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Review article

Use of electronic cigarettes as risk factor for chronic obstructive pulmonary disease: systematic review

Uso de cigarros eletrônicos como fator de risco para doença pulmonar obstrutiva crônica: revisão sistemática

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Abstract

Objective: to describe the relationship between electronic cigarette consumption and pulmonary diseases, with an emphasis on Chronic Obstructive Pulmonary Disease (COPD). **Methodology:** this study is a systematic literature review of a basic descriptive and qualitative nature. The descriptors used were "chronic obstructive pulmonary disease" and "electronic cigarettes," accessed through the Virtual Health Library and PubMed platforms, in Portuguese, English, and Spanish. Studies published in the last six years were included, provided one of the descriptors was present in the title, while those that did not address the guiding question or were not directly related to the theme of this study were excluded. **Results:** nine studies were selected, 44% (N=4) being cross-sectional, resulting in a dataset of 1,823,544 participants. The studies revealed a significant association between the use of electronic cigarettes and an increased risk of COPD, along with the development of more frequent respiratory symptoms and reduced lung function. However, other researchers believe that electronic cigarettes could gradually replace conventional cigarettes, as their harms are lesser. **Conclusion:** this study highlights the need for regulation and awareness of the potential risks associated with electronic cigarette use for lung health. Further research is needed to deepen understanding of their consequences, the limits of e-liquid composition, user characteristics, and usage policies.

Keywords: Electronic cigarettes. Respiratory system. Chronic obstructive pulmonary disease. COPD.

Resumo

Objetivo: descrever a relação entre o consumo de cigarros eletrônicos e doenças pulmonares, enfatizando a Doença Pulmonar Obstrutiva Crônica (DPOC). **Materiais e Métodos:** revisão sistemática da literatura de natureza básica do tipo descritivo e qualitativo. Os descritores utilizados foram *"chronic obstructive pulmonary disease"* e *"electronic cigarettes",* através das plataformas Biblioteca Virtual de Saúde e PubMed, com os idiomas português, inglês e espanhol. Foram incluídos estudos publicados nos últimos seis anos e com um dos descritores presente no título, sendo excluídos aqueles que não respondiam à pergunta norteadora ou não possuíam relação direta com o tema deste estudo. **Resultados:** foram selecionados nove estudos, 44% (n=4) tipo transversal, resultando em um conjunto de dados de 1.823.544 participantes. Estudos revelaram uma associação significativa entre o uso de cigarros eletrônicos e um maior risco de DPOC, além de desenvolver sintomas respiratórios mais frequentes e uma redução na função pulmonar. Entretanto, outros cientistas acreditam que o cigarro eletrônico seja capaz de substituir os cigarros convencionais gradativamente, visto que seus malefícios são menores. **Conclusão:** destaca-se a necessidade de regulamentação e conscientização sobre os riscos potenciais do uso de cigarros eletrônicos para a saúde pulmonar. Mais pesquisas são necessárias para entender a fundo sobre suas consequências, limites da constituição do e-líquido, características do usuário e políticas de uso.

Palavras-chave: Cigarros eletrônicos. Sistema respiratório. Doença pulmonar obstrutiva crônica. DPOC.

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Introduction

Electronic cigarettes, also known as electronic nicotine release systems, are devices developed to heat a liquid containing nicotine or other compounds and produce inhalable vapor, a process commonly called “vaping”. Although initially promoted as a less harmful alternative to conventional cigarettes, the impact of electronic cigarettes on lung health has been the subject of growing debates in the scientific literature[1,2].

Studies suggest that the use of electronic cigarettes may be associated with adverse effects on the respiratory system, including inflammation, oxidative stress and damage to lung tissue[3-5]. Chemicals released during the vaporization process, such as formaldehyde, acrolein and heavy metals may trigger inflammatory responses that contribute to the progression of lung diseases[6-8]. These effects have generated concern particularly in vulnerable groups, such as adolescents and people with pre-existing respiratory conditions[9,10].

Chronic obstructive pulmonary disease (COPD) is one of the main respiratory complications associated with exposure to irritant gases and inflammatory particles, and recent studies have investigated the potential role of electronic cigarette use as a risk factor for the development of this condition[11-13]. An analysis of population data in the United States revealed that e-cigarette users have a higher prevalence of COPD compared to non-users, even among those who had never smoked conventional cigars[14,15]. Approximately 20% of adolescents and 8% of adults between 18 and 24 years old currently use electronic cigarettes in the US, and 60% of these were former smokers of conventional cigarettes, which raises specific preoccupations[2]. The numbers of e-cigarette use have also increased significantly by older adults (mean age 35), mainly in the US and Europe. Prevalence is higher in the UK (6%) and US (4-6%) compared to 1% in the rest of Europe. The highest prevalence is among current conventional cigarette smokers, of whom 31% reported having tried electronic cigars[2].

Although some authors argue that electronic cigarettes may be useful in reducing the use of conventional cigarettes, evidence suggests that this substitution is not without risk. Several studies highlight that the use of electronic cigarettes is associated with respiratory complications, such as persistent symptoms of coughing, dyspnea and reduced pulmonary functions[16-18]. Early exposure to these devices has also been related to negative impacts on lung and brain development, especially in adolescents[19,20].

In view of the above, this study aims to conduct a systematic review about the association between the use of electronic cigarettes with COPD.

Materials and Methods

This study was conducted as a systematic literature review, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and registered in PROSPERO with the number CRD42024628282. The guiding question that guided this review was: "Does the use of electronic cigarettes act as a risk factor for chronic obstructive pulmonary disease (COPD)?" This question was formulated based on the PICO model (Population, Intervention, Control and Outcome):

- Population: Individuals who use e-cigarettes;
- Intervention: Use of e-cigarettes;
- Control: Individuals who do not use e-cigarettes;
- Outcome: Prevalence and/or diagnosis of COPD.

The databases used for the search were PubMed, Virtual Health Library (VHL), MEDLINE, LILACS and IBECS. Articles in Portuguese, English and Spanish were included, published between March 2018 and March 2024. The search strategy was adapted for each database and included the following descriptors and combinations:

- *"*Electronic cigarettes*" AND "*Chronic Obstructive Pulmonary Disease*" (COPD)*;
- "*Cigarros eletrônicos*" *AND* "*Doença Pulmonar Obstrutiva Crônica*" (DPOC);
- "*Cigarrillos electrónicos" AND "Enfermedad Pulmonar Obstructiva Crónica" (EPOC).*

The inclusion criteria were: a) studies published in peer-reviewed journals between 2018 and 2024; b) studies that included participants who use electronic cigarettes and addressed their relationship with COPD; c) observational studies, Clinical trials, systematic reviews or meta-analyses; d) Availability of full text and free access.

As exclusion criteria: a) Studies that focused exclusively on the relationship between e-cigarettes and COVID-19; b) Research that analyzed only the impact of e-cigarettes on quitting smoking without addressing COPD; c) Studies not directly related to the guiding question; d) Studies that addressed other devices, such as cigars or hookahs.

Initially, 52 studies were identified in the specified databases. After the removal of duplicates and application of inclusion and exclusion criteria, there were 14 eligible articles. The screening was carried out in three stages:

1. Initial screening: reading of titles and abstracts to exclude irrelevant articles.
2. Full-text assessment: complete review of remaining articles to verify compliance with inclusion criteria.

3. Quality analysis: studies were assessed by two researchers independently using the Joanna Briggs Institute (JBI) tool for observational studies[21].

The data were extracted using a standardized spreadsheet that included the following information:

- Authors and year of publication;
- Type of study;
- Population and setting;
- Objectives;
- Main results;
- Assessment of methodological quality.

The data were synthesized qualitatively, considering the design of the studies, population evaluated and main findings. The results were organized in tables and compared among studies to identify trends and inconsistencies.

The included studies were critically evaluated using the JBI tool. This evaluation allowed to identify potential biases and ensure the robustness of the presented results[21].

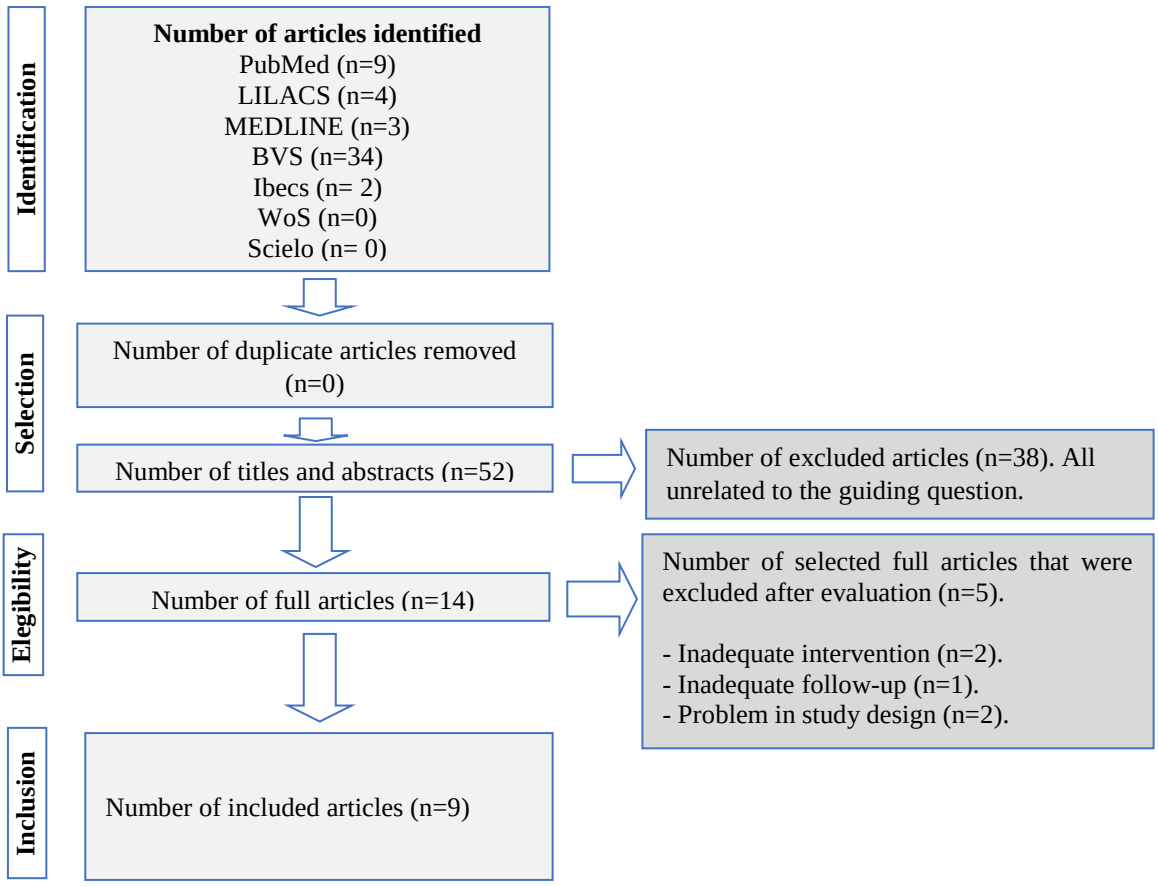
Results

Initially, 52 studies were found from the descriptors of the databases. After applying the inclusion and exclusion criteria, evaluation of title, abstract and keywords, 14 articles were selected in English, Spanish and Portuguese. From the total selected for the final sample, four articles are cross-sectional studies, two observational studies, a longitudinal analysis, a literature review and a prospective study.

The flowchart of the selection process, based on the PRISMA guidelines, is shown in Figure 1.

The total number of participants in the studies cited was 4,596 participants in 2017, 48 participants in 2018, 923,562 in 2019, 705,159 in 2020 and 190,179 participants in 2021, resulting in a data set of 1,823,544 participants distributed among individuals who currently use electronic cigarettes, ex-smokers in "vaping" use, users who never used conventional cigarettes but use EC, double users or who have never used any type of device containing nicotine.

Figure 1. Flowchart of the article screening process for review. (n=9).



Source: created by the author.

The average age of the total sample was 35 years, ranging from 18 to 65 years, with a distribution between the sexes, being 65% male and 35% female participants. Of the regular users of electronic cigarettes, approximately 46% reported an average time of use of these devices of approximately three years, being used daily. About 29% stated that use electronic nicotine release systems when consuming alcoholic beverages and on average 25% of users use electronic cigarettes with conventional cigarettes every day.

Most of the studies were conducted through health systems research databases. For data collection, most studies used as instruments the Maslach Burnout Inventory (MBI) scale to obtain results (n=9). Das publicações filtradas, 11% (n=1) de 2017, 11% (n=1) de 2018, 11% (n=1) de 2020, 22 (n=2) de 2019, e 33% (n=3) artigos de 2021. Chart 1 presents the detail of the works selected for the construction of this study.

Chart 1. Main descriptive characteristics of the articles selected for the construction of this study. (n=9).

Author and year	Design	Scenario and Sample	Objective	Main results
Osei *et al.*, 2016[5]	Longitudinal analysis	Data grouped from 2016 and 2017 from the Behavioral Risk Factor Surveillance System. A total of 705,159 participants were studied.	To examine the association between EC use and a participant's report of having been diagnosed with COPD in a nationally representative sample of adults.	A total of 53,702 (7.6%) participants self-reported chronic bronchitis, emphysema, or COPD. Current EC use was associated with a 75% higher odds of developing lung disease compared with never e-cigarette users.
Russell *et.al.*, 2017[24]	Observational Study	The COPDGene (N=3,536) and SPIROMICS (N=1,060) studies were sponsored by the NIH (National Institutes of Health). The sample consisted of individuals who are current or former smokers and aged between 45 and 60 years.	To determine the use of electronic cigarettes in elderly people at risk or with chronic obstructive pulmonary disease.	From 2010 to 2016, participants who ever used EC steadily increased their risk of COPD to 12–16%. But from 2014 to 2016, current use remained stable at approximately 5%.
Polosa *et al.*, 2018[4]	Prospective study	Vitório Emanuele Hospital. 48 patients included in the initial study, complete data set at 36 months were obtained 44 patients (37 men and 7 women) until the end of the study.	To present results of a long-term prospective evaluation of respiratory parameters in a cohort of COPD patients who ceased or substantially reduced conventional cigarette use with ECs.	Compared to baseline in the EC user group, there was a marked decline in conventional cigarette use. Although there was no change in lung function, significant improvements in COPD exacerbation rates, COPD Assessment Test (CAT) scores, and 6MWD (distance walked on the six-minute walk test) were consistently observed in the EC user group over the 3-year period.
Perez *et al.*, 2019[9]	Cross-sectional study.	Population Assessment of Tobacco and Health (PATH). It was conducted with civilian non-institutionalized adults and youth aged 12–17 in the USA, totaling 32,320 adults.	To examine the association between e-cigarette use and a participant's report of having been diagnosed with COPD in a nationally representative sample of adults.	There was no statistically significant difference in the prevalence of COPD between current and non-users of e-cigarettes (p=0.8) and former users (p=0.7).
Xie *et al.*, 2020[8]	Observational Study	Behavioral Risk Factor Surveillance System. The sample was 891,242 US adult participants who indicated their smoking and vaping status.	To investigate the cross-sectional association of vaping with self-reported COPD diagnosis among never-smokers and former and current smokers in US adults.	Dual users, current smokers, and current e-cigarette users who were former smokers showed higher percentages (4.39%) for self-reported COPD diagnosis than current smokers who never used ECs (2.56%). Therefore, current or past smoking, with or without vaping, is significantly associated with self-reported COPD diagnosis.
Kim; Kang, 2021[6]	Cross-sectional study	Korea National Health and Nutrition Examination Survey. The sample consisted of a total of 12,919 participants aged	To evaluate the association between e-cigarette use and COPD (chronic obstructive	EC (Electronic cigarettes) are an independent risk factor for obstructive pulmonary diseases such as COPD. The prevalence of COPD was 8.8% in Korean

		>40 years who underwent spirometry.	pulmonary disease) among Korean adults aged > 40 years who underwent spirometry.	adults. 1.3% used EC and 2.3% used EC and CC simultaneously.
Kang *et al.*, 2022[22]	Cross-sectional study	Outpatient clinics of eight hospitals in South Korea between November and December 2019. The sample consisted of 51 adult e-cigarette users aged 19 years or older who visited the outpatient clinic as patients with chronic airway diseases or respiratory diseases.	To investigate the current status of e-cigarette use patterns among patients with chronic airway disease or chronic respiratory symptoms.	The predominant diseases among users were asthma (21.6%) and chronic obstructive pulmonary disease (11.8%), and 2% of participants developed lung cancer. Regarding symptoms, 70% complained of coughing and expectoration. Fewer participants (21.6%) reported having chest pain.
Antwi; Rhodes, 2022[7]	Cross-sectional study	2018 USA Behavioral Risk Factor Surveillance Survey. Total sample of 177,209 interviewed participants diagnosed with COPD.	To examine potential associations between e-cigarette use and conventional cigarette (CC) COPD, including sex, age, education, race, and marital status.	Electronic cigarette use was significantly associated with self-reported COPD compared with those who never used ECs. Compared with never EC users who never smoked CCs, the odds of having COPD were significantly higher for daily EC users who never smoked CCs (P=0.04). Similarly, former EC users who never smoked combustible cigarettes were significantly more likely to have the disease (P=0.04).
Hajat *et al.*, 2022[23]	Literature review	Published literature on the health impacts of ENDS (electronic nicotine delivery systems) from 01/01/2015 to 01/02/2020 following the PRISMA guidelines, using PubMed, Embase, Scopus and Google Scholar. 37 studies met the eligibility criteria.	Identify, narratively synthesize, assess strength and quality of evidence, and critically appraise studies that reported disease outcomes associated with EC use.	ENDS have not been shown to cause detrimental cardiovascular disease outcomes and have been shown to be beneficial for hypertensive patients.

Source: created by author.

The methodological evaluation performed with the JBI tool showed that most of the studies had a satisfactory quality, but some presented limitations, such as reduced sample sizes and incomplete descriptions of study environments. Two studies showed unclear results regarding the methods used to measure COPD[7,8] (Chart 2).

Chart 2. Critical assessment of the methodological quality of the included studies using the JBI tool for critical assessment of studies with prevalence data.

JBI	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Osei *et al.*, 2016[5]	Y	Y	N	Y	Y	Y	Y	Y	Y
Russell *et al.*, 2017[24]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Polosa *et al.*, 2018[4]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Perez *et al.*, 2019[9]	Y	Y	N	Y	Y	Y	Y	Y	Y
Xie *et al.*, 2020[8]	Y	Y	N	NC	N	N	NC	Y	Y
Kim; Kang, 2021[6]	Y	Y	Y	N	Y	Y	Y	NC	Y
Kanget *al.*, 2021[22]	Y	Y	Y	NC	Y	Y	Y	Y	Y
Antwi; Rhodes, 2022[7]	Y	Y	Y	N	Y	NC	Y	NC	NC
Hajat *et al.*, 2022[23]	Y	N	Y	N	NC	Y	Y	NC	NA

Captions: S= Yes, N= No, NC= Not Clear, NA= Not applicable.
Q1. Was the sampling frame appropriate to address the target population?
Q2. Were study participants sampled appropriately?
Q3. Was the sample size adequate?
Q4. Were the study subjects and setting described in detail?
Q5. Was data analysis performed with sufficient coverage of the identified sample?
Q6. Were valid methods used to identify the condition?
Q7. Was the condition measured in a standard and reliable way for all participants?
Q8. Was there appropriate statistical analysis?
Q9. Was the response rate adequate and, if not, was the low response rate managed appropriately?

A prospective study carried out in 2018 at the Vittorio Emanuele Hospital aimed to evaluate respiratory parameters, through spirometric indices, in a cohort of patients with COPD after cessation or substantial reduction of conventional cigarette use with electronic cigarettes, after 3 years[5].

According to the results, there was a marked decline in the use of conventional cigarettes after the exchange with electronic cigarette. Although there was no change in lung function, significant improvements in the rates of COPD exacerbation were consistently observed in the CAT scores (COPD assessment test) in the group of EC users during the period of 3 years[5].

New EC users with COPD had a significant decrease in exacerbations of the disease, with their average exacerbation rate dropping from 2.3% at the beginning of the study to 1.3% at the end of the study. The occurrence of respiratory symptoms after the switch was reported in 75.7% of EC users for COPD, while worsening was reported in only 0.8% of patients[5].

On the other hand, other articles present data that EC, although they seem harmless, are rather harmful to the health of its users, because the vapors generated by the device have toxic and harmful products, such as nicotine, heavy metals, volatile compounds and carcinogenes[1-3,6-9].

In an analysis carried out with 705,159 participants, 25,175 (3.6%) were active users of electronic cigarettes, 64,792 (9.2%) active smokers of conventional cigarettes and 207,905 (29.5%) ex-smokers of conventional cigarettes. A total of 432,462 (61.3%) had never tried conventional

cigarettes, while 14,036 (2.0%) were consumers of both electronic and conventional cigarettes. Additionally, 53,702 (7.6%) participants reported having COPD. The median age of active users of electronic cigarettes was between 30 and 34 years. Compared with non-users of electronic cigarettes, active users were more likely to be male, white and active smokers of conventional cigarettes[6].

In all categories of conventional cigarette smoking, a significant association between the use of electronic cigarettes and COPD was observed. Active users of electronic cigarettes had a 75% higher probability of developing COPD compared to non-users (OR=1.75; 95%CI=1.25-2.45). Among never smokers of conventional cigarettes, daily use of electronic cigarettes was associated with higher odds of COPD (OR=2.64, 95%CI=1.43-4.89) compared to non-users of electronic cigarettes. Among former smokers of conventional cigarettes, active users of electronic cigarettes also had a higher probability of developing COPD compared to non-users of electronic cigarettes (OR=2.13; 95%CI=1.82-2.50)[6].

In an additional analysis, never-smokers of conventional cigarettes who had never tried electronic cigarettes served as a reference group, whose consumers of both types of cigarettes had the highest probabilities to develop the outcome of interest (OR=6.89; 95%CI=6.29-7.55). The results suggest possible pulmonary toxicity related to electronic cigarettes in all categories of fuel cigarette smoking, including those who never smoked fuel cigarettes[6].

Considering a study conducted in South Korea, with 12,916 participants aged over 40 years old, users of electronic cigarettes or double use, found that the prevalence of COPD in isolated users of electronic cigarettes was 9.2% in middle-aged adults (40-64 years) and 17.2% in older adults (>65 years). In relation to double use, the prevalence was 13.2% in middle-aged men and 28% in older men. In older men, the probability for COPD was higher in double users, p=0.0037.

The first study to examine the association between e-cigarette use and COPD stratified by fuel cigarette consumption in non-asthmatic adults involving 177,209 adults revealed that former and current e-cigarette users were more likely to report clinical diagnosis of COPD compared to those never used. Double users p=0.97, current users of electronic cigarettes and ex-smokers who never smoked have the value of p=0.003 and p=0.04, respectively[8].

However, there was no significant association between non-users of electronic cigarettes and COPD among current smokers of fuel cigarettes (p=0.17). Although there are growing concerns about the health impacts of e-cigarette use, the short- and long-term health impacts of this behavior have not been clearly established[8].

Discussion

Chronic obstructive pulmonary disease (COPD) is a chronic respiratory disease of progressive nature, which is associated with exposure by inhalation of gases and inflammatory particles, affirming the possible mechanism by which components of electronic cigarettes can cause damage to the lungs, leading to the disease. The inhalation of toxic and irritant chemicals in the vapor produced by devices is one of the main factors[9].

Inflammation of the lungs caused by the use of electronic cigarettes is a significant adverse effect associated with this form of nicotine consumption. Studies have shown that exposure to the chemical components present in electronic cigarettes, such as propylene glycol, glycerin, formaldehyde and acrolein, which are released during the vaporization process, can trigger an inflammatory response in lung tissues, causing irritation and damage to lung tissues and, consequently, inflammation[10].

The long-term consequences of lung inflammation caused by the use of these devices can be severe and include permanent damage to lung tissues. Chronic inflammation can lead to pulmonary fibrosis, a condition in which normal lung tissue is replaced by scar tissue. This results in a significant reduction of lung function and can lead to serious complications, such as respiratory failure[10].

The understanding of the mechanism behind the potential effects of e-cigarettes on lung function is not yet fully understood. However, the current findings are aligned with clinical studies that indicate that the use of electronic cigarettes can cause, in addition to inflammation, increased airway resistance, in some cases reaching levels comparable to the effects of smoking. Moreover, recent laboratory research has identified indicators of oxidative stress associated with the use of electronic cigarettes and observed that the steam produced by these devices can trigger inflammatory responses, increasing susceptibility to bacterial and viral infections of the respiratory tract[11].

Vulnerable groups, such as adolescents and people with pre-existing respiratory conditions, may be more susceptible to the negative effects of e-cigarette use on lung health. Adolescents are at an important stage of development and exposure to toxic substances during this period can have serious consequences for the respiratory system. In addition, people with pre-existing respiratory conditions, such as asthma or COPD, have a higher risk of complications from electronic cigarette use[12].

Studies evaluated 2,668 cases of users of electronic nicotine release system, hospitalized in the year 2020 due to lung disease associated with e-cigarette use, stated that 66% of individuals were male, and the mean age of patients was 24 years (age ranging between 13 to 35 years). 57% said they

used products containing nicotine and 14% said they had dual use (electronic and conventional cigarettes), the average time of use being 12.8 months (ranging from 1 day to 5 years of use)[13].

Furthermore, the main clinical manifestations in these patients were: dyspnea (66.5%), cough (64%), fever (60%), fatigue (40%) and chest pain (35.5%). Gastrointestinal symptoms were frequent: vomiting (48%), nausea (45%), diarrhea (25%) and abdominal pain (19%). Among the 2,668 patients hospitalized with lung injury due to the use of electronic cigarettes, 68 users died after one month of progression of the disease[13].

Lung function assessment also reinforces the link between electronic cigarette use and deterioration of lung health. The reduction of the mean Tiffeneau-Pinelli index (FEV1/FVC) of 0.75 among regular users indicates a reduction in the lungs' ability to expel air effectively. In contrast, non-users presented a mean FEV1/FVC of 0.80, suggesting a relatively normal pulmonary function. This may be an early indicator of pulmonary dysfunction and reinforces the need for continuous monitoring of respiratory health in e-cigarette users[10].

The immediate pathological effects of inhaling substances present in electronic cigarettes may include conditions such as acute hypersensitivity pneumonitis, characterized by inflammation of lung tissue due to chemical exposure, characterized by the inflammation of the lung tissue due to chemical exposure, which should be considered as a differential diagnosis, concomitant with lipid and eosinophilic pneumonia. Recent studies have shown that the steam of ECs produce inflammatory responses and greater susceptibility to bacterial infections and viral respiratory infections. Moreover, scientific evidence suggests a possible association with lung cancer, perhaps due to the carcinogenic substances present in the liquids used in electronic cigars[11].

Evidence from clinical trials in patients with COPD shows indications of respiratory health benefits from the use of electronic cigarettes compared to conventional cigarettes. However, this perspective strongly contrasts with the results obtained in preclinical models (cell cultures and animal models). Studies have shown that prolonged exposure to the components of e-liquid, used in electronic cigarettes, induced the development of adverse effects, such as cytokine expression, hyperreactivity of the airways and lung tissue damage in mice[10].

There are suggestions that chronic exposure to nicotine present in the inhaled e-liquid may trigger characteristics associated with COPD/emphysema. Nevertheless, it is important to note that mice of the A/J lineage are susceptible to developing pulmonary emphysema and COPD characteristics, especially when exposed to toxic substances such as nicotine[11].

Preventive measures can be taken to prevent inflammation of the lungs due to the use of electronic cigarettes. The most effective is to stop smoking completely, either by totally abandoning nicotine consumption or by adopting alternative therapies to help with smoking cessation. In addition,

reducing the consumption of electronic cigarettes can also be beneficial in preventing lung inflammation. It is important to note that the adoption of preventive measures should be accompanied by health professionals, who can provide personalized guidance and support during the process of cessation of electronic cigarette use[12].

As described, this study found articles that prove association of lung diseases such as COPD and the use of electronic cigarettes, but also some studies that affirm that nicotine release devices are allies in smoking cessation, bringing more benefits than harms to human health.

Evidence highlights the need for more robust actions to regulate and monitor e-cigarette use, especially considering the significant risks associated with pulmonary and cardiovascular health. In the clinical setting, health professionals should prioritize awareness of the risks associated with the use of these devices by offering personalized support for cessation of nicotine consumption. Strategies, such as regular monitoring of lung function in e-cigarette users, early identification of respiratory symptoms and implementation of prevention programs in vulnerable populations such as adolescents and patients with pre-existing respiratory diseases, are fundamental.

Furthermore, the replacement of conventional cigarettes by electronic devices should be considered with caution, evaluating individually the potential benefits and harms, always together with evidence-based therapeutic approaches. Finally, public policies should include strict regulations on the composition of e-liquids, labeling and marketing, aiming to mitigate negative health impacts and reduce use among young people and other at-risk populations.

The review presents important strengths, such as the inclusion of recent studies and the use of recognized platforms, such as the Virtual Health Library (VHL) and PubMed, which guarantee the relevance and quality of the analyzed sources. In addition, the focus on specific descriptors such as "electronic cigarettes" and "COPD," contributes to the accuracy of the results. However, there are limitations, such as the predominance of cross-sectional studies, which restrict the possibility of establishing causal relationships. The heterogeneity of methods and samples in selected studies may hinder the generalization of findings. Another weakness is the exclusion of articles in languages other than Portuguese, English and Spanish, which may have limited the scope of the analysis. Finally, the review could have deepened the discussion on the contradictions between clinical and preclinical studies, providing more clarity about the benefits and risks of electronic cigarettes.

Conclusion

This study evaluated the effects of electronic cigarette use on the respiratory system and its possible association with chronic obstructive pulmonary disease (COPD). Regular users of electronic

cigarettes had a significantly higher rate of COPD, even after adjustments for confounding factors. Furthermore, respiratory symptoms such as chronic cough, shortness of breath and sputum production were more common among users, indicating a negative impact on respiratory health. The pulmonary function analysis also suggested a reduction in lung capacity.

Given these results, it is crucial to recognize that the use of electronic cigarettes does not seem to be a safe alternative to conventional tobacco, causing serious risks for respiratory health. More studies are recommended to better understand the mechanisms underlying adverse effects and investigate whether these devices can serve as a bridge to conventional smoking or aggravate COPD in predisposed individuals.

Measures such as stricter regulation and awareness campaigns are essential to protect the respiratory health of the population, especially in view of the growing popularity of electronic cigarettes, especially among young people.

Author contributions

Marcelo José da Silva de Magalhães: conception and design of the research; writing of the manuscript; critical revision of the manuscript in terms of intellectual content and final presentation. **Paloma Esterfany Batista Costa e Débora Lana Rodrigues Oliveira:** data collection; analysis and interpretation of the data; writing of the manuscript. The authors approved the final version of the manuscript and declared themselves responsible for all aspects of the work, including guaranteeing its accuracy and integrity.

Conflict of interests

The authors declare no conflicts of interest.

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