



E-cigarettes Use among People Living with HIV: Prevalence, Health Impacts, and Behavioral Insights

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Authors' contributions

This work was carried out in collaboration among all authors. Author SA conceptualized, methodology, wrote original draft, reviewed and edited the manuscript, supervised the study. Authors TA and SR did the data extraction. All authors read and approved the final manuscript.

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ABSTRACT

Background: Electronic cigarettes (e-cigarettes) have gained popularity as an alternative to traditional tobacco smoking among people living with HIV (PLHIV). While e-cigarettes may offer harm reduction benefits, their impact on PLHIV is not fully understood.

Aim: This study aims to synthesize current research on e-cigarette use among PLHIV, focusing on prevalence, health impacts, mental conditions, perceptions, and attitudes.

Methods: A comprehensive search of PubMed, EMBASE, Web of Science, and PsycINFO databases was conducted. This search included studies from January 2003 to April 2024. We included observational and experimental studies that reported on e-cigarette use among adult PLHIV. Two reviewers independently screened titles, abstracts, and full texts, with data extraction using a standardized form.

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Results: Out of 33 initially identified articles, 4 met the inclusion criteria. The studies, conducted in the USA between 2019 and 2023, included 15,617 adults, with approximately 29.29% smokers and 3.08% e-cigarette users. Findings indicated significant e-cigarette use among PLHIV, ranging from 4% to 11% for daily users. Demographic factors influencing e-cigarette use included younger age, male gender, non-Hispanic white ethnicity, and higher education levels. Dual use of e-cigarettes and combustible cigarettes was common. Mental health issues, such as depression and panic disorder, were more prevalent among e-cigarette users. Health benefits included reduced cigarette consumption and improved respiratory symptoms.

Implications: The findings highlight the complex interplay between e-cigarette use, HIV progression, mental health, and overall well-being in PLHIV. These insights are crucial for developing targeted interventions and public health strategies to reduce smoking-related harm in this population.

Conclusion: E-cigarette use among PLHIV is prevalent and associated with both benefits and risks. Continued research is essential to monitor long-term health impacts and inform evidence-based guidelines and interventions tailored to the needs of PLHIV.

Keywords: E-cigarettes; HIV; electronic nicotine delivery system; people living with HIV.

ABBREVIATIONS

E-cig : E-cigarette

PLHIV : People Living with HIV

USA : United States

1. INTRODUCTION

Electronic cigarettes (e-cigarettes) have emerged as an alternative to traditional tobacco smoking, gaining popularity among various populations, including people living with HIV (PLHIV) [1,2]. As a group already vulnerable to numerous health complications, the use of e-cigarettes among PLHIV presents both potential benefits and risks that warrant careful consideration and investigation [3,4].

Tobacco smoking is highly prevalent among PLHIV, with rates significantly exceeding those in the general population [5]. This high prevalence of smoking contributes to increased morbidity and mortality in this population, exacerbating the health challenges already posed by HIV [6]. In this context, e-cigarettes have been proposed as a potential harm reduction tool, offering a less harmful alternative to combustible cigarettes and a possible aid in smoking cessation efforts [7].

However, the impact of e-cigarette use among PLHIV remains incompletely understood. While some studies suggest potential benefits in terms of smoking reduction and improved respiratory symptoms, others raise concerns about the long-term health effects, particularly in the context of HIV infection [8,9]. The complex interplay between e-cigarette use, HIV progression, mental health, and overall well-being in this population presents a significant gap in our current knowledge.

Understanding the prevalence, patterns, and implications of e-cigarette use among PLHIV is crucial for several reasons. Firstly, it can inform targeted interventions and public health strategies aimed at reducing smoking-related harm in this vulnerable population. Given the higher prevalence of smoking and the associated health risks among PLHIV, tailored interventions are essential. These interventions could include educational campaigns, cessation programs, and harm reduction strategies specifically designed to address the unique needs and challenges faced by PLHIV. By understanding how and why PLHIV use e-cigarettes, public health officials can develop more effective strategies to reduce overall tobacco use and improve health outcomes in this group.

Secondly, understanding these patterns can guide healthcare providers in offering evidence-based advice to PLHIV regarding e-cigarette use. Healthcare providers are often on the front lines of managing the complex health needs of PLHIV, and they require accurate, up-to-date information to provide appropriate guidance. Knowledge about the prevalence and motivations for e-cigarette use can help providers have informed discussions with their patients about the risks and potential benefits of e-cigarettes, particularly in the context of smoking cessation. This can lead to more personalized and effective treatment plans that consider both the physical and mental health aspects of nicotine dependence.

Lastly, this understanding can contribute to the broader discussion on the role of e-cigarettes in harm reduction and public health policy. As the

debate over the safety and efficacy of e-cigarettes continues, data specific to high-risk populations like PLHIV can provide valuable insights. This information can help shape regulatory policies and public health recommendations, ensuring they are inclusive of and responsive to the needs of all populations, including those with chronic health conditions like HIV. By contributing to this broader discussion, the findings of this study can help balance the potential benefits of e-cigarettes as harm reduction tools against their risks, leading to more nuanced and effective public health policies. Therefore, the aim of this study was to synthesize current research on e-cigarette use among PLHIV, focusing on prevalence, health impacts, mental conditions, perceptions and attitudes.

2. METHODOLOGY

We conducted a comprehensive search of major electronic databases, including PubMed, EMBASE, Web of Science, and PsycINFO. The search strategy employed a combination of MeSH terms and keywords related to e-cigarettes (such as "electronic cigarettes," "vaping," "e-cigs") and HIV (including "HIV," "AIDS," "people living with HIV"). We included studies published from the inception of e-cigarettes (approximately 2003) to April 2024. The search was limited to English-language publications. We considered various study designs, including observational studies (cross-sectional, cohort, and case-control) and experimental studies (randomized controlled trials) that reported on e-cigarette use among adult PLHIV (18 years and older).

Two independent reviewers screened titles and abstracts, followed by full-text review of potentially eligible studies. Disagreements were resolved through discussion or consultation with a third reviewer. Data extraction was performed using a standardized form developed for this narrative review. We collected detailed information on study characteristics (author, year, country, study design), e-cigarette prevalence, health outcomes associated with e-cigarette use, perceptions and attitudes towards e-cigarettes among PLHIV.

3. RESULTS

Our systematic search initially identified 33 articles. After removing 8 duplicates, 25 articles remained for title and abstract screening. This process excluded 13 articles, leaving 12 for full-

text review. After thorough assessment, 8 more articles were excluded, resulting in a final inclusion of 4 articles for our systematic review [10-13].

Across the four studies conducted in the USA between 2019 and 2023, a total of 15,617 adults participated, approximately 11,457 were male, and 4,160 were female. Approximately 29.29% of the total 15,617 adults across the studies were smokers, while about 3.08% were e-cigarette users. The results are summarized as follows:

3.1 Prevalence and Patterns of e-cigarette Use among PLHIV

3.1.1 Usage rates

Across the studies, there is a consistent finding of significant e-cigarette use among PLHIV, with rates varying from 4% to 11% for daily users. For instance, Hahn et al. Found 11% (n = 812) ever users and 4% (n = 264) daily users among 7,431 participants, [10] while Thorne et al. found 5.9% (n = 448) current users and 27.9% (n = 2105) ever e-cigarette user among 8,150 participants [11].

3.1.2 Demographic factors

Younger individuals, males, non-Hispanic whites, and those identifying as homosexual or gay show higher rates of e-cigarette use. Education level also plays a role, with higher usage among those with more than a high school education. For example, Thorne et al. Reported current e-cigarette use among PLHIV was about 2 times higher among males (6.7%, CI: 5.9 - 7.5), those who reported being homosexual or gay (8.0%, CI: 6.8- 9.1) or bisexual (6.4%, CI: 4.4, 8.4), White Americans (8.4%, CI: 7.3- 9.6). Current e-cigarette use was also highest among PLHIV diagnosis was <5 years ago (9.5%, CI: 7.6 - 11.4) compared with among those who were diagnosed >10 years ago (4.7%, CI: 4.0 - 5.4) [11].

3.2 Concurrent Use of Combustible Cigarettes and e-cigarettes

3.2.1 Dual use

Many PLHIV who use e-cigarettes also continue to use combustible cigarettes, indicating a pattern of concurrent use. Hahn et al. Noted that half of e-cigarette users (3,789 individuals) also used CCs [10].

3.2.2 Transition from combustible cigarettes

A significant portion of PLHIV using e-cigarettes report a reduction in or complete transition from combustible cigarettes to e-cigarettes. For instance, Cioe et al. Found that 36.8% (n = 7) of participants completely transitioned from combustible cigarettes to e-cigarettes [12].

3.3 Mental Health and E-cigarette Use

3.3.1 Mental health issues

Higher prevalence of depression and panic disorder among e-cigarette users compared to non-users suggests a potential link between e-cigarette use and mental health conditions. Hahn et al. Reported that 27% (2006 of 7431) of e-cigarette users had depression, and 21% (1560 of 7431) had panic disorder [10].

3.3.2 Self-medication

Hahn et al. Suggested the use of e-cigarettes among PLHIV may be partly driven by attempts to self-medicate for mental health issues [10].

3.4 Health Outcomes and Perceptions

3.4.1 Reduced cigarette consumption

E-cigarette use among PLHIV leads to significant reductions in daily cigarette consumption and exhaled carbon monoxide levels. For example, Yingst et al. Reported a 48% reduction in cigarettes per day during the cigalike e-cigarettes use period and a 55% reduction during the button-operated e-cigarettes use period [13].

3.4.2 Respiratory improvements

Users report improved respiratory symptoms, such as reductions in coughing, wheezing, and shortness of breath. Cioe et al. Noted significant declines in exhaled carbon monoxide levels from 15.7 to 6.68 parts per million (ppm) [12].

Table 1. Overview of the included studies in the review

Author, Year, Country	Study aim	Sample size	Study outcomes
Hahn et al. [10] 2023 USA	<ul style="list-style-type: none"> Examined demographics, e-cig usage patterns, depression, and panic symptoms among PLHIV 	7431	<ul style="list-style-type: none"> E-cigarette usage: 11% ever users, 4% daily users Demographic factors: Higher usage among males, non-Hispanic whites, and homosexual/gay individuals Dual use: 50% of e-cigarette users also used combustible cigarettes Mental health issues: 27% depression, 21% panic disorder Health outcomes: Significant reductions in daily cigarette consumption and improved respiratory symptoms
Thorne et al. [11] 2023 USA	<ul style="list-style-type: none"> Examined e-cig use prevalence, socio demographic, behavioral, and clinical characteristics. among PLHIV 	8150	<ul style="list-style-type: none"> E-cigarette usage: 5.9% current users Demographic factors: Higher usage among males (6.7%), non-Hispanic whites (8.4%), individuals aged 25-34 years (10.5%)
Cioe et al. [12] 2020 USA	<ul style="list-style-type: none"> Examined acceptability and health-related effects of e-cigs among PLHIV 	19	<ul style="list-style-type: none"> Health outcomes: 36.8% transitioned from combustible cigarettes to e-cigarettes, significant declines in exhaled carbon monoxide levels
Yingst et al. [13] 2019 USA	<ul style="list-style-type: none"> Examined acceptability of two types of e-cigs (cigalike vs button-operated) use among PLHIV 	17	<ul style="list-style-type: none"> Health outcomes: 48% reduction in cigarettes per day during cigalike use, 55% reduction during button-operated use

Abbreviations: E-cig, e-cigarette; PLHIV, people living with HIV; USA, United State

4. DISCUSSION

4.1 Contribution to Literature

This study significantly enhances the current understanding of e-cigarette use among PLHIV, addressing a critical gap in the literature. Previous research has primarily focused on the prevalence and general health impacts of e-cigarette use in the broader population, with limited attention to specific subgroups such as PLHIV. This study, however, delves into the nuanced behaviors and health outcomes associated with e-cigarette use within this vulnerable population, providing a more comprehensive view of how these devices are utilized and their effects.

Our review of e-cigarette uses among PLHIV in the USA found significant prevalence (4% to 11% daily use) and concurrent use with combustible cigarettes. E-cigarette users showed higher rates of depression and panic disorder, yet reported reductions in cigarette consumption and improved respiratory symptoms. Monitoring long-term health impacts is crucial.

Comparing our findings on e-cigarette use among PLHIV with studies focusing on smokers living with HIV reveals several nuanced insights. Studies like those by Hoang et al. and Gamarel et al. have extensively documented high rates of tobacco use among PLHIV, emphasizing the persistent challenges in smoking cessation efforts within this population [14,15] Similarly, our study highlights significant prevalence rates and patterns of dual use of e-cigarettes and combustible cigarettes among PLHIV, indicating ongoing nicotine dependence despite attempts to quit smoking. This overlap underscores the complex nature of tobacco and nicotine use behaviors among individuals with HIV, where traditional smoking cessation strategies may not fully address the evolving landscape of alternative nicotine products like e-cigarettes.

However, where our study specifically explores e-cigarette use among PLHIV, it introduces a newer dimension to the discussion by examining the adoption of these devices as potential harm reduction tools or alternative smoking cessation aids. This contrasts with studies focusing solely on combustible cigarette use among smokers with HIV, which primarily emphasize traditional cessation methods and their efficacy [16].

Moreover, both sets of studies converge on identifying mental health challenges such as depression and anxiety among smokers or e-cigarette users with HIV, suggesting common underlying factors influencing smoking behaviors and complicating cessation efforts. By comparing these findings, we gain a more comprehensive understanding of the diverse factors influencing tobacco and nicotine use behaviors among PLHIV. This insight is crucial for developing tailored interventions that address both substance use and mental health needs effectively within this vulnerable population, promoting holistic health outcomes.

In our review, Hahn et al, suggested that the use of e-cigarettes among PLHIV may be partly driven by attempts to self-medicate for mental health issues.¹⁰ This correlation supports the notion that individuals might be using e-cigarettes as a coping mechanism to manage their mental health symptoms. In contrast to previous studies that primarily focused on the physical health implications of e-cigarette use, our research sheds light on the psychological dimensions driving this behavior. For example, Lechner et al. found that adults who use e-cigarettes were more likely to report symptoms of depression and anxiety compared to non-users [17]. This dual perspective is crucial for developing comprehensive public health interventions. By acknowledging the role of mental health in e-cigarette use, healthcare providers can better address the underlying causes and offer more holistic support. This might include integrated treatment plans that combine smoking cessation efforts with mental health support, thus addressing both the physical and psychological needs of PLHIV.

One of the included studies in our review found a notable reduction in exhaled carbon monoxide levels with improvements in respiratory symptoms such as coughing, wheezing, and shortness of breath among PLHIV [12]. This significant reduction in carbon monoxide is indicative of improved respiratory function, as carbon monoxide is a known marker of oxidative stress and reduced lung health [18]. By lowering carbon monoxide levels, users likely experience less irritation and inflammation in the airways, contributing to the alleviation of these symptoms [19]. These improvements have significant implications for public health, particularly for individuals with respiratory conditions or those at

risk of developing them. The data suggests that interventions aimed at reducing carbon monoxide exposure could be beneficial in managing and improving respiratory symptoms. Further research is warranted to explore the long-term effects of these improvements and to identify additional factors that contribute to enhanced respiratory health in users.

4.2 Strengths and limitations

Our systematic review benefits from a comprehensive search strategy that rigorously covered major databases, ensuring a broad inclusion of relevant studies. The use of standardized data extraction methods further enhanced the consistency in reporting key variables across diverse study designs, thereby bolstering the robustness and applicability of our findings. However, our review also faces limitations. The generalizability of our findings is constrained as they primarily reflect data from studies conducted within the USA, limiting broader applicability to other geographic regions and populations. Moreover, the predominantly observational nature of most included studies restricts our ability to draw causal inferences or conduct longitudinal assessments of outcomes. Additionally, the relatively limited number of studies meeting our inclusion criteria narrowed the scope of synthesized findings, highlighting potential gaps in the existing literature.

4.3 Future Research Directions

Future research should prioritize longitudinal studies to assess the long-term health effects of e-cigarette use among PLHIV, offering insights into its impact on health outcomes and smoking behaviors over time. It is essential to include diverse populations beyond the USA in future studies to capture cultural and regional variations in e-cigarette use patterns and their implications. Qualitative methods should be integrated to delve deeper into the motivations and perceptions surrounding e-cigarette use among PLHIV, providing a richer understanding of the behavioral and psychosocial factors at play. Furthermore, comprehensive health impact assessments should be conducted, encompassing cardiovascular and respiratory outcomes among others, to establish a clearer risk-benefit profile of e-cigarettes specifically tailored to PLHIV. These research avenues are crucial for informing

evidence-based policies and interventions aimed at supporting smoking cessation efforts and promoting overall health among PLHIV worldwide.

5. CONCLUSION

Our systematic review provides a comprehensive exploration of e-cigarette use among PLHIV, synthesizing findings that highlight both the prevalence and complexities surrounding this emerging phenomenon. We have highlighted significant patterns of dual use with combustible cigarettes, identified associations with mental health conditions, and illuminated potential health benefits such as reduced cigarette consumption and improved respiratory outcomes. Continued research efforts are essential to inform evidence-based guidelines and interventions tailored to the unique needs of PLHIV who use e-cigarettes.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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