


THE ELECTRONIC CIGARETTE TREND: THE IMPACTS ON ORAL HEALTH

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ABSTRACT

Objective: The objective of this narrative literature review article is to address the electronic cigarette, an invention created in recent years, which has been widely used by adolescents, young people and adults, and is a product that has been causing several problems in the oral mucosa, dental structure and oral health, impacting in an extremely negative way. Methodology: To construct this narrative literature review article, a methodology was outlined in a thoughtful and strategic way, so that the maximum amount of information that could be added to the topic of the article could be obtained from online books, doctoral and master's theses, course completion papers, case reports, review articles, monographs, PICs and research on the topic addressed. Thus, to obtain this range of information, research was carried out in the following databases and websites: DeCs, BVS/BIREME, PROSPERO, Web of Science, CAPES Periodicals Portal, Science Direct, Scielo, PUBMED Central, The Cochrane Library, LUMEN ET VIRTUS Magazine, FT Magazine, Research,

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society and development journal combined with the Google Academy website. Results: The electronic cigarette was initially created as something that was supposed to be less corrosive and would cause fewer problems than the conventional cigarette, being something that was created for people who already smoke, so that they would start using this “healthier” cigarette, until the dependence diminished so that smokers could later quit all types of cigarettes. Conclusion: Thus, it is seen that the electronic cigarette has a range of harmful effects on the human body, being a product that causes problems in the oral cavity.

Keywords: Electronic Cigarettes. Electronic Cigarette Use. Oral Health. Oral Cancer. Oral Manifestations.

INTRODUCTION

Over the years, with the advancement of technology, new products have been developed and old products have been improved. However, in certain cases, these "advances" are not as beneficial when put into practice. Cigarettes are something that have become less popular in Brazil after decrees issued by the national tobacco control policy (Instituto Nacional do Câncer, 2019-2020). However, in 2013, tobacco companies began to enter the electronic cigarette (EC) market, motivated by the huge drop in conventional cigarette sales, trying to compensate for the decline with this new product that has grown rapidly within the market, as it is sophisticated, modern and affordable (Brandon et al., 2015). The electronic cigarette is an electronic device that releases nicotine and other aerosol additives to the user, imitating the traditional forms of tobacco, cigarettes, cigars and pipes, but in the form of pen drives or pens, more common everyday objects and more "aesthetically beautiful", bringing a more attractive look than conventional ones (Knorst et al., 2014).

Electronic cigarettes, also known as pods, vapes and e-cigs, are electronic mechanical devices powered by a lithium battery and are mainly composed of glycerin, propylene glycol and flavorings that give them a sweet, fruity or tobacco-like smell and flavor, and can be composed with or without nicotine (Agência Nacional de Vigilância Sanitária, 2009). These components are mainly responsible for negatively affecting the mouth, contributing to the formation, development and intensification of diseases that affect the stomatognathic system, such as: bone loss, increased bacterial plaque, increased periodontal pockets, hairy tongue, demineralization of tooth enamel, irritation of the oral mucosa, xerostomia, carious lesions, periodontal disease, hyperplastic candidiasis, angular cheilitis, halitosis and nicotine stomatitis (Menezes et al., 2021).

Furthermore, the unbridled use of PODs is responsible for a group of local oral diseases and inflammations, cellular alterations and oxidative stresses. However, even though they are less harmful and damaging when compared to conventional ones, vapes release cytotoxic and carcinogenic agents (Tommasi et al., 2019). Thus, it is seen that electronic cigarettes, although they were created to be less harmful than conventional cigarettes, are responsible for a set of impacts on oral health. Thus, the objective of this article is to address conventional and electronic cigarettes by comparing them, showing how and what vapes cause to oral health and what types of problems they can cause.

METHODOLOGY

To construct this narrative literature review article, a methodology was outlined in a thoughtful and strategic manner, so that the maximum amount of information that could add to the topic of the article was obtained, from online books, doctoral and master's theses, course completion papers, case reports, review articles, monographs, PICs and research on the topic addressed. Thus, in order to obtain this range of information, research was carried out in the following databases and websites: DeCs, BVS/BIREME, PROSPERO, Web of Science, CAPES Periodicals Portal, Science Direct, Scielo, PUBMED Central, The Cochrane Library, LUMEN ET VIRTUS Magazine, FT Magazine, Research, society and development journal combined with the Google Academy website. During the construction of the article, gray literature was also used, to enrich with pertinent and reliable information to compose the work. In order to construct this narrative literature review article, it was necessary to use a work as a basis, a study that shows how the research methodology, structuring and development of this type of article should be. Thus, Rother's work (2007) was used as a guide during the creation of this article, serving as a basis for the formation and completion of this work. The following descriptors were used to acquire the largest amount of rich, current information, with tested and proven scientific basis, to provide greater precision in the creation of this review work: Electronic Cigarettes; Electronic Cigarette Use; Oral Health; Oral Cancer; Oral Manifestations.

RESULTS

SMOKING AND ORAL CAVITY

The World Health Organization considers smoking to be the leading preventable cause of death in the world (Xavier et al., 2020). Smoking causes changes in the patient's immune responses, causing immunological problems, bringing a greater susceptibility to acquiring: periodontal diseases, microbial action, loss of the sensation of taste of consumed foods, atrophy of taste buds, bad breath, stains on the teeth, reduced salivary flow, stomatitis and even a greater ease of developing oral cancer (Souza & Mialhe, 2008).

The dentist has the duty to analyze the oral cavity in order to identify possible cancerous lesions, especially when it comes to smokers who have a greater chance of developing this problem. It is extremely important that the dentist knows how to analyze the different oral neoplasms, which are lesions that begin in the oral cavity as a whole, in the lips, oral mucosa, teeth, hard palate, floor of the mouth, gums, retromolar trigone, third

molar region and the first two thirds of the tongue. It is essential that the dentist explains to his smoking and non-smoking patients how negative this practice is, addressing the different pathologies and oral problems that can develop if this practice occurs (Consolado et al., 2010; Xavier et al., 2020).

ELECTRONIC CIGARETTE

An electronic cigarette is a device that offers its users doses of nicotine combined with other substances in aerosol form. The POD consists of three main components in its device: an atomizer, a battery and a cartridge that contain nicotine, with some brands producing nicotine-free vapes in certain countries. Most e-cigs have a light indicator on the tip, which will light up when the user is using the device, signaling that the cigarette is lit and releasing vapor to be inhaled or inhaled. Most electronic cigarettes were developed in a way that imitates the traditional ways of using cigarettes, cigars, tobacco and pipes, however, they have a difference in their physical appearance, being a product that has the form of an everyday object, like a flash drive or pen, and is a very common choice for individuals who want to use nicotine in a more discreet way when compared to traditional forms (World Health Organization, 2014; Bullen et al., 2013).

Vape cartridges are not standardized, varying from brand to brand, and most of them contain nicotine to produce the aerosol, such as glycerol in water or propylene glycol. The nicotine level is a component that varies from manufacturer to manufacturer, and in certain cases does not correspond to the quantity stated by the manufacturer. Certain POD brands use substances that modify the flavor of the inhaled product, using substances such as vanilla, coffee, mint, fruit, chocolate and other flavor extracts, making the product more attractive, especially to young people and teenagers. Studies carried out on the cartridges that make up vapes have shown that most of them contain several substances that are harmful to the human body, such as acetaldehyde, heavy metals, formaldehyde, volatile organic compounds, acrolein and nitrosamines derived from tobacco (Goniewicz et al., 2013; World Health Organization Study Group on Tobacco Regulation, 2009; Westenberger, 2009).

When the user inhales some type of electronic cigarette, a sensor detects the airflow that is being created and at the same time the liquid in the cartridge heats up, causing it to evaporate, releasing nicotine through the vapor, some of which may be released into the environment when the individual exhales. The vapor reaches around 40-60 °C, through the

device that, according to the manufacturers, can generate 10 to 250 jets, which, depending on the brand of vape, can be compared to 5 to 30 conventional cigarettes. In recent times, with the increase and popularization of these devices, a third generation of e-cigs has been developed, which have more powerful batteries combined with more technologically advanced vaporizers, enabling the release of larger doses of nicotine, which may indicate a greater risk of dependence on the part of users (Bertholon, 2013; Farsalinos, 2014).

ELECTRONIC CIGARETTE AND ITS IMPACT ON THE ORAL CAVITY

Regarding conventional cigarettes, tobacco, hookah, cigars and pipes, it is already known that this is an extremely negative practice for oral health, however, a large part of society has little idea of how bad electronic cigarettes are, therefore, research was carried out on studies that have scientific basis and evidence on how this practice can harm the balance, maintenance and health of the entire oral cavity (Huilgol et al., 2018; Silva et al., 2022). Toxicity is one of the major concerns surrounding this product. Research has shown that the products released in the vapors of electronic cigarettes are extremely toxic and carcinogenic, such as nitrosamin, glycerol and propylene glycol, which can induce the formation of carcinogenic nitrosamines, and others that will form acetaldehyde and formaldehyde if they are oxidized, which is something that can be a potential agent that generates inflammation and that when heated, becomes carcinogenic to human tissue, and can be identified through saliva and can cause nicotine stomatitis (Ebersole, 2020; Sultan et al., 2021).

Authors of studies have reached data that show the relationship between electronic cigarettes and periodontal disease, which can later cause cardiovascular problems. Through these studies, information was obtained that individuals who use the device have an increase in bacterial plaque and probing depth, an abnormal increase in salivary flow and bone loss. However, there will be a lower incidence of gingival bleeding due to the fact that the nicotine present in the device causes vasoconstriction. However, the individual will have great swelling and gingival pain due to the damage suffered by the endothelial cells and periodontal ligaments (Yang et al., 2020; Thomas et al., 2022; Rouabhia, 2020). Studies show that dental anatomy is completely impacted when an individual uses this product, triggering processes of: alteration of sensitivity, luminosity, translucency and coloration of the tooth, causing cracks in it and triggering abscess processes, while other authors, highlight the fact of lesions caused by the overheating that the oral cavity goes

through, which causes problems such as: chronic induction of nasosinusal and lung cancer, in addition to causing burns on the lips (Vohra et al., 2020; Yang et al., 2020).

A study analyzed individuals who use e-cigs, ex-smokers and people who have never smoked. After this study, data was obtained indicating that POD users have a higher prevalence of oral mucosa lesions, as well as other problems such as: hairy tongue, melanosis, squamous cell carcinoma, hyperplastic candidiasis, presence of lichen planus, median rhomboid glossitis, nicotinic stomatitis and erythematous candidiasis (Ralho et al., 2019; El-Sakhawy et al., 2023; Lima Menezes et al., 2021; Machado et al., 2023).

Regarding saliva, research has analyzed its antimicrobial properties and it was seen that, when compared to the control group and non-smokers, vape users have changes caused by the presence of flavorings that make up the e-cig, in addition to the increased growth and adhesion of biofilm of the cariogenic pathogen *Streptococcus mutans*, triggering an abnormal growth of this species, which can be easily compared to an individual's mouth after ingesting high amounts of sugar and acidic drinks (Cichońska et al., 2019; Cichońska et al., 2022).

A study identified in the liquids found in electronic cigarettes the presence of metals such as: iron, carbon, nickel, lead and aluminum combined with nitidine and other psychoactive substances, which are toxic, irritating and carcinogenic components in which cytotoxicity impairs the functioning of the physiology of the organs and cells of the oral structure (Silva et al., 2022). Even though certain e-cigs are without nitidine, they will still be something that will have toxic components in their composition such as the flavorings used, which are applied with the intention of bringing the aromatic, sweet, fruity or citrus flavor characteristic of most POD brands (de Almeida Miranda et al., 2022). A range of oral pathologies are commonly developed and restored in the mouth through the use of electronic cigarettes. Research has shown that xerostomia, black hairy tongue and contact dermatitis can be caused by the same, in addition to the fact that a large part of the individuals presented dryness in the mucosa and lips, which will increase the keratin layer, favoring the development of carcinogens, all of this being caused by the contact of the mouth with the vaporized substances, which will cause the release of pro-inflammatory cytokines responsible for causing these respective pathologies (Sampaio et al., 2022).

DISCUSSION

The invention of the cigarette was something that had a great impact on society and that has repercussions to this day, a positive impact on the economy but a negative impact on society, taking into account that it is a product that does not benefit people's health, but in reality only contributes in a harmful way to the human organism as a whole, both the body and oral health as both are connected and influence the balance of the other. However, as bad as cigarettes are for your health, many people used them when they were first created, because they were considered something "chic", "elegant" and "beautiful" in the context and vision of the time, where people who used cigarettes were seen as modern and refined people, who did not know the impact that this product would cause in the long term, but nowadays we already know what the consumption of this can cause. In the same way, POD emerged, presented itself as something modern, chic, technological and that produces a sensation seen as "pleasurable" when used, but that in reality is already responsible for causing a range of health problems and that in the future will cause even more problems, just as cigarettes did.

Electronic cigarettes were designed in a thoughtful and fully articulated way. Conventional cigarettes left bad odors on people's clothes, environments, and skin and hair. Electronic cigarettes leave no trace of odor, only in the environment and in the mouth when inhaled and released by the user. However, they release smoke that quickly dissipates and has a sweet, fruity or citrusy smell that is seen as a "good" and "pleasant" smell, solving the old cigarette defect of having a bad smell. Another factor that was considered in POD was the taste. Cigarettes leave a bitter taste due to nicotine. Vapes were created to produce a good taste similar to everyday fruits and sweets, creating an attractive way for people, who can achieve this taste without even having to consume the specific food. In this way, this is a factor that solved the problem of cigarettes having a bad taste. Nowadays, we live in a society where aesthetics are important, and the appearance of products is no exception. Vapes have a shape, color and appearance that is designed to simulate something more technological, sophisticated and modern, with colors corresponding to each flavor, such as: grape being purple, banana being yellow, green apple being green, pineapple being yellow, peach being orange and other shapes, following a logic corresponding to the flavor that each POD will deliver, creating this attractive and playful color effect, all serving to attract the consumer. One point that is clear between conventional and electronic cigarettes is the fact that electronic cigarettes do not need a lighter to light up. The consumer simply pulls

and can inhale, without having to light something with fire, making them something that can be used in different environments without leaving smoke and a burning smell, often going unnoticed, increasing their ease of use and practicality. Thus, POD was created in a way that sought to correct the factors that were not attractive in conventional cigarettes, aiming to create a greater possibility of use in society, so that this product would be more attractive due to its well-structured technology, everything thought out and articulated so that it could attract more users who were attracted by the aspects presented.

Nowadays, with the growth in the use of electronic cigarettes, several companies that produce them have started to emerge. However, there is no "fixed formula" that is used to make each e-cig, which is a point that makes it very difficult to study this product, at the moment in which each brand of POD uses a different concentration of nicotine, with PODs having low concentrations and others with high concentrations of nicotine. In addition, the other main problem is the other substances that are found in the composition, compounds that have few studies on their impact on the oral cavity and that in each different brand are presented in different concentrations and quantities, together with several different substances, which highlights the need for a standardization of the compounds used in the production of vapes, in addition to studies that seek to understand the action of each respective compound within the oral cavity and what it can cause. Thus, it is evident that more studies are needed around the composition of this product and what they can do to oral health.

Considering that a large proportion of teenagers, young people and adults today have already had contact with electronic cigarettes or have routine contact with them, it is seen that this is something that has a certain urgency to be studied, aiming to find more answers that serve as a driver for people to have information about the harms of using this product, so that later there is a drop in the number of users.

Addressing the problems triggered by e-cigs, it is seen that, just like conventional cigarettes, they are responsible for developing or intensifying pathologies, lesions and other oral problems, being a great enemy to the balance, maintenance and performance of oral health, being important that people stop using this product in order to obtain good and healthy oral health.

CONCLUSION

In this way, the electronic cigarette has become a fashion within society, which was created to become a substitute for cigarettes in the lives of smokers, but which in reality began to be used by teenagers, young adults and adults in their majority and who often had never smoked before, but who adopted this practice because it is something that does not leave a bad smell on clothes, person or environment, being attractive due to its technological and beautiful appearance, in addition to having a good, fruity, citrus or sweet taste, making the person interested in using it, often without even knowing about the existence of nicotine and its addictive potential and that it will probably cause dependence in the user. Furthermore, PODs are responsible for a set of oral health problems. It has been seen that they can cause pre-cancerous lesions or even cancer, causing various symptoms such as: bone loss, increased bacterial plaque, increased periodontal pockets, hairy tongue, demineralization of tooth enamel, irritation of the oral mucosa, xerostomia, carious lesions, periodontal disease, hyperplastic candidiasis, angular cheilitis, halitosis and nicotine stomatitis.

Therefore, the conclusion is that electronic cigarettes do cause many problems to balance, functioning and oral health, and their use has been increasing more and more, but the real impact that they can cause on oral and systemic health is still unknown. We already know about several problems that are caused by this use, however, we still do not know what they can cause in the long term, as it is a recent invention. Therefore, taking into account that in the short term there is already a range of harm, in the long term there must be more intense and worse consequences.

In this way, it is extremely important that more studies be carried out on these devices, aiming to acquire more information about their constituents, which in most cases do not have a "standard" of substances in their composition, presenting more than nicotine, which can further increase substance dependence and oral damage. It is extremely important that each dentist seeks to report cases of patients who use vapes or who already have some injury or problem caused by this product, so that more dentists can have access to these case reports, creating a monitoring chain in relation to the use of this product and oral health, so that lectures and publications on social networks can then be held with the aim of providing health education, making people aware of POD and its harmful effects, thus carrying out actions that aim to prevent and improve oral health.

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