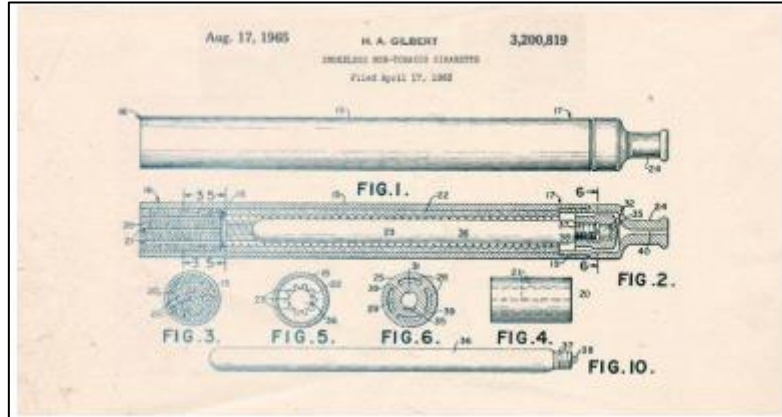
In 1963, Herbert A. Gilbert patented a device he called a "smokeless cigarette," heating a liquid solution to produce vapor. However, due to the lack of technology available at the time, Gilbert's invention was not commercialized and remained unknown for decades (INCA, 2016).

The significant turning point came in the twenty-first century, when technology enabled the viable commercial development of e-cigarettes. In 2003, Chinese pharmacist Hon Lik created the first modern e-cigarette, which used an ultrasound heating system to vaporize a liquid solution containing nicotine. Since then, the market for e-cigarettes has grown exponentially, especially after 2007, when they were introduced to the European and American markets (Cerqueira, 2023).

These devices have gained rapid popularity due to their portable design, diversity of attractive flavors, and the initial perception that they are less harmful than conventional cigarettes. However, recent research has raised concerns about the adverse health effects associated with e-cigarette use, especially among youth and adolescents, who are a vulnerable demographic group (INCA, 2016).

The history of e-cigarettes reflects not only technological advancements but also significant challenges in terms of regulation, public health, and consumer behavior. Understanding its evolution and impact is crucial to guide effective public health policies and educational interventions aimed at reducing the risks associated with its use, especially among younger people.

Figure 1. Patented Smokeless Tobacco Cigarette Design by Herbet A. Gilbert



Source: AMB, 2021

Modern e-cigarettes were invented in 2003 by Chinese pharmacist Hon Lik, inspired by the loss of his father to lung cancer and the search for a safer alternative to smoking. Hon Lik developed a device that used an ultrasonic piezoelectric element to vaporize a liquid solution containing nicotine (Cavalcante, 2018).

Starting in 2006, e-cigarettes began to expand into the European and North American markets. Initially, its design mimicked the shape of traditional cigarettes, which made it easier to accept among smokers. However, over time, these devices have evolved significantly. The first generation of e-cigarettes, known as "cigalikes", was followed by the introduction of more advanced devices, such as vape pens and mods (Glaser, 2022).

These new generations of devices offered greater control over power and vapor production, as well as the ability to customize the user experience with different liquids and flavors. Features such as rechargeable batteries, larger liquid tanks, and replaceable coils have become standard (Costa et al., 2022).

With the growing popularity of e-cigarettes, concerns have arisen regarding their safety and impact on public health. Governments and health agencies around the world have begun to implement regulations to control the production, marketing, and use of these devices. In Brazil, data from the 2018 VIGITEL survey showed a significant reduction in the number of smokers in recent years, with the current prevalence at 9.3%, while in the United Kingdom the prevalence of smokers of traditional cigarettes is 14.7% and e-cigarettes is 6.3% of the population (Brazil, 2019).

The National Health Survey conducted by the IBGE every five years in households also revealed a drop in the number of smokers in Brazil, with 14.7% of the population being smokers in 2013, compared to 34.8% in 1989 (Brasil, 2014).



This data highlights not only the technological evolution of e-cigarettes, but also the ongoing challenges in terms of regulation and public health policies to address their use and impact on society.

THE GROWING USE OF E-CIGARETTES AMONG YOUNG PEOPLE: IMPACTS, INFLUENCES, AND CHALLENGES

The dramatic increase in e-cigarette use among adolescents and young adults represents a paradigm shift in tobacco consumption. Recent studies indicate that the prevalence of e-cigarette use exceeds that of traditional tobacco in this age group, evidencing a worrying trend (Oliveira; Da Silva, 2022).

The perception of lower health risk is one of the main factors driving the use of electronic cigarettes among young people. The widespread misinformation that these devices are less harmful than conventional cigarettes, due to the absence of smoke and the variety of liquids with different nicotine contents, continues to be a significant attraction (Bispo, 2022). In addition, the availability of a wide range of flavors, ranging from fruity to sweet and minty, amplifies the attractiveness of these products, especially among young people sensitive to the sensory and aesthetic characteristics of the products (Gutecoski; Scallop; Biazon, 2023).

The social environment exerts a crucial influence on the adoption of e-cigarettes by young people. Introduction through friends or family facilitates the acceptance and normalization of these devices in social contexts, such as schools and youth events (Cavalcante, 2018). Additionally, social media platforms play a significant role in promoting and glamorizing the use of e-cigarettes, effectively reaching a young audience.

Although the e-cigarette industry promotes these products as "safer" alternatives to traditional smoking, scientific evidence highlights the risks associated with their use, especially among developing adolescents. The presence of nicotine in vaporized liquids can lead to dependence and negatively impact brain development (Torre, 2019).

In addition to immediate health risks, such as acute respiratory problems, there are growing concerns about the long-term impacts of e-cigarette use. Studies indicate that the use of these devices can serve as a gateway to conventional smoking, increasing the health risks associated with tobacco (Rodrigues, 2023).

Faced with these challenges, many nations have adopted measures to address the use of e-cigarettes among young people. These include severe restrictions on advertising, bans on sales to minors, and the implementation of comprehensive educational programs in schools and



communities (INOVA-HC-FMUSP, 2020). The complexity of the problem calls for continuous and adaptable approaches to mitigate the negative impacts of e-cigarettes on youth public health and promote healthy behaviors from an early age.

SHORT- AND LONG-TERM HEALTH IMPACTS OF E-CIGARETTE USE AMONG YOUNG PEOPLE: CHALLENGES AND PREVENTIVE APPROACHES

Although initially promoted as a less harmful alternative to conventional cigarettes, e-cigarettes present a range of risks that continue to be closely studied by the scientific community. In the short term, users often experience airway irritation due to inhaled chemical vapors, which can cause inflammation and increase airway resistance (d'Almeida et al., 2020). Recent studies also point to the possibility of immediate adverse effects on the cardiovascular system, such as increased blood pressure and heart rate, resulting from exposure to nicotine present in vaporized liquids (Pinto et al., 2020).

In addition to the direct physical impacts, there are significant concerns about the neurological and behavioral effects of e-cigarette use among young people. Exposure to nicotine during the period of brain development can negatively affect cognitive and emotional functions, potentially influencing academic performance and long-term psychological well-being (Santos et al., 2021). Nicotine dependence can also lead to additional risk behaviors, such as subsequent use of conventional cigarettes.

In the long term, the health impacts of e-cigarettes are still being investigated, but there are worrying indications about the potential development of chronic diseases. Epidemiological studies suggest that prolonged use may be associated with a higher incidence of chronic respiratory diseases, such as bronchitis and asthma, due to continuous exposure to irritants present in vapors (Pereira et al., 2024). Additionally, there are growing concerns about the impact of the chemical components of e-cigarettes liquids on lung function over time, potentially contributing to the development of conditions such as chronic obstructive pulmonary disease (COPD).

In the field of cardiovascular health, studies continue to investigate the effects of long-term use of e-cigarettes. Chronic exposure to nicotine and other toxic compounds in vapors can increase the risk of heart disease, including arteriosclerosis and hypertension, with potential impacts on vascular functioning and heart health (Oliveira; Da Silva, 2022). These risks are of particular concern among young people, whose usage habits can establish lasting health patterns throughout adulthood.



While e-cigarettes continue to be studied for a better understanding of their health impacts, it is crucial to implement robust preventive measures. This includes stricter regulatory policies, public education about the associated risks, and ongoing support for research to inform effective public health policies and interventions aimed at reducing use among young people.

METHODOLOGY

The methodology adopted for this narrative review aimed to comprehensively address the perception and use of e-cigarettes among young people, as well as to investigate the factors that influence this behavior and the potential short- and long-term health consequences. Initially, a targeted research question was formulated: "What are the perceptions, usage patterns, influencing factors, and health impacts associated with youth e-cigarette use?"

A systematic literature search was conducted in widely recognized academic databases, including PubMed, Scielo, and Lilacs, using specific search terms such as "e-cigarettes," "vaping," "adolescents," "young adults," "perception," "influencing factors," and "long-term consequences." The review focused on articles published between 2019 and 2024, ensuring the relevance and timeliness of the included studies.

Original articles, literature reviews, longitudinal and cross-sectional studies, and clinical trials that directly addressed the topics of interest were selected for analysis. Duplicate articles, editorials, and those that were not aligned with the specific objectives of the review were excluded to ensure the accuracy and focus of the analysis.

After the initial selection based on titles and abstracts, the selected articles were submitted to a complete and critical reading. The extraction of relevant data included information on the research design, sampling, methodology employed, main findings, and conclusions of the reviewed studies.

Data analysis was conducted in a narrative manner, organizing the findings into main thematic categories: prevalence and patterns of e-cigarette use among young people, behavioral and social influencing factors, and short- and long-term health consequences. This approach allowed not only to synthesize the available information, but also to identify gaps in knowledge and areas that need future research.

Finally, the narrative review discussed the implications of the findings for the development of public policies and clinical practices, emphasizing the importance of educational and regulatory strategies to mitigate the potential negative impacts of e-cigarette use among young people.



RESULTS

The narrative review on e-cigarette use among young people revealed a series of detailed results that highlight both the patterns of use and the health impacts associated with these devices. The comprehensive analysis of the selected studies showed that the use of e-cigarettes among adolescents and young adults is intrinsically linked to multiple influencing factors and has a series of consequences both in the short and long term.

Firstly, regarding the patterns of use, the studies reviewed point to a significant prevalence of vaping among young people, being motivated by the widespread perception that electronic cigarettes are less harmful to health than traditional cigarettes. This perception is reinforced by the availability of a wide range of attractive flavors and the facilitated accessibility of these devices through physical stores and online platforms. Peer influence and exposure to vaping behavior models in social contexts, such as schools and youth events, have also emerged as critical factors driving the use of these products among young people.

In terms of short-term health impacts, the reviewed studies highlight a number of adverse effects associated with vaping. Among the most common are irritation of the airways, manifested by persistent cough and respiratory distress, and the occurrence of acute symptoms such as nausea and dizziness, especially in new users. In addition, there are reports of cases of acute intoxication due to accidental ingestion of liquids from e-cigarettes, which can result in serious complications such as vomiting, tachycardia, and, in extreme situations, even seizures.

In the long term, concerns extend to potential chronic health impacts. Continuous exposure to the chemical components present in e-cigarette vapors raises serious concerns about the development of chronic respiratory diseases, such as bronchitis and chronic obstructive pulmonary disease (COPD). Studies also indicate an association between long-term use of e-cigarettes and an increased risk of developing cardiovascular problems, including hypertension and endothelial dysfunction.

In addition to the physical impacts, the review also addressed the psychosocial effects of e-cigarette use among young people. Psychological dependence on nicotine, even in smaller amounts and in vaporized forms, can negatively influence brain development in adolescents, affecting cognitive and behavioral functions essential for healthy growth.

The results of this narrative review provide a comprehensive and detailed overview of e-cigarette use patterns among young people, their influencing factors, and the substantial short- and long-term health impacts. These findings reinforce the importance of effective public policies, targeted education campaigns, and integrated prevention strategies to mitigate the risks



associated with vaping among young people and promote healthy youth development environments.

FINAL CONSIDERATIONS

It is essential to address the complexity and severity of e-cigarette use among young people, in light of the results of the reviewed research. E-cigarettes, although initially promoted as a less harmful alternative to conventional smoking, are associated with a number of health risks that cannot be underestimated. The literature review showed that young users of these devices face not only immediate problems, such as respiratory and cardiovascular problems, but are also at risk of developing nicotine dependence, which can negatively impact their physical and mental development.

Understanding the factors driving e-cigarette use among young people has revealed a complex interplay of social, cultural, and commercial influences. Curiosity, peer influence, aggressive marketing, and the misperception of lower risk are critical determinants in this scenario. Therefore, effective public policies must not only restrict the availability of these devices to young people, but also actively address marketing strategies that make them attractive to this age group.

In addition, the review underlined the urgent need for robust education campaigns that correct misinformation and provide accurate information about the real health risks associated with e-cigarette use. Such campaigns should be tailored to the characteristics and preferences of young people, using effective and accessible communication methods.

In the context of the implications for clinical practice and public policy, it is crucial that health professionals are well informed about the effects of e-cigarettes to guide appropriate prevention and cessation interventions. In parallel, it is essential to strengthen regulations that aim to limit young people's access to these products and restrict marketing practices that glamorize them.

An integrated approach that combines ongoing research, public education, effective regulation, and clinical interventions is essential to address the growing challenge of e-cigarette use among young people. Only with coordinated and multifaceted efforts will we be able to mitigate the negative impacts of these devices on the health of this population and promote safer and healthier environments for future generations.



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