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Reasons why dual users of e-cigarette and conventional tobacco initiate or maintain dual use. A systematic review

Razones por las que los consumidores duales de cigarrillo electrónico y tabaco convencional inician o mantienen el consumo dual. Una revisión sistemática

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Abstract

Some smokers use electronic cigarettes (e-cigs) as an aid to quit smoking or as a harm reduction strategy. However, these smokers may end up using e-cigs and conventional cigarettes, becoming dual users. The main aim of this study was to assess the reasons why dual users use e-cigs. In addition, as a secondary objective, the conflicts of interest and funding of the included studies were analyzed.

Methods. A search was conducted in PubMed, EMBASE, Web of Science and PsychInfo databases until November 2023. Cross-sectional studies were selected that included dual users of conventional tobacco and e-cigs and analyzed the reasons for e-cig use. The Newcastle Ottawa Quality Assessment Scale was applied to assess the quality of the included studies.

Results. Fourteen studies were included. One assessed reasons for initiation, 12 for maintenance of use, and one assessed both separately. Reduction in the number of cigarettes smoked and the perception that e-cigs are less harmful were the main reasons for initiation and maintenance of use. Among the 10 studies that presented a conflict of interest statement, three had conflicts with the pharmaceutical industry. Information on funding was included in 12 studies, of which nine received public funding and one received funding from the pharmaceutical industry.

Conclusions. Identifying the reasons for e-cig use among dual users of e-cigs and conventional tobacco is fundamental for the design of smoking cessation programs and programs aimed at increasing the population's knowledge of new forms of consumption.

Keywords: electronic cigarettes, tobacco, dual consumer, conflicts of interest, funding

Resumen

Algunos fumadores utilizan los cigarrillos electrónicos (e-cigs) como ayuda para dejar de fumar o como una estrategia de reducción de daños. Sin embargo, pueden acabar consumiendo e-cigs y cigarrillos convencionales, convirtiéndose en consumidores duales. El objetivo principal de este estudio fue evaluar los motivos por los que los consumidores duales utilizan e-cigs. Además, como objetivo secundario, se analizaron los conflictos de intereses y la financiación de los estudios incluidos.

Métodos. Se realizó una búsqueda en las bases de datos de PubMed, EMBASE, Web of Science y PsychInfo hasta noviembre de 2023. Se seleccionaron estudios transversales que incluyeran consumidores duales de tabaco convencional y e-cigs y analizaran los motivos de uso de e-cigs. Se aplicó la *Newcastle-Ottawa Quality Assessment Scale* para valorar la calidad de los estudios incluidos.

Resultados. Se incluyeron 14 estudios. Uno valoró las razones de inicio, 12 las de mantenimiento del consumo de e-cigs, y uno valoró ambas separadamente. La reducción del número de cigarrillos fumados y la percepción de que los e-cigs son menos dañinos fueron las razones principales de inicio y mantenimiento de su consumo. Entre los 10 estudios que presentaron una declaración de conflictos de interés, tres tenían conflictos con la industria farmacéutica. En 12 estudios se incluyó información sobre la financiación, de los cuales nueve recibieron financiación pública y uno de la industria farmacéutica.

Conclusiones. Identificar los motivos de uso de e-cigs entre los consumidores duales de e-cigs y tabaco convencional es fundamental para el diseño de programas de deshabituación tabáquica y programas orientados a aumentar el conocimiento de la población en las nuevas formas de consumo.

Palabras clave: cigarrillos electrónicos, tabaco, consumidor dual, conflictos de interés, financiación

Electronic cigarettes (e-cigs) were first marketed in the early 2000s and their popularity has grown continuously since then, especially among younger people (Fadus et al., 2019). This increase in popularity could be related to the industry's strategy of promoting these devices both for smoking cessation as well as harm reduction (Ministerio de Sanidad, 2022). Some studies indicate that the dual use of e-cigs and conventional tobacco is an intermediate step between conventional smoking and non-smoking (Martínez-Loredo et al., 2022). According to data from the latest 2021 Eurobarometer report, 57% of e-cig users reported that they use them to reduce or quit smoking and 37% said they believe e-cigs to be less harmful than conventional cigarettes (European Commission, 2021).

To date, leading public health organizations such as the Centres for Disease Control and Prevention (CDC) indicate there is no evidence regarding the long-term effectiveness of e-cig use as a smoking cessation strategy (United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2020). Moreover, the possible long-term effects on human health have not yet been determined. However, some studies have concluded that e-cigs affect lung function, cause respiratory symptoms (Pisinger & Døssing, 2014; Wasfi et al., 2022) and increase the risk of heart disease (Skotsimara et al., 2019).

Despite the uncertainty generated around the effects of e-cigs and their use as an aid to smoking cessation, there are smokers who have replaced conventional cigarettes with e-cigs (Cornelius et al., 2022), either completely or partially. As a result, many become dual users of e-cigs and conventional tobacco. According to data from the 2021 Eurobarometer, 59% of e-cig users also smoke conventional cigarettes (European Commission, 2021) and in the United States, 37% of e-cig users are also conventional cigarette smokers (Cornelius et al., 2022). With reference to the negative effects of e-cigs on dual users, some studies have concluded that dual users of e-cigs and conventional tobacco increase their total dependence on nicotine (Martínez et al., 2020) and the addictive potential of e-cigs may be greater than conventional cigarettes (Jankowski et al., 2019). Although dual use can reduce conventional cigarette smoking, some studies have observed that it delays the decision to quit smoking completely (Flacco et al., 2019; Piper et al., 2019).

In addition to smoking cessation and harm reduction, other reasons have been identified that lead a conventional smoker to be an e-cig user, for example, out of curiosity, being able to use these devices in places where cigarette smoking is banned, or for a better taste (Kinouani et al., 2020; Simonavicius et al., 2017). Hence, it is necessary to know more about the motivations leading smokers to

be dual users. The aim of this study was to describe the reasons why tobacco smokers use e-cigs at the same time. In addition, potential conflicts of interest in the included studies were also assessed.

Methods

A systematic review was carried out following the recommendations of the 2020 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021). The review was registered in the International Prospective Register of Systematic Reviews (PROSPERO), with reference: CRD42023375505.

Literature search

A PubMed search was conducted in November 2022 and updated in November 2023. The search strategy used was: dual user* AND (ecig OR e-cigarette OR "Electronic Nicotine Delivery Systems"[Mesh] OR "Vaping"[Mesh]) AND (reason* OR opinion* OR "Public Opinion"[Mesh] OR belief* OR attitude*) NOT student*. This search was also replicated in EMBASE, Web of Science and PsychInfo including studies published up to November 2023. The search was not limited by study period or language. In addition, the references of the included articles were reviewed.

Inclusion and exclusion criteria

Cross-sectional studies were included whose participants were drawn from the general population, were aged 18 or older, dual users of conventional tobacco and e-cigs, and provided information on perceptions, motivations or reasons for the use of e-cigs. The studies included in the review involved conventional tobacco users who began using e-cigs or which included a population of dual consumers (of e-cigs and conventional tobacco) at the time of the survey. Studies were excluded if they focused on specific groups (i.e., population with a disease, or students), included children under 18 years of age, saw e-cigs as the gateway to conventional cigarettes, made predictions about the dual use of e-cigs and conventional tobacco, analyzed the results in a group of dual users with a specific characteristic (i.e., willingness to pay an amount of money for an e-cig). Studies published in languages other than English or Spanish were also excluded, as were editorials, conference papers, letters to the editor and opinion articles.

Study selection

The selection of articles was carried out independently by three researchers. Titles and abstracts were reviewed to select potentially relevant studies, and these were read in full text to select those that met the inclusion/exclusion criteria. Discrepancies were resolved by consensus.

Data extraction

An ad hoc Excel spreadsheet was created to document the information from each record. Data were extracted by two researchers independently, and discrepancies were discussed with a third researcher until agreement was reached.

The information recorded included the name of the first author, the journal of publication, the year of publication, the scope of the study, the year of the study, the age and sex of the participants, the information gathering method, the type of response (open/closed), the definition of user or dual user employed, the sample size of dual users and the reasons for using e-cigs.

The reasons for using e-cigs were classified into 11 main categories: smoking cessation, reduction in tobacco use, less harmful to health, perception of health benefits, greater acceptance, fun or curiosity, behaviour imitation, cheaper, more attractive (includes better taste, smell or design), fewer restrictions than tobacco, and other reasons (including reasons not related to the categories above). More detailed information on the reasons included in each category for each of the studies can be found in Annex 1 of the Supplementary material.

Regarding conflicts of interest on the part of the authors while conducting the study, the presence or otherwise of conflicts was noted (Yes/No) and, if any, whether the conflicts were with the pharmaceutical, tobacco or e-cig industries (Yes/No). The definition of conflict of interest proposed by the Association of American Medical Colleges (AAMC) was used, in which conflict of interest is understood as a situation in which financial considerations or other personal considerations could compromise, or have the appearance of compromising, the judgment of a researcher when conducting or communicating research (Petersdorf, 1990). To this end, it was verified that these conflicts were declared in the corresponding section and/or in the acknowledgments or in the funding section.

In relation to funding received to carry out the study, information was collected on whether the study received funding (Yes/No), the source of funding (university, government/public institution, pharmaceutical industry, tobacco industry, e-cig industry, other sources) and type of funding (scholarship/project, donation, other).

Study quality assessment

Quality assessment of the studies included was performed by two researchers independently. The scale used was the Newcastle-Ottawa Quality Assessment Scale (Modesti et al., 2016) for studies with a cross-sectional design. The maximum score is 10 points, with scores between 0 and 4 points reflecting unsatisfactory quality, 5-6 satisfactory quality, 7-8 good quality, and 9-10 very good quality. Discrepancies were resolved by consensus.

Results

After reviewing the titles and abstracts of the 228 publications initially identified, 42 full-text publications were assessed. Finally, 14 studies met the inclusion criteria and were included in the study (Figure 1).

Characteristics of the studies included

The 14 studies involved 6,845 dual users. Of the 14 studies, seven (50.0%) were conducted in the United States (Harlow et al., 2022; Harrell et al., 2015; LeVault et al., 2016; Morgan et al., 2020; Rass et al., 2015; Rhoades et al., 2019; Temourian et al., 2022), three (21.4%) in Germany (Adriaens et al., 2017; Rütther et al., 2016; Schoren et al., 2017), one (7.1%) in France (Couraud et al., 2018), one (7.1%) in the United Kingdom (Simonavicius et al., 2017), one (7.1%) in Mexico (Zavala-Arciniega et al., 2021) and one (7.1%) in the Netherlands (Romijnders et al., 2019). All studies were published between 2015 and 2023. Two studies (13.3%) explained the reasons for starting e-cig use (Adriaens et al., 2017; Schoren et al., 2017) and 13 studies (86.7%) focused on the reasons for continuing e-cig use (Adriaens et al., 2017; Couraud et al., 2018; Harlow et al., 2022; Harrell et al., 2015; LeVault et al., 2016; Morgan Snell et al., 2020; Rass et al., 2015; Reitsma et al., 2021; Rhoades et al., 2019; Romijnders et al., 2019; Rütther et al., 2016; Simonavicius et al., 2017; Temourian et al., 2022) (Table 1). One study (Adriaens et al., 2017) was counted twice because it analyzed the motivations for starting and maintaining e-cig use separately. The study by Rütther et al. (2016) assessed different scales that analyzed aspects related to e-cigs, which include several reasons why dual users smoke e-cigs. These scales are the positive scale, social norms scale, and motivation/intention to quit scale.

Characteristics of the included population

Most studies included a population ≥ 18 years of age with no upper age limit (Adriaens et al., 2017; Harlow et al., 2022; Harrell et al., 2015; LeVault et al., 2016; Morgan Snell et al., 2020; Rass et al., 2015; Rhoades et al., 2019; Romijnders et al., 2019; Rütther et al., 2016; Schoren et al., 2017; Simonavicius et al., 2017; Zavala-Arciniega et al., 2021), except in the study by Couraud et al. (2018), which used a defined age range (40-75 years). Regarding sex, the percentage of women was greater than 50% in five studies (35.7%) (Couraud et al., 2018; Morgan Snell et al., 2020; Romijnders et al., 2019; Schoren et al., 2017; Simonavicius et al., 2017), and one study (7.1%) (Rhoades et al., 2019) failed to provide information regarding the sex distribution of participants.

Results on the reasons for being a dual consumer

In the two studies (Adriaens et al., 2017; Schoren et al., 2017) assessing the reasons for starting to use e-cigs, the main reasons found were different. In the study by Adriaens

Figure 1
Flow diagram of the studies included

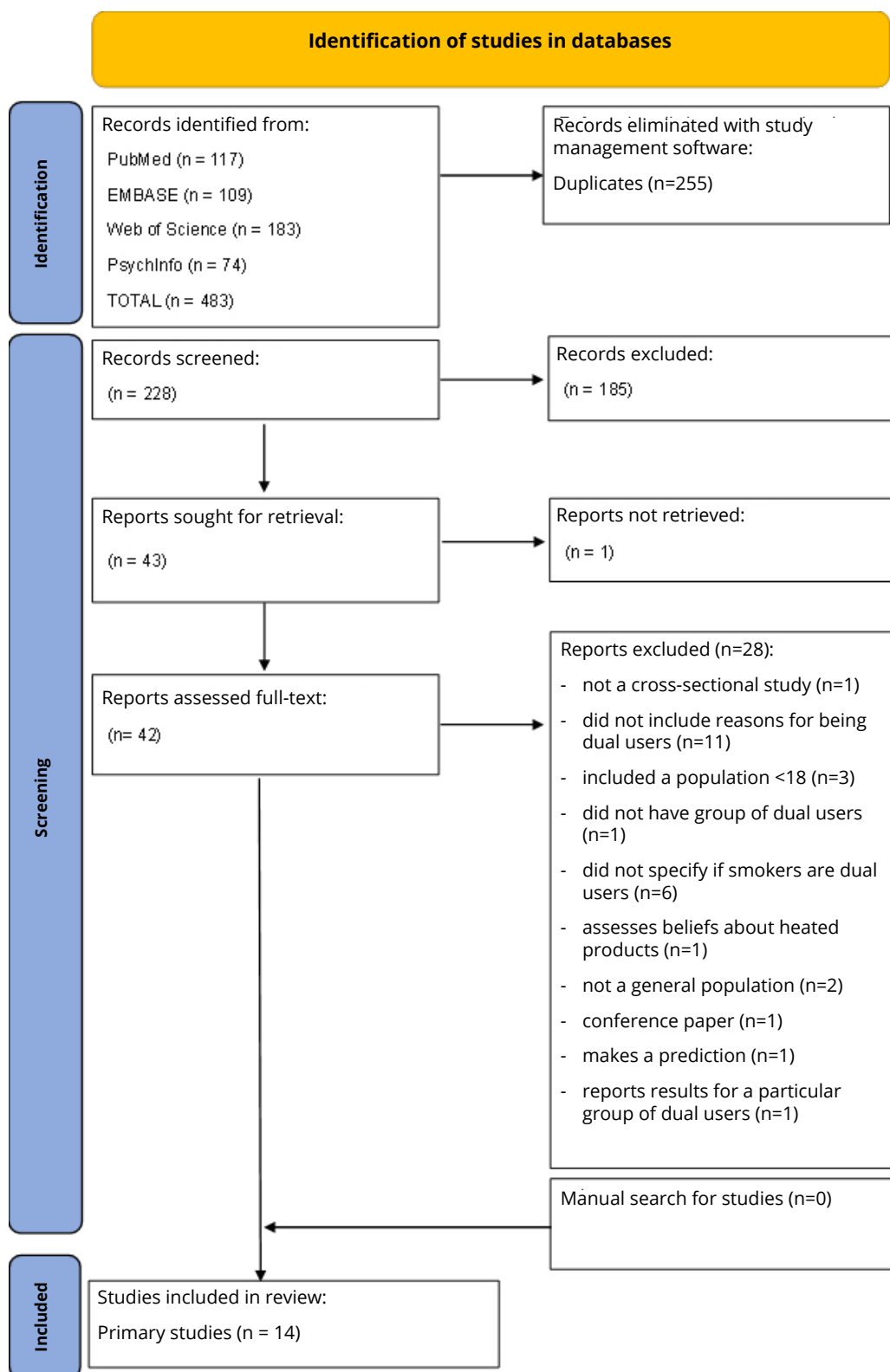


Table 1
Main characteristics of the studies included

Author and year of publication	Study period	Country	Age (years)	Sex	Information collection method	Dual users sample size	Dual user definition
Harrell, 2015	2013	United States	18 or over	W: 30.2%; M: 69.8% (dual users)	Online survey	381	Smoking e-cigs and conventional cigarettes in the last 30 days
Rüther, 2015	2012	Germany	18 or over	W: 34.4%; M: 65.6% (dual users)	Survey	96	n/s
Rass, 2015	2014	United States	18 or over	W: 47.0%; M: 53.0%	Online survey	350	Smoking e-cigs and conventional cigarettes in the last week*
LeVault, 2016	2014	United States	18 or over	W: 49.0%; M: 51.0%	Survey	122	n/s
Adriaens, 2017	2016	Germany	18-73 (mean: 43.0)	W: 25.0%; M: 75.0%	Online survey	40	Smoking e-cigs and conventional cigarettes at time of survey
Schoren, 2017	2014	Germany	18-65	W: 61.2%; M: 38.8%	Online survey	83	Smoking e-cigs and conventional cigarettes at time of survey
Simonavicius, 2017	2016	United Kingdom	18 or over	W: 54.2%; M: 45.8%	Online survey	289	Smoking e-cigs and conventional cigarettes at time of survey
Couraud, 2018	2014	France	40-75	W: 50.4%; M: 49.6%	CATI interview	74	Smoking e-cigs and conventional cigarettes at time of survey
Romijnders, 2019	2016	Nether-lands	18 or over	W: 56.9%; M: 43.1%	Online survey	80	n/s
Rhoades, 2019	2016	United States	18 or over	n/s	Survey	44	Smoking e-cigs and conventional cigarettes at time of survey
Morgan, 2020	2015-2016	United States	18 or over	W: 95.0%; M: 05.0%	Survey	1026	Smoking e-cigs and conventional cigarettes in last 30 days
Zavala, 2022	2018-2019	Mexico	18 or over	W: 45.2%; M: 54.8% (dual users)	Online survey	954	Smoking e-cigs and conventional cigarettes in last month
Harlow, 2022	2016-2018	United States	18 or over	W: 46.1%; M: 53.9%	CAPI interview	1544	Smoking e-cigs and conventional cigarettes at time of survey
Temourian, 2022	2020	United States	305 (mean)	W: 31.1%; M: 69.9%	Online survey	1762	Smoking e-cigs and conventional cigarettes in last month

Note. Abbreviations: CAPI computer-assisted personal interviewing, CATI computer-assisted telephone interviewing, e-cigs electronic cigarettes, M men, W women, n/s not specified.
* Users had to be using both products for at least 3 months.

Table 2
Reasons indicated in each of the included studies for why dual users of e-cigs and conventional tobacco start or continue using e-cigs

Main categories of reasons for electronic cigarette use												
Author	Smoking cessation	Reduction of tobacco use	Less harmful to health	Perception of health benefits	More accepted	Fun or curiosity	Behavior imitation	Cheaper	More attractive	Fewer restrictions than tobacco	Other reasons	Main reason
Reasons for starting e-cig use												
Adriaens et al. 2017	X	X	X		X	X	X	X		X		Smoking cessation
Schoren et al. 2017	X	X	X					X	X	X	X	Less harmful to health
Reasons for continuing e-cig use												
Harrell et al. 2015	X			X					X		X	Satisfaction and better taste
Rüther et al. 2015	X	X	X					X		X	X	Positive attitude scale*
Rass et al. 2015	X	X	X	X				X	X	X	X	Less harmful to my health
LeVault et al. 2016	X	X										Smoking cessation and reduction of tobacco use
Adriaens et al. 2017	X	X	X		X		X	X		X	X	Reduction of tobacco use
Simonavicius, et al. 2017	X	X				X		X		X	X	Reduction of tobacco use
Couraud et al. 2018	X	X										Reduction of tobacco use
Romijnders et al. 2019			X			X				X	X	Less harmful to health
Rhoades et al. 2019		X	X	X			X	X	X	X	X	Reduction of tobacco use
Morgan et al. 2020	X	X								X		Reduction of tobacco use
Temourian, et al. 2022	X	X				X				X	X	Fun
Harlow et al. 2022	X	X	X		X			X	X	X	X	Less harmful to health
Zavala et al. 2022	X	X	X	X	X	X		X		X		Less harmful to health
Total	13/15	13/15	9/15	4/15	4/15	5/15	3/15	9/15	5/15	12/15	10/15	

Note. There are 15 studies in the table because the study by Adriaens et al. is counted twice since it assessed reasons for both starting and maintaining use.

*Positive attitude scale includes: to save money, to feel healthier, because it is easy to use, because I can vape a liquid without nicotine content, because it is better for the environment, because I can vape anywhere, to reduce tobacco use, to satisfy my need for nicotine, to quit smoking, because e-liquid is less harmful to my health, to avoid harming the health of those around me, to deal with nicotine addiction.

Table 3
Conflicts of interest and funding in the studies included

	COI present	The study had funding	Source of study funding	Type of funding
Reasons for starting e-cig use				
Adriaens, 2017	No	No	n/a	n/a
Schoren, 2017	No	Yes	University	Not stated
Reasons for maintaining e-cig use				
Harrell, 2015	Yes, pharmaceutical industry	Yes	Government/public institution	Grant/project
Rüther, 2015	Yes, pharmaceutical industry	No	n/a	n/a
Rass, 2015	No COI section	No funding section	n/a	n/a
LeVault, 2016	No COI section	Yes	Government/public institution	Grant/project
Simonavicius, 2017	No	Yes	Government/public institution	Grant/project or donation
Couraud, 2018	Yes, pharmaceutical industry	Yes	Pharmaceutical industry	Not stated
Romijnders, 2019	No	Yes	Government/public institution	Grant/project
Rhoades, 2019	No	Yes	Government/public institution	Grant/project
Morgan, 2020	No COI section	Yes	Government/public institution	Grant/project
Temourian, 2022	No	Yes	University	Grant/project
Harlow, 2022	No	Yes	Government/public institution	Grant/project
Zavala, 2022	No COI section	No funding section	n/a	n/a

* Note. COI: conflicts of interest, n/a: not applicable.

et al. (2017), the main reason was the belief that e-cigs had more advantages than other smoking cessation aids, while being less harmful to health was the main reason found in Schoren et al. (2017) (Table 2).

A variety of reasons was found in the 13 studies that assessed the reasons for continuing to use e-cigs. In five studies (38.4%) (Adriaens et al., 2017; Couraud et al., 2018; Morgan Snell et al., 2020; Rhoades et al., 2019; Simonavicius et al., 2017) the main reason was to reduce tobacco use. In four studies (30.8%) (Harlow et al., 2022; Rass et al., 2015; Romijnders et al., 2019; Zavala-Arciniega et al., 2021) the fundamental reason was related to the belief that e-cigs are less harmful, either for the user themselves or for the people around them. In one study (7.7%), the main reason was for fun (Temourian et al., 2022), and in another (7.7%) for greater satisfaction and better taste (Harrell et al., 2015). In the study by Rüther et al. (2016) (7.7%), the reasons were to quit smoking, health reasons and others, assessed jointly. In the study by LeVault et al. (2016) (7.7%) the main reasons were to quit smoking and reduce tobacco use, which were also assessed together. The remaining reasons collected in the studies assessing continued e-cig use are shown in Table 2, and the more detailed results of each study on the reasons analyzed are presented in Annex 1 of the supplementary material.

Conflicts of interest and funding

Nine studies (64.3%) had a section for declaring conflicts of interest (Adriaens et al., 2017; Couraud et al., 2018; Harlow et al., 2022; Rhoades et al., 2019; Romijnders

et al., 2019; Rüther et al., 2016; Schoren et al., 2017; Simonavicius et al., 2017; Temourian et al., 2022). In one study (7.1%), conflicts of interest were declared in the Acknowledgments section (Harrell et al., 2015) and in four (28.6%) no declaration of conflicts of interest was found in any section (LeVault et al., 2016; Morgan Snell et al., 2020; Rass et al., 2015; Zavala-Arciniega et al., 2021) (Table 3).

Of the total of ten studies that declared the existence or otherwise of conflicts of interest, three studies (30.0%) had conflicts with the pharmaceutical industry (Couraud et al., 2018; Harrell et al., 2015; Rüther et al., 2016) and seven (70.0%) declared they had no conflicts of interest (Adriaens et al., 2017; Harlow et al., 2022; Rhoades et al., 2019; Romijnders et al., 2019; Schoren et al., 2017; Simonavicius et al., 2017; Temourian et al., 2022) (Table 3). The conflicts of interest identified were receiving honoraria, grants or subsidies for research, carrying out consultancies or participating in presentations. No differences were found in the conclusions of the studies reporting no conflicts of interest compared to those that did.

In ten studies (71.4%), funding was reported for the purpose of carrying out the study. In seven studies (70.0%) the funding was received as a scholarship/project, in one study (10.0%) as a scholarship/project and donation, and in two (20.0%) the type of funding was not specified. Two studies did not include a funding section (Rass et al., 2015; Zavala-Arciniega et al., 2021). No differences were found in the conclusions of the studies that indicated having received funding compared to those that declared they had not received it.

Study quality assessment

Five studies (35.7%) were classified as being of unsatisfactory quality because they scored between three (Adriaens et al., 2017; Rass et al., 2015; Rhoades et al., 2019; R  ther et al., 2016) and four (Romijnders et al., 2019) points out of ten, while 42.9% ($n = 6$) of the studies (Couraud et al., 2018; Harrell et al., 2015; LeVault et al., 2016; Schoren et al., 2017; Temourian et al., 2022; Zavala-Arciniega et al., 2021) were classified as satisfactory, scoring five points out of ten, while three studies (21.4%) (Harlow et al., 2022; Morgan Snell et al., 2020; Simonavicius et al., 2017) were of good quality, with seven points out of ten.

Discussion

The majority of the included studies show that the main reasons for using e-cigs are to reduce tobacco use and the belief that they are less harmful than conventional cigarettes. However, two studies assessing the reasons for e-cig maintenance found the main reason to be that smokers continued to use them for fun and for higher satisfaction and better taste. In relation to conflicts of interest, three studies presented conflicts of interest with the pharmaceutical industry, although the results and conclusions of these studies were similar to the others. In the majority of studies that reported receiving funding, this came from public organizations.

From the results of the studies reviewed, it can be deduced that smokers begin to use e-cigs as a method of smoking cessation, or with the aim of reducing conventional cigarette smoking. Participants consider that these products will have fewer negative effects on their health or that of the people around them. Recently published narrative reviews coincide with the results obtained in this review (Coleman et al., 2022; Kapan et al., 2020). In addition, other reasons for the use of these devices have been identified, such as the belief that they are less harmful, their lower prices, the fact that they can be used in places where smoking is prohibited, the control of withdrawal symptoms, reducing the exposure of other people to secondhand tobacco smoke, or the variety of flavours. These reasons were also noted in previous reviews (Coleman et al., 2022; Kapan et al., 2020).

Although one of the main reasons for using e-cigs is to reduce and quit tobacco smoking, dual users continue to smoke conventional cigarettes. They therefore continue to be exposed to the risks that come with smoking and are, in addition, exposed to the potential risks that can be identified in association with the e-cig use. Furthermore, some studies have analyzed the transition made by dual users over time, although the results are contradictory. While some studies observed that after two years, dual users began to use e-cigs exclusively or stopped smoking and using e-cigs (Mart  nez-Loredo et al., 2022), other studies showed that dual users

stopped using e-cigs but continued smoking conventional cigarettes (Coleman et al., 2019).

Different organizations have concluded that there is not enough evidence to demonstrate the effectiveness of e-cigs as a tool for smoking cessation or reduction (Krist et al., 2021; United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2020). This is in line with the conclusion reached in the latest Surgeon General report published in 2020 (United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2020) and in a Cochrane review (Hartmann-Boyce et al., 2021). Moreover, these reports also indicate the need for randomized clinical trials and observational studies, with follow-up times long enough to be able to establish the impact that these devices may have on smoking cessation.

At the European level, the European Commission, the Scientific Committee on Health, Environmental and Emerging Risks of the European Commission and medical societies such as the European Respiratory Society (ERS) also indicate that the available evidence on the effectiveness of these devices for quitting and reducing smoking is scarce (Bals et al., 2019; European Commission. Directorate-General for Health and Food Safety, 2021). The Spanish Society of Pneumology and Thoracic Surgery (SEPAR) issued a position paper on harm reduction strategies, in which they indicated that the effectiveness of e-cigs or heated tobacco to reduce the prevalence of tobacco smoking had not been demonstrated (Jim  nez Ruiz et al., 2022).

The fact that a large number of dual users indicate that their main reason for using e-cigs is related to reducing tobacco use should be taken into account. For example, in psychological therapy, which is the primary treatment of choice for quitting smoking, one of the main components consists of reducing nicotine and tar by changing to a brand of tobacco that has a lower concentration of both substances (Beco  a et al., 2014). However, many dual users are unaware of the existence of conventional cigarettes with different nicotine concentrations. Furthermore, another reason reported by many users is that they start or maintain using e-cigs because they are less harmful than smoking conventional cigarettes. However, as these devices were only recently introduced on the market, their long-term effects are unknown. The European Commission, the Scientific Committee on Health, Environmental and Emerging Risks of the European Commission has published a document in which they indicate that there is moderate evidence of the harmful health effects of e-cigs, especially on the cardiovascular system, and weak to moderate evidence indicating the risk of respiratory carcinogenicity associated with exposure to nitrosamines, acetaldehyde and formaldehyde (European Commission. Directorate-General

for Health and Food Safety, 2021). This type of information needs to be transmitted to the population to banish the idea that e-cigs are harmless.

In relation to conflicts of interest, this review found four studies which failed to include a conflict of interest statement. This could compromise the transparency that should be required for all scientific studies. Given the commercial interests involved in devices such as e-cigs, a section declaring conflicts of interest is essential. This present review identified three studies that declared conflicts of interest with the pharmaceutical industry, one of which had also received funding from it. It should be noted that in recent years, the tobacco industry has invested in or acquired several pharmaceutical companies (Sy, 2023). There is evidence that the existence of conflicts of interest affects the conclusions and the position that the authors of these studies may have, either in favour or against, in this case, the use of e-cigs (Hendlin et al., 2019). Nevertheless, the studies included in this review that presented conflicts of interest with the industry reported similar results and conclusions to those studies without conflicts of interest.

This study has some limitations. With the exception of one of the studies included (Rüther et al., 2016), no objective measures such as a CO measurement or cotinine determination were used to determine whether participants were actually smokers. Secondly, only studies with a cross-sectional design were included. Thirdly, the response options in all studies were closed, so other results may have been obtained if the participants had been able to answer open-ended questions. The main strength of this study is that it is a systematic review of the literature. Furthermore, the quality of the studies was assessed with a validated scale. An additional strength is that the potential conflicts of interest of the studies including the financing and economic ties of the authors with the industry were assessed exhaustively.

Dual users consume e-cigs to quit smoking, reduce tobacco use, and because they perceive them to be less harmful than conventional cigarettes. It is necessary to assess the messages related to e-cigs use that government and health organizations are transmitting. In this context, more research is also necessary to determine whether e-cigs are actually useful as a method of smoking cessation and reduction of tobacco use, as well as to assess their possible health effects, especially in the long term. There are also other reasons for e-cig use by dual users consume, such as for fun, because they can vape in places where tobacco smoking is forbidden or because of their flavours. These results highlight the importance of tightening how these devices are regulated and confirm the need for more scientific evidence regarding their health effects.

Conflict of interests

All authors declare that they have no conflicts of interest.

Supplementary material

Supplementary material can be requested from the authors.

References

- Adriaens, K., Van Gucht, D. & Baeyens, F. (2017). Differences between dual users and switchers center around vaping behavior and its experiences rather than beliefs and attitudes. *International Journal of Environmental Research and Public Health*, 15(1). <https://doi.org/10.3390/ijerph15010012>
- Bals, R., Boyd, J., Esposito, S., Foronjy, R., Hiemstra, P. S., Jiménez-Ruiz, C. A.,... Blasi, F. (2019). Electronic cigarettes: A task force report from the European Respiratory Society. *European Respiratory Journal*, 53(2). doi:10.1183/13993003.01151-2018
- Becona, E., Fernández del Río, E., López-Durán, A., Martínez Pradedá, U., Martínez-Vispo, C. & Rodríguez-Cano, R. (2014). El tratamiento psicológico de la dependencia del tabaco. Eficacia, barreras y retos para el futuro. *Papeles Del Psicólogo*, 35(3), 161–168.
- Coleman, B., Rostron, B., Johnson, S. E., Persoskie, A., Pearson, J., Stanton, C.,... Hyland, A. (2019). Transitions in electronic cigarette use among adults in the Population Assessment of Tobacco and Health (PATH) Study, Waves 1 and 2 (2013-2015). *Tobacco Control*, 28(1), 50–59. <https://doi.org/10.1136/tobaccocontrol-2017-054174>
- Coleman, S. R. M., Piper, M. E., Byron, M. J. & Bold, K. W. (2022). Dual use of combustible cigarettes and e-cigarettes: A narrative review of current evidence. *Current Addiction Reports*, 9(4), 353–362. doi:10.1007/s40429-022-00448-1
- Cornelius, M. E., Loretan, C. G., Wang, T. W., Jamal, A. & Homa, D. M. (2022). Tobacco product use among adults — United States, 2020. *MMWR Recommendations and Reports*, 71(11), 397–405. <https://doi.org/10.15585/mmwr.mm7111a1>
- Couraud, S., Cortot, A. B., Pivot, X. B., Touboul, C., Lhomme, C., Blay, J. Y.,... Greillier, L. (2018). Beliefs and behavior regarding e-cigarettes in a large cross-sectional survey. *Preventive Medicine Reports*, 10, 332–336. <https://doi.org/10.1016/j.pmedr.2018.04.009>
- European Commission. Directorate-General for Health and Food Safety. (2021). Opinion on electronic cigarettes.
- European Commission. (2021). Special Eurobarometer 506 attitudes of Europeans towards tobacco and electronic cigarettes. <https://doi.org/10.2875/490366>
- Fadus, M. C., Smith, T. T. & Squeglia, L. M. (2019). The rise of e-cigarettes, pod mod devices, and JUUL among youth: Factors influencing use, health implications, and downstream effects. *Drug and Alcohol Dependence*, 201, 85–93. doi:10.1016/j.drugalcdep.2019.04.011

- Flacco, M. E., Ferrante, M., Fiore, M., Marzuillo, C., La Vecchia, C., Gualano, M. R.,... Manzoli, L. (2019). Cohort study of electronic cigarette use: Safety and effectiveness after 4 years of follow-up. *European Review for Medical and Pharmacological Sciences*, 23(1), 402–412. https://doi.org/10.26355/eurrev_201901_16789
- Harlow, A. F., Cho, J., Tackett, A. P., McConnell, R. S., Leventhal, A. M., Stokes, A. C. & Barrington-Trimis, J. L. (2022). Motivations for E-cigarette use and associations with vaping frequency and smoking abstinence among adults who smoke cigarettes in the United States. *Drug and Alcohol Dependence*, 238, 109583. doi:10.1016/j.drugalcdep.2022.109583
- Harrell, P. T., Simmons, V. N., Piñeiro, B., Correa, J. B., Menzie, N. S., Meltzer, L. R.,... Brandon, T. H. (2015). E-cigarettes and expectancies: Why do some users keep smoking? *Addiction (Abingdon, England)*, 110(11), 1833–1843. <https://doi.org/10.1111/add.13043>
- Hartmann-Boyce, J., McRobbie, H., Butler, A. R., Lindson, N., Bullen, C., Begh, R.,... Hajek, P. (2021). Electronic cigarettes for smoking cessation. *Cochrane Database of Systematic Reviews*, 2022(9). <https://doi.org/10.1002/14651858.cd010216.pub6>
- Hendlin, Y. H., Vora, M., Elias, J. & Ling, P. M. (2019). Financial conflicts of interest and stance on tobacco harm reduction: A systematic review. *American Journal of Public Health*, 109(7), E1–E8. <https://doi.org/10.2105/ajph.2019.305106>
- Jankowski, M., Krzystanek, M., Zejda, J. E., Majek, P., Lubanski, J., Lawson, J. A. & Brozek, G. (2019). E-cigarettes are more addictive than traditional cigarettes-A study in highly educated young people. *International Journal of Environmental Research and Public Health*, 16(13). <https://doi.org/10.3390/ijerph16132279>
- Jiménez Ruiz, C. A., Solano-Reina, S., de Higes-Martínez, E., Cabrera-César, E., Sandoval-Contreras, R., Granda-Orive, J. I. de,... Rábade-Castedo, C. (2022). Documento de posicionamiento de la Sociedad Española de Neumología y Cirugía Torácica (SEPAR) ante las estrategias de reducción del daño del tabaco. *Open Respiratory Archives*, 4(2). <https://doi.org/10.1016/j.opresp.2022.100175>
- Kapan, A., Stefanac, S., Sandner, I., Haider, S., Grabovac, I. & Dorner, T. E. (2020). Use of electronic cigarettes in European populations: A narrative review. *International Journal of Environmental Research and Public Health*, 17(6). <https://doi.org/10.3390/ijerph17061971>
- Kinouani, S., Leflot, C., Vanderkam, P., Auriacombe, M., Langlois, E. & Tzourio, C. (2020). Motivations for using electronic cigarettes in young adults: A systematic review. *Substance Abuse*, 41(3), 315–322. <https://doi.org/10.1080/08897077.2019.1671937>
- Krist, A. H., Davidson, K. W., Mangione, C. M., Barry, M. J., Cabana, M., Caughey, A. B.,... Wong, J. B. (2021). Interventions for tobacco smoking cessation in adults, including pregnant persons: US preventive services task force recommendation statement. *JAMA*, 325(3), 265–279. <https://doi.org/10.1001/jama.2020.25019>
- LeVault, K., Mueller-Luckey, G., Waters, E., Foglema, A., Crumly, D. & Jenkins, W. (2016). E-cigarettes: Who's using them and why? *J Fam Pract*, 6, 390–397.
- Martínez-Loredo, V., González-Roz, A., Dawkins, L., Singh, D., Murphy, J. G. & MacKillop, J. (2022). Is e-cigarette use associated with persistence or discontinuation of combustible cigarettes? A 24-month longitudinal investigation in young adult binge drinkers. *Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco*, 24(7), 962–969. <https://doi.org/10.1093/ntr/ntac049>
- Martínez, Ú., Martínez-Loredo, V., Simmons, V. N., Meltzer, L. R., Drobes, D. J., Brandon, K. O.,... Brandon, T. H. (2020). How does smoking and nicotine dependence change after onset of vaping? A retrospective analysis of dual users. *Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco*, 22(5), 764–770. <https://doi.org/10.1093/ntr/ntz043>
- Ministerio de Sanidad. (2022). *Informe sobre los cigarrillos electrónicos. Situación actual, evidencia disponible y regulación*. 1–39. <http://www.cnpt.es/documentacion/publicaciones/4a0615f922e444ab5117990c3ede662e5ad64f098dfec2909e0fd3abed374295.pdf>
- Modesti, P. A., Reboldi, G., Cappuccio, F. P., Agyemang, C., Remuzzi, G., Rapi, S.,... Okechukwu, O. S. (2016). Cross sectional study Newcastle - Ottawa Quality Assessment Scale. *PLoS ONE*, 11(1), 1–2.
- Morgan Snell, L., Barnes, A. J. & Nicksic, N. E. (2020). A longitudinal analysis of nicotine dependence and transitions from dual use of cigarettes and electronic cigarettes: Evidence from waves 1–3 of the PATH Study. *Journal of Studies on Alcohol and Drugs*, 81(5), 595. <https://doi.org/10.15288/jsad.2020.81.595>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D.,... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372. <https://doi.org/10.1136/bmj.n71>
- Petersdorf, R. G. (1990). Guidelines for dealing with faculty conflicts of commitment and conflicts of interest in research. July 1990. Association of American Medical Colleges Ad Hoc Committee on Misconduct and Conflict of Interest in Research. *Academic Medicine : Journal of the Association of American Medical Colleges*, 65(7), 489–496.
- Piper, M. E., Baker, T. B., Benowitz, N. L., Koblin, K. H. & Jorenby, D. E. (2019). Dual users compared to smokers: Demographics, dependence, and biomarkers. *Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco*, 21(9), 1279–1284. <https://doi.org/10.1093/ntr/nty231>

- Pisinger, C. & Døssing, M. (2014). A systematic review of health effects of electronic cigarettes. *Preventive Medicine*, 69, 248–260. <https://doi.org/10.1016/j.ypmed.2014.10.009>
- Rass, O., Pacek, L. R., Johnson, P. S. & Johnson, M. W. (2015). Characterizing use patterns and perceptions of relative harm in dual users of electronic and tobacco cigarettes. *Experimental and Clinical Psychopharmacology*, 23(6), 494–503. <https://doi.org/10.1037/pha0000050>
- Reitsma, M. B., Kendrick, P. J., Ababneh, E., Abbafati, C., Abbasi-Kangevari, M., Abdoli, A.,... Zuniga, Y. H. (2021). Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: A systematic analysis from the Global Burden of Disease Study 2019. *The Lancet*, 397(10292), 2337–2360. [https://doi.org/10.1016/S0140-6736\(21\)01169-7](https://doi.org/10.1016/S0140-6736(21)01169-7)
- Rhoades, D. A., Comiford, A. L., Dvorak, J. D., Ding, K., Hopkins, M., Spicer, P.,... Doescher, M. P. (2019). Vaping patterns, nicotine dependence and reasons for vaping among American Indian dual users of cigarettes and electronic cigarettes. *BMC Public Health*, 19(1). <https://doi.org/10.1186/s12889-019-7523-5>
- Romijnders, K. A. G. J., Pennings, J. L. A., van Osch, L., de Vries, H. & Talhout, R. (2019). A combination of factors related to smoking behavior, attractive product characteristics, and socio-cognitive factors are important to distinguish a dual user from an exclusive e-cigarette user. *International Journal of Environmental Research and Public Health*, 16(21). <https://doi.org/10.3390/ijerph16214191>
- Rüther, T., Wissen, F., Linhardt, A., Dipl-Psych, D. S. A., Pogarell, O. & de Vries, H. (2016). Electronic cigarettes-attitudes and use in Germany. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, 18(5), 660–669. <https://doi.org/10.1093/ntr/ntv188>
- Schoren, C., Hummel, K. & de Vries, H. (2017). Electronic cigarette use: Comparing smokers, vapers, and dual users on characteristics and motivational factors. *Tobacco Prevention & Cessation*, 3(Abril). <https://doi.org/10.18332/tpc/69392>
- Simonavicius, E., McNeill, A., Arnott, D. & Brose, L. S. (2017). What factors are associated with current smokers using or stopping e-cigarette use? *Drug and Alcohol Dependence*, 173, 139–143. <https://doi.org/10.1016/j.drugalcdep.2017.01.002>
- Skotsimara, G., Antonopoulos, A. S., Oikonomou, E., Siasos, G., Ioakeimidis, N., Tsalamandris, S.,... Tousoulis, D. (2019). Cardiovascular effects of electronic cigarettes: A systematic review and meta-analysis. *European Journal of Preventive Cardiology*, 26(11), 1219–1228. <https://doi.org/10.1177/2047487319832975>
- Sy, D. (2023). *Tobacco industry's "wellness" tactic: Ethical dilemma and solutions*. doi:10.18332/tpc/159119
- Temourian, A. A., Song, A. V., Halliday, D. M., Gonzalez, M. & Epperson, A. E. (2022). Why do smokers use e-cigarettes? A study on reasons among dual users. *Preventive Medicine Reports*, 29, 101924. <https://doi.org/10.1016/j.pmedr.2022.101924>
- United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. (2020). *Smoking Cessation: A Report of the Surgeon General*.
- Wasfi, R. A., Bang, F., de Groh, M., Champagne, A., Han, A., Lang, J. J.,... Prince, S. A. (2022). Chronic health effects associated with electronic cigarette use: A systematic review. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.959622>
- Zavala-Arciniega, L., Barrientos-Gutiérrez, I., Arillo-Santillán, E., Gallegos-Carrillo, K., Rodríguez-Bolaños, R. & Thrasher, J. F. (2021). Profile and patterns of dual use of e-cigarettes and combustible cigarettes among Mexican adults. *Salud Publica de Mexico*, 63(5), 641–652. <https://doi.org/10.21149/12365>

