



Vaping and COVID-19 pandemic: changes in e-cigarette use and conclusions for the future – narrative review

Vaping i pandemia COVID-19: zmiany w używaniu e-papierosów i wnioski na przyszłość – przegląd narracyjny

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Abstract

Introduction and Objective. Electronic cigarettes (e-cigarettes) have become the most common form of nicotine consumption among adolescents and young adults. Little is known about the impact of government-imposed restrictions during the COVID-19 pandemic on the vaping behaviour of both adolescents and adults. This study aimed to explore scientific research concerning the prevalence of e-cigarette usage following the onset of the COVID-19 pandemic.

Review Methods. A systematic, comprehensive search of English-language literature in online databases (PubMed, Web of Science, Elsevier, Scopus, Google Scholar) was conducted from January 2023 – June 2023. A key word search was conducted for publications published from March 2020 when the COVID-19 pandemic was announced to December 2022.

Brief description of the state of knowledge. Most of the analyzed articles reported changes in e-cigarette use during the COVID-19 pandemic. The reasons for the increase in the use of e-cigarettes during the pandemic included: boredom, loneliness, stress caused by lockdown, and online purchases. The decrease in e-cigarette consumption is attributed to stay-at-home orders causing barriers to e-cigarette access, limited peer group gatherings, and increased time spent at home with the family. The Covid-19 pandemic also impacted attempts to stop the use of e-cigarettes.

Summary. Understanding the factors that influenced changes in e-cigarette use during the COVID-19 pandemic should be used to develop prevention programmes for adolescents and young adults. Educating young people and increasing knowledge about the harmful effects of using e-cigarettes may contribute to reducing the initiation of using e-cigarettes, and is a strong incentive to quit smoking.

Key words

use, e-cigarette, vaping, COVID-19

Abbreviations

COVID-19 – Coronavirus disease 2019, **EU** – European Union; **EVALI** – electronic cigarette or vaping product use-associated lung injury; **PRISMA** – Preferred Reporting Items for Systematic Reviews; **SARS-CoV-2** – severe acute respiratory syndrome coronavirus 2; **UK** – United Kingdom; **US** – United States

Streszczenie

Wprowadzenie i cel pracy. Elektroniczne papierosy (e-papierosy) stały się najpowszechniejszą formą zażywania nikotyny wśród młodzieży i młodych dorosłych. Niewiele wiadomo na temat wpływu ograniczeń nałożonych przez rząd podczas pandemii COVID-19 na zachowania związane z wapowaniem zarówno wśród nastolatków, jak i dorosłych. Celem tego badania było przeanalizowanie badań naukowych dotyczących rozpowszechnienia używania e-papierosów po wybuchu pandemii COVID-19.

Metody przeglądu. Systematyczne, kompleksowe przeszukiwanie literatury anglojęzycznej w internetowych bazach danych (PubMed, Web of Science, Elsevier, Scopus, Google Scholar) prowadzono od stycznia do czerwca 2023 roku. Wyszukiwanie według słów kluczowych przeprowadzono dla publikacji opublikowanych od marca 2020 roku, kiedy to została ogłoszona pandemia COVID-19, do grudnia 2022 roku.

Opis stanu wiedzy. Większość analizowanych artykułów raportowała zmiany w korzystaniu z e-papierosów w czasie pandemii COVID-19. Przyczyny wzrostu używania e-papierosów w trakcie pandemii były następujące: nuda, samotność, stres wywołany izolacją oraz możliwość łatwego nabycia ich w Internecie. Spadek konsumpcji e-papierosów przypisuje się nakazom pozostania w domu, powodującym bariery w dostępie do nich, ograniczonej liczby spotkań w grupach rówieśniczych i zwiększonej ilości czasu spędzanego w domu z rodziną. Pandemia COVID-19 wpłynęła również na próby zaprzestania używania e-papierosów.

Podsumowanie. Zrozumienie czynników, które wpłynęły na zmiany w używaniu e-papierosów podczas pandemii COVID-19, powinny zostać wykorzystane do opracowania programów profilaktycznych dla młodzieży i młodych dorosłych. Edukacja młodych ludzi i zwiększanie wiedzy na temat szkodliwych skutków używania e-papierosów może przyczynić się

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do ograniczenia inicjacji używania e-papierosów i stanowi silną zachętę do rzucenia palenia.

Słowa kluczowe

COVID-19, e-papieros, waporyzacja, używanie

INTRODUCTION AND OBJECTIVE

E-cigarettes, also known as electronic nicotine delivery system, have gained popularity as the predominant method of nicotine intake among teenagers and young adults [1,2]. Originating in 2003 in China [3], followed by launches in the United States (US) in 2006 [4], and Europe in 2005 [5], these devices have been marketed as ostensibly ‘safer’ substitutes for conventional tobacco smoking. These devices are promoted as smoking cessation tools, but e-cigarettes are rarely used for this purpose by young people [4]. Although electronic cigarettes show lower toxicity compared to cigarettes, they still contain harmful substances [6]. There are fears that e-cigarettes could become a ‘gateway’ to cigarette smoking [7, 8]. Studies indicate, that the use of electronic cigarettes by adolescents and young adults increases the risk that they will ever use combustible cigarettes [3].

Studies indicate that e-cigarettes contain high levels of toxic compounds [9] that adversely affect the cardiovascular, respiratory and gastrointestinal systems, [10, 11]. An increased risk of cancer cannot be ruled out [12]. Young people are often not informed about the ingredients of electronic cigarettes and the adverse effects of their use [4]. Lack of knowledge about electronic cigarettes among adults and youth is pervasive, with many being unaware that early exposure to nicotine increases the likelihood of lifelong nicotine addiction, and that the most popular devices provide higher levels of nicotine than traditional cigarettes [13].

E-cigarettes pose a public health risk as they are attractive to youth and maybe a first choice for nicotine initiation. The reasons that young adults and adolescents use e-cigarettes include social acceptance, curiosity, taste/flavourings, quick use, and lack of odour [1]. Research suggests that electronic cigarettes have a ‘gateway’ effect to cannabis use and combustible cigarettes [1, 4]. Smokers who do not engage in daily e-cigarette use demonstrate a higher likelihood of becoming chronic tobacco users compared to those who refrain entirely from vaping [14].

Numerous studies have shown that adolescents who smoke cigarettes and have experimented with electronic cigarettes are more inclined to start using traditional cigarettes later [7, 15–20]. Additionally, it suggests that electronic cigarette users are also more likely to use other substances [21]. Young people point to the appeal of e-cigarettes because of the flavours used and the flavourings added to the e-liquids used for vaping [1, 22]. Teens report vaping ‘everywhere’ in the school, including bathrooms, cafeterias, and stairwells [23].

The increasing prevalence of electronic cigarette usage among young adults and teenagers is frequently linked to sophisticated marketing strategies [24]. Research has indicated that higher exposure to advertising among the youth is associated with an increase in e-cigarette usage [25]. Notably, the most substantial levels of exposure occur through social media channels [2, 26] and within retail environments [27]. Adolescents perceive advertisements promoting flavoured e-liquids as directed towards their demographic rather than targeting older cohorts [28]. Such advertising endeavours engender the heightened allure and

proclivity to procure and sample e-cigarettes [29]. Notably, flavours play an important role in online marketing of electronic cigarettes [2], the sweet flavours especially increase the appeal of all e-cigarettes [30]. Among individuals who engage in e-cigarette usage, fruit-flavoured e-cigarettes (such as strawberry or cherry) emerge as the prevailing choice in terms of flavour preference [31]. New e-cigarettes (such as Pod and Pod-Mods) mimic common electronics, making them additionally attractive to young people [32]. The COVID-19 (coronavirus disease 2019) pandemic affected changes in daily life which included changes in e-cigarette use, especially among young adults [33] and adults.

Restrictions during the pandemic affected access to and use of e-cigarettes by young adults (bans on leaving home, limited social gatherings, and closing of tobacco stores) [34, 35]. Studies have shown changes in nicotine use related to availability (closing of some stores, malls) or ‘stay at home’ orders, resulting in a reduction of smoking/vaping. Other studies, however, indicate higher levels of smoking to reduce stress or loneliness at home [36]. To date, little is known about the impact of government-imposed restrictions during the COVID-19 pandemic on adolescent and adult e-cigarette use behaviour.

This review shows how the frequency of electronic cigarette use by young people and adolescents changed during the pandemic. Also examined are their associations with future intentions to quit using e-cigarettes. Understanding how e-cigarette use changed during the COVID-19 pandemic is important because it affects coping with e-cigarette use after the pandemic [33, 34].

REVIEW METHODS

Search Strategy. A systematic, comprehensive search of English-language literature in online databases (PubMed, Web of Science, Elsevier, Scopus, Google Scholar) was conducted from January 2023 – June 2023. A key word search was conducted for publications dating from March 2020 when the COVID-19 pandemic was announced, to December 2022. This date limitation was selected because of the announcement of the COVID-19 pandemic, and the resulting restrictions put in place during this period to prevent the spread of the disease. The reference lists of the included articles were manually searched to identify any articles not originally indexed in these databases.

The literature search used key words related to e-cigarette use during the pandemic, e.g. ‘e-cigarette’, ‘vaping’, ‘use’, and ‘COVID-19’. A total of 172 articles were found. Two researchers (ML and MZ) independently checked the titles, abstracts and full texts of the articles. The reference lists were then checked to identify other potentially eligible articles for review. A third researcher (DK) resolved any disagreements. Narrative review methodology and the established Cochrane rapid review process were used.

Selection criteria. The inclusion criteria for the articles are as follows: 1) the study designs included meta-analyses,

cross-sectional studies, case-control studies, and cohort studies of the connection between e-cigarette use and the COVID-19 pandemic, 2) they were available in English, 3) the research sample was greater than 20, 4) have been published in a peer-reviewed journal as a pre-print or report. As a result, 41 articles on electronic cigarette use during the COVID-19 pandemic were selected. Two reviewers approved inclusion of articles in the review, with excellent agreement ($k = 0.90$).

Exclusion criteria. Included duplicate articles, conference abstracts, reports, and commentaries issued before 2020, and publication in a language other than English. All articles were peer-reviewed.

Study criteria. Two researchers (ML and MZ) independently reviewed the titles of identified references and eliminated any irrelevant studies. One reviewer (ML) reviewed all abstracts and rated those which should be included in the review. A second reviewer (MZ) double-checked a random sample of 20% of the abstracts to ensure consistent application of the eligibility criteria.

The full text of the remaining studies was obtained and reviewed independently by two authors (ML and MZ) of the review. Any inconsistencies were resolved through discussion and intervention by a third (DK) independent author. Articles were displayed by summary and title. Duplicate and irrelevant items were excluded by the researchers. The remaining English-language manuscripts were subject to full-text review.

Various factors were taken into account when selecting studies, including authors, the main purpose of the study, year of publication, results and type of research. Finally, for the purposes of this review, the following information was obtained from each research: study population; outcome type (e-cigarette use, COVID-19), and results.

Study selection. 172 articles were initially searched. 41 articles met the eligibility criteria according to Preferred Reporting Items for Systematic Reviews (PRISMA), and addressed the change in the prevalence of e-cigarette use during the pandemic (Fig. 1). The research included

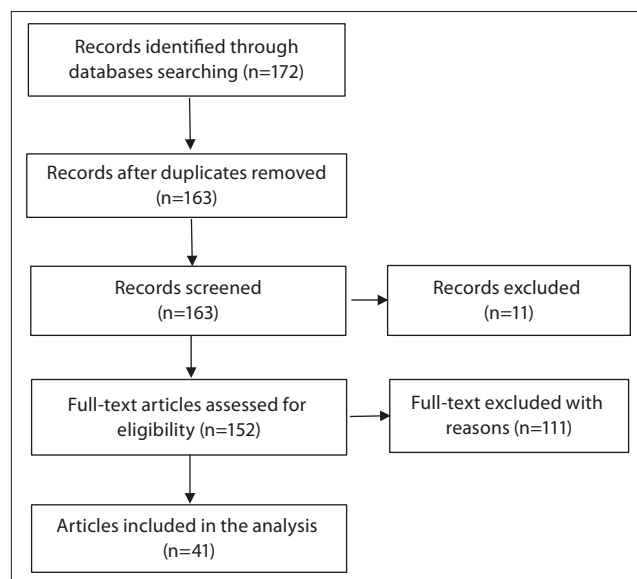


Figure 1. PRISMA Diagram of Study Selection

in the review covered the period from 2020 – 2022. Eight manuscripts were published in 2020, 19 in 2021, and 14 in 2022. All articles reported studies conducted on samples from one country, with most of the studies conducted in the United States ($n = 25$). The review also included studies from the United Kingdom ($n = 4$), Canada ($n = 3$), Italy ($n = 2$), Belgium ($n = 1$), Poland ($n = 1$), South Korea ($n = 1$), Iran ($n = 1$), China ($n = 1$), Iceland ($n = 1$), and Saudi Arabia ($n = 1$).

In total, 26 articles presented studies based on cross-sectional designs, 6 were based on longitudinal designs, 2 were cohort studies, 2 were screening studies, 1 was a qualitative study, 3 were interview studies, and 1 was a review. Additionally, 23 studies concerned adults, and 18 articles concerned young adults and adolescents.

BRIEF DESCRIPTION OF THE STATE OF KNOWLEDGE

Changes in the use of e-cigarettes. Of the 41 articles researching the prevalence and changes in electronic cigarette use during the COVID-19 pandemic, 15 reported an increase in e-cigarette use/vaping [37–51], while 16 studies found a decrease in e-cigarette use/vaping [52–67], and various changes in e-cigarette use were reported in 10 studies [68–77]. Table 1 shows selected studies.

Within the compendium of 41 articles, 16 studies demonstrate a decrease in e-cigarette use. This decrease in consumption is attributed to multifarious factors: stay-at-home directives causing barriers to e-cigarette access, limited peer-group gatherings, and increased time spent in the home with family. Especially blockades introduced at the start of the COVID-19 pandemic and staying indoors reduced e-cigarette use [62, 65].

E-cigarettes with restricted access to stores were more likely to report reduced e-cigarette use [55]. In contrast, in a study by Adriaens et al., one in seven pre-during lockdown returned partially or completely to smoking during lockdown [69].

The COVID-19 pandemic has also influenced attempts to quit e-cigarette use. Perceptions of risk play a significant role in influencing the use of electronic cigarettes. Tattan-Birch et al. reported that 12.2% of smokers who had recently attempted to quit smoking were motivated by COVID-19 [54], while Kalkhor et al. found that 41% of electronic cigarette users tried to quit because of the pandemic [73]. Streck et al. demonstrated that the pandemic led to an increased interest to quit smoking in 42% of individuals who use e-cigarettes, with 20% of them actually making quit attempts since the onset of the pandemic [70].

While the pandemic provided an incentive to quit smoking, it might also have prompted vapers to return to smoking. Popov et al. reported that transient smokers/e-cigarette users were wanted to quit due to concern about their health, but many felt that the stress of the COVID-19 pandemic was unbearable without the use of tobacco [64]. Participants who perceived risks to health from electronic cigarettes were more likely to have decreased or quit their use of e-cigarettes [50].

Thus, stress reduction or loneliness were one of the reasons for increase e-cigarette use [36]. Moreover, among analyzed studies, risk factors associated with vaping were: boredom and spending more time at home, possibility of online purchase, social substance-using occasions, opportunities to be away from the watchful eyes of parents/guardians (on-campus learning) [37,39,43,44].

Table 1. Changes in the prevalence of e-cigarette use during the COVID-19 pandemic

Authors, Year of Publication	Type of Study/ material	Country	Main objective	Prevalence of e-cigarette use
Gaiha, 2020 (1)	cross-sectional/ human	US	changes in the access and use of e-cigarettes since the beginning of the COVID-19 pandemic among adolescents and young adults	↓
Sokolovsky, 2021	longitudinal/ human	US	changes in tobacco use since campus closure, focusing on smoking and frequency of electronic nicotine vaping	↓
Tattan- Birch, 2020	cross-sectional/ human	UK	to estimate the links between reported COVID-19, e-cigarette use, and the extent to which COVID-19 prompted vaping, trying to quit smoking and smoking, and smoking more at home	↓ (11.2% attempts to quit)
Kreslake, 2020	cross-sectional/ human	US	to investigate whether the COVID-19 pandemic has affected e-cigarette use among young people	↓
White, 2021	screening survey/ human	US	assessing the relationship between risk perceptions of tobacco products for COVID-19, and changes in tobacco use since start of the pandemic	↑ (27,3%) ↓ (23,8%)
Klemperer 2020	cross-sectional/ human	US	changes in tobacco use among dual users and motivation to quit because of COVID-19	↓ (24.9%) ↓ (21.2% attempts to quit) ↑ (29,1%)
Hopkins, 2021	cross-sectional/ human	Canada	assessment of changes in e-cigarette use among adolescents and young adults in response to the COVID-19 pandemic	↓ no changes (55.3%)
Gallus, 2022	cross-sectional/ human	Italy	assessment of changes in e-cigarette use in comparison to usage patterns during the pandemic	↑
Caponnetto, 2020	cross-sectional/ human	Italy	assessment of changes in e-cigarette use during COVID-19, investigating smoking-related behaviour during the social distancing and stay-at-home policies for COVID-19	↑
Kalkhoran, 2021	cross-sectional/ human	US	analysis of changes in the use of flammable cigarettes and e-cigarettes among adults	↑ (23%) no changes (41%) ↓ (41% attempts to quit)
Adriaens, 2020	cross-sectional/ human	Belgium	assessing the impact of vaporizer shop closures on vaping and/or smoking behaviour among current vapers	↑ (25%) no changes (60%) ↓ (6% attempts to quit)
Hwang, 2022	cross-sectional/ human	South Korea	changes in the use of tobacco products during the COVID-19 pandemic	↑ (39.8%) no changes (33%) ↓ (27.2%)
Rosenthal, 2022	cross-sectional/ human	US	whether the use of cigarettes and e-cigarettes by young adults varies according to socio-demographic conditions, mental health, and the use of other substances	↑
Dumas, 2022	longitudinal/ human	Canada	investigate e-cigarette use during the COVID-19 pandemic	↑
Sylvestre, 2022	longitudinal/ human	Canada	examination of changes in substance use before and during the COVID-19 pandemic in young adults	↑
Sun, 2022	cross-sectional/ human	China	changes in tobacco use, intentions, and attempts to quit during the COVID-19 pandemic	↑ (5.2%) no changes (87.4) ↓ (7.5%)
Sharma, 2020	cross-sectional/ human	US	evaluation of the use of vaping products	↓ (44%)
Streck, 2021	cross-sectional/ human	US	assessing respondents' perceptions of COVID-19 risk from smoking or vaping, interest in quitting smoking, trying to quit, and changing tobacco consumption during a pandemic	↑ (27%) ↓ (20% attempts to quit)
Chaffee, 2021	cohort/ human	US	comparison of drug use and physical activity-related behaviours among adolescents before and after the reduction of staying at home	↓
Kalan, 2021	cross-sectional/ human	Iran	analysis of beliefs and behaviours related to tobacco use and COVID-19 infection	↓
Jackson, 2022	cross-sectional/ human	UK	to measure whether the prevalence and actual effectiveness of various smoking cessation aids has changed since the Covid-19 pandemic	↓
Case, 2022	interview/ human	US	how the COVID-19 pandemic affected young adults' perceptions and behaviours about vaping	↑ (54%)
Kale, 2022	longitudinal/ human	UK	assessing changes in smoking and vaping in the first year of the COVID-19 pandemic, identifying the factors associated with any changes, and examining whether COVID-19 acted as a source of motivation for smokers and vapers to quit	↓ (25% attempts to quit)
Gonzalez, 2021	screening/ human	US	whether smoking, e-cigarette use, and the rate of consumption of these products differed before and after the pandemic lockout order	↓
Giovenco, 2021	interview/ human	US	identification of the factors of change in the patterns of use and access to inhaled tobacco products during the initial COVID-19 'blockage' period	↓
Clendennen, 2021	cross-sectional/ human	US	assessment of the link between perceived stress and addiction and increased, decreased, or sustained use of marijuana, e-cigarettes, and cigarettes due to COVID in the last 30 days	↑ (34%) no changes (43%)

Table 1. Changes in the prevalence of e-cigarette use during the COVID-19 pandemic (continuation)

Authors, Year of Publication	Type of Study/ material	Country	Main objective	Prevalence of e-cigarette use
Popova, 2021	qualitative research, focus groups/ human	US	to investigate how smoking and vaping changed in the first year of the COVID-19 pandemic	↓
Denlinger-Apte, 2022	cohort/ human	US	assessment of changes in the use of cigarettes and e-cigarettes	↓
Thorisdottir, 2021	longitudinal, population-based study/ human	Iceland	mental health and substance use impacts of the COVID-19 pandemic	↓
Klein, 2021	interview/ human	US	changes in tobacco use among young adults	↑
BinDhim, 2021	cross-sectional/ human	Saudi Arabia	studying the prevalence of certain behavioural health risk factors, indirect risk factors, and chronic diseases at different time points in 2020	↑
Yingst, 2021	cross-sectional/ human	US	assessment of use frequency, reasons for the change in use, and attempts to quit smoking	↑
Wang, 2021	cross-sectional/ human	US	characteristics of e-cigarette use behaviour among adolescents	↑
Merz, 2020	cross-sectional/ human	US	how the COVID-19 pandemic changed e-cigarette user habits and risk perceptions	↑ (32%) no changes (58%) ↓ (10%)
Mantey, 2022	cross-sectional/ human	US, Texas	e-cigarette susceptibility or use analysis	↑
Gentzke, 2021	cross-sectional/ human	US	widespread use of tobacco products among adolescents	↑
Jankowski, 2022	cross-sectional/ human	Poland	assessment of the current prevalence and use patterns of tobacco and e-cigarettes	↑
Layman, 2022	review/ human	US	review of the literature on drug use trends among adolescents during the SARS-CoV-2 (COVID-19) pandemic	↓
Kale, 2021	cross-sectional/ human	UK	to investigate the link between vaping and self-reported diagnosed/suspected Covid-19; changes in vaping behaviour since Covid-19 and factors associated with these changes; as well as whether Covid-19 has motivated current or recent ex-vapers to quit	↑ (42%) no changes (48.3%) ↓ (9.7%)
Romm, 2022	longitudinal/ human	US	changes in tobacco and e-cigarette use among young adults before and during the COVID-19 pandemic and related risk/protection factors	↑ (23.2%) ↓ (28.6%)
Yang, 2021	cross-sectional/ human	US	changes in the use of any of the four tobacco products during the COVID-19 pandemic, including new initiation, quitting, switching, or changes in consumption levels	↑

↓ decrease of the prevalence, ↑ increase of the prevalence

DISCUSSION

The review centers on examining the prevalence of e-cigarette use and the shifts that occurred during the course of the COVID-19 pandemic. In numerous studies conducted during that time, an attempt was made to comprehend changes in health behaviours, including aspects such as alcohol consumption, smoking/vaping, substance use, dietary habits, physical activity. One of the main objectives of these researches was to understand the factors associated with changes in risky behaviour, especially among young people. Understanding the determinants of the prevalence of vaping is of paramount importance as it provides valuable information for the development of preventive programs.

These studies also contribute to identifying the risk and protective factors influencing health behaviours during such extraordinary circumstances as a pandemic. Preventive actions based on the findings of research can contribute to improving public health and mitigating the adverse health effects of the pandemic on society. The focus should be on providing education about the risks associated with

vaping and persuading society that they are not a healthier alternative to traditional smoking.

Among 41 studies, 15 showed an increase in e-cigarette use [37–51]. The reasons for this increase indicated in these articles were boredom, loneliness, stress caused by lockdown, possibility of online purchase or on-campus learning while far away from home.

Additionally, 10 of the studies demonstrated both increases and decreases in usage prevalence [68–77].

Vaping can be perceived as more socially acceptable than traditional smoking and may be considered a less harmful addiction. This perception may lead to the approval of e-cigarette use among young people by adults. There was a general attitude that e-cigarettes were younger, newer, modern, and marked as a cooler product. People also perceived e-cigarettes as less risky because of their role as a cessation product.

We need to be aware that there is a lack of information about e-cigarettes. In this context, individuals such as parents, educators, youth advocates, and healthcare providers play a crucial role in safeguarding young individuals from the adverse effects associated with tobacco products,

including e-cigarettes. In addition, healthcare providers in particular can enhance their patient screening practices by incorporating inquiries about the usage of all forms of tobacco products, including e-cigarettes. This approach allows for a more comprehensive assessment of consumption patterns of tobacco product, and facilitates targeted assistance for those individuals seeking to quit their tobacco product usage.

Perceiving a higher risk of both contracting COVID-19 and experiencing severe complications is linked to a greater motivation to quit smoking. This implies that the threat of COVID-19 may act as a strong incentive for smokers to seek cessation.

It is important not to downplay tobacco cessation initiatives because of the ongoing pandemic; in fact, there is a pressing demand for creative approaches to assist individuals who wish to quit smoking, especially during this challenging period.

Some factors have been shown to be effective in preventing substance use: restrictions on social gatherings, reduced substance availability and accessibility, and increased time spent at home with the family. It is probable that these factors have provided significant safeguards against substance use during the COVID-19 pandemic, as evidenced by the decrease in prevalence documented in the majority of the reviewed studies. The decreases in vaping during lockdown may be attributed to the shift in the social function of smoking among young people due to social isolation. Additionally, it could be linked to the higher probability of young smokers successfully quitting, when compared to older smokers.

However, the diverse measures implemented to curb the transmission of COVID-19, such as wearing mask, maintaining physical distance, and community lockdowns with limitations on social gatherings, may have adversely affected both mental health and social welfare. This impact could potentially lead to an increase in or worsening of substance use behaviours. Craig et al. reported that both mental health problems and substance use (with over 50% of youth engaging in some form of substance use in the past 90 days) among adolescents increased during the pandemic [78]. COVID-19 stress has also been found to be associated with substance use (alcohol use, binge drinking, cannabis use, and vaping), particularly when used alone [79]. In Canada, Chaiton et al. documented that the majority of individuals between the ages of 16–25 who engaged in substance consumption, exhibited an escalated pattern of substance use during the pandemic. Specifically, there was a net increase of +37% in the use overall of electronic cigarettes (e-cigarettes) during the COVID-19 pandemic [80].

Some mitigation measures were more drastic, such as border closures, city and town lockdowns, curfews, stringent restrictions on social gatherings, including religious services, limited access to workplaces and entertainment venues such as restaurants, theatres, and sports events, together with mandates for physical (or social) distancing and mask-wearing. In many locations these initiatives involved the closure of schools, limitations on youth services, such as sports clubs and extracurricular programmes, and the prohibition of social gatherings. Such restrictions could be effective in preventing risky behaviour by deprivation of the opportunity to use drugs or alcohol, etc. [37].

On the other hand, as a result of the COVID-19 pandemic, more people may have been thinking about their health,

and potentially thinking about quitting smoking/vaping. In addition, the overlapping awareness of the EVALI epidemic in the USA which caused lung injury through the illegal use of cannabis products in e-cigarettes, may have changed the perception of harm, as daily nicotine vaping decreased significantly between 2019–2020. Higher risk perceptions for COVID-19 were associated with reductions in tobacco use since the pandemic began for exclusive e-cigarette users and dual users [50, 68, 72, 77, 81–84]. These findings suggest that an increased perception of risks may lead to a reduction in e-cigarette use. Given the significant influence of risk perceptions on health behaviours, it is beneficial to provide education that connects vaping to health harms, such as lung damage. These results also imply that health professionals can utilize the pandemic as an opportunity to promote nicotine cessation, or at least reduce its use.

Based on 41 studies published to date, including the presented review, the overall results imply that the prevalence of e-cigarettes use in the initial period of the pandemic, decreased due to the lockdown and related e-cigarette purchase restrictions. However, these positive results of the overall decrease in e-cigarette use should be treated with some caution. Most studies indicate an increase in the prevalence of e-cigarette use during the COVID-19 pandemic among young adults and adolescents, as well as adults. More data is needed to better characterize how the COVID-19 pandemic may have affected e-cigarette use.

Public health implication. The COVID-19 pandemic and the implemented preventive measures introduced (orders and prohibitions) have had an impact on the demand and supply of e-cigarettes among adolescents and young adults. This review highlights the necessity for further research to comprehend how the COVID-19 pandemic has altered e-cigarette usage, and how it has presented opportunities for changing e-cigarette use behaviour. This information is crucial for devising effective solutions to decrease the use of e-cigarettes and other substances during future pandemics.

Essential public health protection measures should be implemented, such as prohibiting the sale of e-cigarettes to individuals under the age of 18, and imposing restrictions on the online sale of e-cigarettes. Raising awareness among youths about the effects of using e-cigarettes should be a key component of addiction prevention efforts. These findings should prompt governments to focus on implementing and promoting tobacco-free homes, and intensifying efforts to enforce the ban on smoking and the use of e-cigarettes in public places.

Recommendations for future research. This review suggests the need for further longitudinal studies to assess the latent and long-term impact of the COVID-19 pandemic on e-cigarette use behaviour among adolescents, young adults, and adults. Further research will allow possible meta-analyses of e-cigarette use during and after the COVID-19 pandemic. These analyses are essential for gaining a comprehensive understanding of how the pandemic affected e-cigarette use and to what extent, as well as for identifying the underlying causal factors.

Limitations of the study. Most of the studies featured in the presented review are cross-sectional studies in which exposure and effects are measured over the same period.

In several studies which used longitudinal designs and cohort designs, the measures of performance varied, and observations were of limited duration.

SUMMARY

Understanding the factors that influenced changes in e-cigarette use during the COVID-19 pandemic should be used to develop prevention programs for adolescents and young adults. Educating young people and increasing knowledge about the harmful effects of using e-cigarettes (not only during the pandemic) may contribute to reducing the initiation of using e-cigarettes, and is a strong incentive to quit smoking.

Data Availability Statement

Data sharing not applicable.

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Conflicts of Interest

The authors declare no conflict of interest

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