# Review Article: Examination of the impacts of e-cigarettes smoking on the tobacco non-smokers

## ABSTRACT

**Significance and Aim:** The effects of cigarettes smoking on both smokers and non-smoker have been an issue of global public health concern. This led to the emergence of e-cigarettes as an alternative to help smokers in their smoking quitting journey. However, it has remained unclear on the public health costs this has on the non-smokers. The ILR Review is developed to examine the public health the use of e-cigarettes have on non-smokers.

**Methods:** The ILR sourced data from four databases Scopus, Medline, CINAHL, and Google Scholar. This was through a keyword search process using the ‘e-cigarettes’ or ‘vaping’ AND ‘addiction’ AND ‘non-smokers’ AND ‘effects OR consequences, search phrases. The search protocol was replicated for all the databases. The findings from the search process were Scopus (419), Medline (283), CINAHL (311), and Google Scholar (321). The ILR applied inclusion and exclusion criteria and the GRADE model to assess the quality of the articles. Consequently, only 23 articles remained for analysis and inclusion in the ILR findings. Finally, the articles were screed through the EQUATOR PRISMA tool and extracted in readiness for analysis.

**Findings and Analysis:** The results demonstrate that the use of e-cigarettes has two leading public health implications on non-smokers, namely (i) the risk of new addictions and (ii) the risk of health-related illnesses. The findings affirm that the ease of accessing the e-cigarettes, the marketing craze, and the low cost of acquiring them has exposed a rising number of young people to its new addiction. The addiction could at times progress into tobacco smoking addiction. Secondly, the findings indicate that second hand smoke exposure, also known as passive smoking exposes the public to increased lung cancer, lung diseases and COPD illnesses.

**Conclusion:** The ILR concludes that e-cigarettes have far-reaching public health concerns on non-smokers. This necessitates the need for increased restrictions and control on the e-cigarettes access and availability. This is in addition to enacting strict regulations on smoking areas and freedom.

**Key Words:** e-cigarettes, vaping, addiction, non-smokers, effects, consequences

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**1. Introduction**

Existing literature demonstrates a link between smoking and smokers and non-smokers ill health. In the short term, some of the effects of smoking include bad breath, reduced energy, and the risk of decreasing senses of smell and taste (Roberts, Stickley, Gilmore, Danishevski, Kizilova, Bryden, Rotman, Haerpfer and McKee, 2013; Vlachopoulos, Ioakeimidis, Abdelrasoul, Terentes-Printzios, Georgakopoulos, Pietri, Stefanadis and Tousoulis, 2016; Qiu, Liang, Liu, Zeng, Hou, Huang, Lai and Dai, 2017). In the long term, smokers argue that smoking causes and intensifies the exposure risk to lung cancer, with over 90% of diagnosed lung cancer cases linked to smoking. This is in addition to other diseases such as heart diseases, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD), among others (Chen, Wampfler, Jatoo, Garces, Busta, Mandrekar and Yang, 2012; Pesch, Kendzia, Gustavsson, Jockel, Johnen, Pohlabeln, Olsson, Ahrens, Gross, Bruske and Wichmann, 2012). To the non-smokers, the risk,
The search keywords and phrases used were ‘e-cigarettes’ or ‘vaping’ AND ‘addiction’ AND ‘non-smokers’ AND ‘effects OR ‘consequences’. The search keywords and phrases were replicated in the remaining three databases. This was to ensure uniformity for the obtained findings in the ILR search (Bolderston, 2008; Onwuegbuzie, Leech and Collins, 2012). Once the search process was complete, the next step was to determine the relevant and feasible articles for use. This included inclusion and exclusion criteria. The inclusion criteria were based on the publication year (within the last decade (2010-2021), publication language (published in English or with an English version), article availability (must have a full PDF available), respectively (Bandara, Furtmueller, Gorbacheva, Miskon and Beekhuyzen, 2015; Ferrari, 2015).

Any articles obtained published before 2010, lacking an English language version and without an entire PDF, were excluded from the ILR analysis. Further, the ILR examined the articles for quality. This was through the GRADE framework use. The model evaluates articles quality through the dimensions of accuracy, risk of bias and relevance to the review topic. The quality assessment ranks articles from high quality (+++) through moderate quality (++) to low quality (+). For an article to be considered quality and fit for inclusion in a study, it should have a minimum moderate (+) quality ranking (Aggarwal, Grantcharov and Darzi, 2007; Huguet, Hayden, Stinson, McGrath, Chambers, Tougas and Wozney, 2013). The final steps in the review data collection and analysis were on screening and data extraction. First, on screening, the ILR used the EQUATOR PRISMA tool to ensure that all the ILR review steps and procedures were followed. In the extraction of the obtained data, the ILR used two authors. It applied the two authors’ extraction model, where one author has expertise in research methodology while the second was an expert in public health. Any conflicts and disagreements in the data quality assessment and extraction were resolved through a consensus by all the authors (Furlan, Pennick, Bombardier and van Tulder, 2009). The final step was in findings analysis. An ILR, the review analysed the obtained data thematically. This allowed for the integration of the obtained findings to ensure the creation of a new pool of knowledge and understanding of the e-cigarettes public health implications on the non-smokers.

The e-cigarettes market has expanded exponentially and was estimated at USD 12.41 billion in 2019. This market capitalisation is projected to grow at an estimated compounded annual growth rate (CAGR) of 23.8% from 2020 to 2027 to rise to an estimated USD 45 Billion in 2026 (Grand Review Research, 2020). The growth in the e-cigarettes industry has been linked to the perceived health benefits for smokers. The use of e-cigarettes is attributed to reduced tar and carbon monoxide production, two of the most toxic products in cigarettes smoke. Additionally, e-cigarettes use is linked to reduced risk exposure to smoking-related health complications such as lung cancer and stroke (Bhattacharya, Vilardaga, Kientz and Munson, 2017; McClelland, Sesoko and MacDonald, 2020).

Further, it reduces Nicotine withdrawal risks and helps smokers navigate the smoking quitting process with ease and with minimal health and psychological challenges. Despite the existing literature on the value of e-cigarettes over traditional tobacco cigarettes, there is a literature gap on the implications of e-cigarettes on non-smokers. This includes its impacts on third parties and the public at large. Some of the emerging public issues of concern include the rising risks of addiction to e-cigarettes, the attraction for e-cigarettes among the younger youth population, and the general public health impacts of the e-cigarettes general public health and well-being.

II. Aim
The integrated literature review (ILR) aimed at examining the public health impacts of e-cigarettes on non-smoker. This is evaluated through the dimensions of the risks of addiction for traditional smoker and non-smokers, attraction to e-cigarettes among the youth, and the general health implications. The ILR aims at establishing if the use of e-cigarettes poses a higher public health risk to non-smokers or whether its use is a feasible public health strategy to address the effects of smoking on non-smokers.

III. Materials and Methods
The ILR review was based on the search of existing literature on the topic and establishing patterns and trends in the literature. The first step in the ILR analysis was literature search. The researcher identified four different databases, namely Scopus, Medline, CINAHL, and Google Scholar. The four databases were based on the number of articles they hold on public health topics such as e-cigarettes smoking and the quality of available articles (Bolderston, 2008; Onwuegbuzie, Leech and Collins, 2012; Bandara, Furtmueller, Gorbacheva, Miskon and Beekhuyzen, 2015). They have peer-reviewed articles, thus increasing the quality and reliability of the articles. A search strategy and protocol was developed for the Scopus database.
is addiction for non-smokers (Czoli, Hammond and White, 2014; Menakuru and Ali, 2018). Unlike traditional tobacco-based cigarettes, e-cigarettes are increasingly attractive for the young population. The vaping culture is identified as an issue of concern among the youth and teenagers. Studies indicate that there are a rising number of teenagers and youth into e-cigarettes who were traditionally non-smokers. Studies report a percentage ranging from 30% to 45% of teenagers e-cigarette smokers as non-traditional smokers. The craze for e-smoking is hedged on two variables (Pepper, Reiter, McRee, Cameron, Gilkey and Brewer, 2013; White, Li, Newcombe and Walton, 2015; Morean, Kong, Cavallo, Camenga and Krishnan-Sarin, 2016). First, there is growing peer pressure for e-cigarettes. The marketing and advertising strategies in the public domain on e-cigarettes have focused on their aesthetics and creating a better image and status. Thus, this has promoted and aided the risk of more teenagers and youth engaging in the vaping culture (Pepper, Ribisl and Brewer, 2016; Glantz and Bareham, 2018). The lack of smoke and bad breath reduces the vaping and smoking stigma, thus increasing the teenagers’ probability of smoking.

Alternatively, studies indicate a low cost per e-cigarette than traditional tobacco cigarettes (Choi and Forster, 2014; Shiffman, Sembower, Pilitteri, Gerlach and Gitchell, 2015). Thus, this has encouraged teenagers and the youth to engage in vaping due to its ease of access and low related costs. There is a rising risk of addiction among the traditional non-smokers to nicotine smoking. Although the risks could be considerably low compared to tobacco smoking, there remains higher than for non-smokers. This is a public health concern as the rise in nicotine smoking in e-cigarettes exposes society to increased risks to smoking-related diseases (Pepper, Ribisl and Brewer, 2016; Baufhoff, Montero and Scharf, 2017). Equally, clinical trials have developed on the risk of nicotine addiction among teenagers and the risk of progressing into tobacco smoking. The trials indicate a convergent of findings that as the youth get addicted to nicotine, the risk of progressing into tobacco smoking is significantly higher. Thus, this demonstrates that e-cigarettes have a high public health safety concern for non-smoking youths (Cooper, Harrell, Perez, Delk and Perry, 2016; Singh, Windle, Filion, Thombs, O’Loughlin, Grad and Eisenberg, 2020).

b) Health Related Risks

The marketing of e-cigarettes was based on the propagation of the theory that vaping and using e-cigarettes was safe for the passive/non-smokers (King, Smith, McNamara, Matthews and Fridberg, 2015; Gallart-Mateu, Elbal, Armenta and De la Guardia, 2016). However, a critical analysis of existing literature, reviews, and clinical trials indicate a rising public health concern issue (Díez-Izquierdo, Cassanello-Penarroya, Lidón-Moyano, Matilla-Santander, Balaguer and Martínez-Sánchez, 2018; Morgenstern, Nies, Goecke and Hanewinkel, 2018). Findings indicate that e-cigarettes are unsafe for passive smokers. Studies suggest that e-cigarettes smoking aerosols contain nicotine, ultra-fine particles, and other toxins linked to increased exposure risk to lung cancer. Industry reports such as the 2018 NAP report and other studies such as Barrington-Trimis and Leventhal (2018) and Farsalinos, Barbouni and Niaura (2021) demonstrated that second-hand vapour contains nicotine, participate matter, and volatile organic compounds (VOCs). All these concentrations have been ascertained as being above the recommended levels (Grana, Benowitz and Glantz, 2014; Schober, Szendrei, Matzen, Osiander-Fuchs, Heitmann, Schettgen, Jöres and Fromme, 2014; Nowak, Jöres and Rüther, 2014). Exposure to e-cigarette smoke exposes the non-smoker to the risk of all smoking-related diseases such as cancer and COPD, among others. The public health concerns extend to additional risks to children. Studies indicate that besides the aerosols exposure and link to diseases, children are at a higher risk. If the e-cigarette liquids come into contact with their skin or enticing candy-like e-cigarette flavours, it exposes them to the risk of drinking the liquids, which poses significantly higher risks (Peterson and Hecht, 2017; Schober, Fembacher, Frenzen and Fromme, 2019).

V. Discussion

A critical evaluation of the ILR findings indicates that although the use of e-cigarettes has reduced the related smoking risks for traditional smokers, it has its share of public health concerns (Aveyard, Arnott and Johnson, 2018; Ashley, Spears, Weaver, Huang and Eriksen, 2020). Unfortunately, a critical examination of the existing literature demonstrates a minimal focus on the impacts it has on non-smokers. Essentially, the e-cigarettes were developed as an alternative for smoking and as a humane way of helping the willing to quit smoking but are already addicted. First, one of the public health concerns in the ILR is the risk of rising addiction among the youth and teenagers. There have been concerns on the rising marketing and advertisements for e-cigarettes. The leading global media platforms and online advertisements platforms have been at the forefront of advertising. One of the risks noted in public health is the use of celebrity and role model marketing. Celebrities are viewed as role models among teenagers (Campbell-Heider and Snow, 2016; Kilby, Anitsal and Anitsal, 2018; Wang, Chen, Ho, Leung, Wang and Lam, 2020). Thus, through use in such advertisements, the youths are influenced towards smoking e-cigarettes. An additional trigger towards the current rise in e-cigarettes addiction among teenagers and youths is the propagated message on the low health implications on using e-cigarettes. Unfortunately, the e-cigarette cartridges vary in intensity, including an option for adjusting voltage that impacts the nicotine release, exposing them to addiction in the long run period (Bell and Keane, 2012; Nowak, Jöres and Rüther, 2014; Harrell, Simmons, Pineiro, Correa, Menzie, Meltzer, Unrod and Brandon, 2015).

Also, the findings demonstrate a rising concern on vaping and the use of e-cigarettes is on general public health. Due to the initial misconceptions on the vaping impacts, there was minimal regulation on e-cigarettes use. Reports indicate that there was a high exposure among families and children at the initial stages since it was considered safe to smoke e-cigarettes in public places, in houses, cars, and with children (Pisinger, 2014; Gornall, 2015). Exposure to second-hand smoke and nicotine exposes the public to equal risks to cancer and respiratory and lung-related diseases, just like exposure to tobacco smoke. An evaluation of the findings demonstrates the rising need for public health policies and measures on the regulation of use and access to e-cigarettes (Watson and Forshaw, 2015; Green, Bayer and Fairchild, 2016). Although a feasible tool in helping cope with tobacco smoking, studies indicate the need to consider restricted access to e-cigarettes. This would mean that only the smokers in the process of quitting and under a physician’s directive and guidance would be allowed access to the e-cigarettes. This is one step in ensuring that the e-cigarettes are not accessible among the youths, thus reducing their risks of exposure and
addiction (Bell and Keane, 2012; Green, Bayer and Fairchild, 2016). Secondly, there should be proper regulation and policy guidelines on smoking areas. This should include protecting smoking in all public spaces and enhancing policy guidelines to insulate vulnerable groups such as children. Major case of public health impacts on the non-smokers is mainly as a result of ignorance and lack of awareness. Strategies should be developed to create public awareness on the potential risks of e-cigarettes vapor exposure for the non-smokers (Saddleson, Kozlowski, Giovino, Murphy, Goniewicz, Homish, Wrotniak and Mahoney, 2015; Martinez, Hughes, Walsh-Buhi and Tsou, 2018).

VI. Conclusion
In summary, the ILR analysis has examined the impacts of e-cigarettes on non-smokers as an issue of public health concern. The review development is based on the rising popularity, use, and acceptable of the e-cigarettes among both traditional smokers and non-smokers. The analysis demonstrates that the e-cigs have two leading public health implications on non-smokers: the risk of new addictions and the risk of health-related complications. The findings are a demonstration of the need to handle the rising use of the e-cigarettes cautiously. The review findings indicate the urgent need for public awareness generation. There exists a high ignorance degree on the potential side effects of the e-cigarettes on the non-smoker, and as such the erroneous assumption that they are safe compared to tobacco cigarettes smoking exposure. This can be addressed through global awareness programs under the World Health Organization (WHO), regional partnerships and through national related agencies. Secondly, a deliberate action should be developed to reduce e-cigs exposure and accessibility among young people. This could be achieved by restricting access or making them a prescription medication for those quitting smoking alone. Further clinical trials and studies should be based on the examination of the long term impacts of e-cigarettes exposure among children and the youth as this is a high risk and vulnerable society category.

Conflict of Interest
There is no conflict of Interest

References
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