

Short communication

Breastfeeding and electronic cigarettes: A Health perspectives

Abstract

Exclusive breastfeeding during the first six months of life is the best practice to be adopted for the infant, since it also offers benefits to the mother, family and the entire society. Breast milk is a living, complex product with great variability that contains in its composition more than 200 substances necessary for the nutrition of the child. However, breast milk can occasionally serve as a vehicle for harmful substances, as is the case with mothers who smoke. Occasionally, milk can be a vehicle for transmitting harmful substances to the child, as in the case of smoking. In recent decades, there has been a large increase in the use of electronic cigarettes, whose components can be found in breast milk, as is the case with nicotine. Smoking is a major global public health problem and, currently, electronic cigarettes have attracted many new smokers, especially among younger people. This article presents the main characteristics of electronic cigarettes and the nicotine and its effects on the mother and child's body, also discussing some measures to protect health and reduce the habit of using electronic cigarettes.

Keywords: breastfeeding – breast milk – electronic cigarettes - nicotine

Introduction

Smoking is considered a chronic disease and a serious public health problem that affects approximately 1.3 billion people, equivalent to more than 22% of the world's population, and is responsible for more than 8 million deaths each year as a result of the various direct and indirect effects caused by the components found in cigarettes. Among the numerous components found in cigarettes, nicotine is the main harmful factor because it is a psychoactive substance that causes dependence and several diseases such as chronic bronchitis, emphysema, chronic obstructive pulmonary disease, high blood pressure, stroke, angina, heart attack and several types of cancer (Le Foll B et al.,2022; Farber HJ,2025). In addition to the direct effect caused by smoking, people are also subject to contact with the smoke generated by burning cigarettes, known as secondhand smoke, which releases more than 7,000 compounds and chemical substances of various natures into the environment, also responsible for many diseases (Carlsen KCL et al.,2018). Also, many substances generated by burning cigarettes can be ingested, inhaled or absorbed through contact with household objects or in closed environments, which is called thirdhand smoke (Hageman JR et al.,2023).

Given the magnitude of this serious problem, many actions have been developed with the aim of reducing the habit of smoking, ranging from educational campaigns to raise awareness about the harmful effects of smoking to pharmacological and psychiatric treatments aimed at nicotine addiction. Among these actions, we can highlight the emergence of the so-called electronic cigarettes, whose prototypes were developed in the 1930s and, gradually, were improved as more modern, attractive and functional models, and which from the beginning of the 21st century spread throughout the world, attracting mainly adolescents and younger people (Besaratnia A et al.,2020; Chong-Silva C et al.,2025), due to the perception of lower risks compared to traditional smoking and the attractiveness of one of its components, which are flavoring substances (Bonner E et al.,2012; Winickoff JP et al.,2024). The use of electronic cigarettes has become a global public health problem and requires attention from the entire society.

E-cigarette

Electronic cigarette (e-cig), also called vape or electronic nicotine delivery system (ENDS) is a device that has a power source (usually a rechargeable lithium battery), a heater (atomizer) and a liquid reservoir containing solvent (propylene glycol or vegetable glycerine), flavorings (mint, fruit, tobacco, ethyl vanillin, ethyl maltol, bubblegum, alcoholic flavors such as margarita and strawberry) and nicotine in variable concentrations, designed to provide emissions through heating that transforms part of the liquid into an aerosol to be inhaled and to mimic the experience of smoking. (Jonas A,2022).

Due to the thermal degradation of solvents inhaled vapor may contain several substances such as aldehydes, acetone, acrolein, polycyclic aromatic hydrocarbons and metals (cadmium, chromium, nickel, lead) that are irritants to the respiratory mucosa, among other deleterious effects (Gordon T et al.,2022; Sun Y et al.,2024) such as cardiovascular, cerebrovascular and systemic diseases (Deprato A et al.,2025; Tao X. et al.,2024; Li X. et al.,2024; Kathuria H,2022). The concentration of nicotine in e-cig can vary between 3 and 36 ng/mL, and in some products it can reach up to 50 ng/mL.

In addition to the inhaled part, the so-called secondhand aerosol emitted by a e-cig, which is also harmful to health, contains chemical elements such as ultrafine particles and heavy metals, the concentrations of which vary and depend on the type of device, the voltage used and the intensity and technique of inhalation (Walleu SC et al.,2019). E-cig can expose people to other risks such as acute poisoning through swallowing, inhaling or absorption through the skin of mucous membranes of the fluid contained in replaceable ampoules (Carlsen KCL et al.,2018) and battery explosions that can cause burns (Chong-Silva C. et al.,2025; Gilley M. et al.,2020).

Nicotine

Nicotine is an alkaloid with a high capacity to cause dependence, derived from the leaves of *Nicotiana tabacum*, a plant of the Solanaceae family, also identified by the name 3-[2(n-methylpyrrolidiny)]pyridine, whose chemical formula is $C_{10}H_{14}N_2$. It is a colorless, hygroscopic, oily liquid with a characteristic odor that turns brown when exposed to ambient air (Sansone L et al.,2023).

Since it is a weak base, nicotine, after inhalation, reaches its peak in a few minutes, is distributed throughout various organs and tissues, and its absorption is greater in neutral or acidic environments, mainly through the mucous membranes of the oral cavity and nose, skin and lungs, which, due to the large alveolar surface, absorb between 60% and 80% of the inhaled amount. The half-life of nicotine is approximately 2 hours. (Napierala M et al.,2016) Between 70% and 80% of the body's nicotine is metabolized by the liver into cotinine, via cytochrome oxidase 2A6 and 2D6 enzymes, with the remainder metabolized by the lungs and kidneys (Schelp LJ et al.,2009). Cotinine, whose half-life is approximately 20 hours, is excreted via urine, feces, gastric juice, saliva, sweat and bile (Karaconji IB,2005).

Upon entering the body, nicotine crosses the blood-brain barrier in a few seconds and binds to nicotinic acetylcholine receptors that are present in the central nervous system, in postganglionic sympathetic and parasympathetic neurons and in the neuromuscular junction, stimulating the release of several neurotransmitters such as acetylcholine, norepinephrine, serotonin and dopamine, which, when activating the endogenous opioid system, provoke and reinforce pleasant experiences (Ferkol T,2025). Its effects can be quickly verified, highlighting sweating, bronchospasm, tachycardia, increased secretion in the bronchial tree, increased cardiac contractility and blood flow in the coronary arteries, nausea, vomiting, agitation and tremors. Other effects, which may arise in the medium and long term, such as endothelial dysfunction, thrombogenesis, changes in fat metabolism and hyperlipidemia, peptic disease, gastroesophageal reflux, interference in the immune response, angiogenesis and cell proliferation can also be found in smokers (Sansone L et al.,2023).

Breast milk

Exclusive breastfeeding during the first six months of life is the best practice to be adopted for the infant, since it also offers benefits to the mother, family and the entire society. Breast milk is a living, complex product with great variability that contains in its composition more than 200 substances necessary for the nutrition of the child, such as water, proteins, fats, carbohydrates, vitamins and minerals. In addition, it also provides the infant with several non-

nutritional components with protective anti-inflammatory and anti-infectious activity, such as immune cells (lymphocytes, macrophages, neutrophils and epithelial cells), immunoglobulins of classes A, D, E, G, M, complement system, interleukins 6, 8 and 10, cytokines, bifidus factor, lactoferrin, antioxidants and some hormones (Nuzzi G et al.,2021; Primo CC et al.,2013; Yi DY. Et al.,2021).

Breast milk, in addition to its high nutritional value, provides the child with protection against many diseases such as diarrhea, anemia, acute otitis media, lower respiratory tract infections, allergies, a lower likelihood of chronic diseases in later life, and better growth and neuromotor development (Mosca F et al.,2017). However, breast milk can occasionally serve as a vehicle for harmful substances, as is the case with mothers who smoke. Although tobacco and its derivatives are not included in the list of substances that contraindicate breastfeeding, they can cause harm to both the child and the nursing mother.

Nicotine in milk

The amount of nicotine present in breast milk can be up to 2.9 times greater than in maternal serum, and the greater it is the shorter the interval between inhalation and breastfeeding. Nicotine is well absorbed by the infant's intestine due to the large contact area, and its half-life in breast milk is approximately two hours. After inhalation, nicotine reaches a peak concentration in about 30 to 60 minutes and begins to disappear rapidly from breast milk, not being stored there (Sansone L et. Al,2023).

Cotinine, the main product of nicotine metabolism, remains in breast milk due to its longer half-life, which can lead to accumulation in cases of smokers who are not satisfied with just one cigarette (Ahmed F et al.,2019). In the maternal organism, nicotine is responsible for harmful effects such as decreased prolactin and milk volume, inhibition of the milk ejection reflex due to increased epinephrine that can reduce the circulation of oxytocin, and reduced lactation time (Napierala M et al.,2016).

The composition of breast milk is also compromised, with lower concentrations of fat and polyunsaturated fatty acids (PUFA), changes in taste (Nordhagen LS et al.,2020); lower concentrations of iodine and vitamins C and E (Macchi M et al.,2021). Furthermore, milk can also contain cadmium, a toxic metal that can alter the metabolism of other metals such as copper, iron, magnesium, selenium, and zinc (Napierala M et al.,2016; Jenssen BP et al.,2023;Viachou M et al.,2024), which are essential for the growth and development of children.

The clinical manifestations caused by nicotine and observed in children are changes in the sleep-wake pattern, impaired sucking, reduced appetite and consequent low weight gain, restlessness, irritability, excessive crying, hyperexcitability, blushing, tachycardia, apnea, nausea, vomiting, colic, low iodine intake, increased risk of sudden infant death syndrome, and future impairment of the central nervous system, lungs, and liver (Ahmed F et al.,2019;Gunnerbeck A,2019).

Conclusion

Smoking is the leading preventable cause of disease and early death worldwide, and its reduction should be considered one of the main goals for improving health conditions in all age groups. Although e-cigarettes are recognized as emitting lower concentrations of nicotine and other harmful elements than those found in traditional cigarettes, they still pose risks to the health of users, their families, and society as a whole (Toll BA et al.,2024). With regard to children born to mothers who smoke and are breastfed, the health risks are well demonstrated and draw attention to the need for measures to reduce factors also related to the use of e-cigarettes. All mothers should be advised to feed their babies exclusively with breast milk for the first 6 months after birth and continue to supplement with other foods until the child is 2 years old, if possible, so that the child can take advantage of all the nutrients for their growth and development (Talbert JA et al.,2025;Meek JY et al.,2022).

In this context, it is important to highlight the importance of public actions to be developed in health and education services, disseminating information about the harm and consequences to individual and collective health (Watt E et al.,2025; Jenssen BP et al.,2023). Opportunities such as individualized or group care in health services, both for adolescents and adults, and in childcare consultations should be used to discuss the harm caused by all forms of smoking. In addition to information and awareness campaigns, legislators and government officials should also implement measures such as regulating the age for purchasing e-cigarettes, protecting people in closed environments, and strict monitoring of the manufacture and distribution of these products.

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