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Nicotine Fact Sheet 3: Nicotine and the Lungs

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Abstract

Fact Sheet 3 describes the effects of nicotine on the lung and respiratory tract. Respiratory conditions caused by localised nicotine (not gases, added flavourings or particulates) are plausible given laboratory animal models and clinical evidence demonstrating the potential for nicotine in cigarettes, e-cigarettes or vaping exposure to cause a wide range of physiologic effects on the pulmonary system. Effects include altered gene expression, inhibited nasal and bronchial cilia, impaired macrophage function, increased endothelial stiffness, and increased inflammation. These effects may be seen in young "never smokers", particularly those with no previous respiratory illnesses.

1. Nicotine Uptake in the Respiratory Tract

Nicotine is readily taken up in the respiratory tract, which, apart from the lungs, includes the nose (Wall et al., 2022), the ears, the mouth and the eustachian tubes of the ears (Russell et al., 1983; Wall et al., 2022). Nicotine nasal spray was an effective pharmacotherapy for smoking cessation (Russell et al., 1983) and was available in Australia for some years.

2. Nicotine and the Cough Reflex

Dr William Whitby, previously a GP of Bondi Junction, once had a sign in his practice that said, "Asthmatics are Welcome to Smoke". Whitby had written a book, "Smoking is Good for You" (Whitby, 1982), and he believed that all his asthmatic patients felt better and coughed less when they smoked. Whitby was subsequently exposed as heavily supported by the tobacco industry (Chapman, 2003). However, he was right in a way. Renee commented on this in an editorial in 1995—an increase in coughing is a commonly reported side-effect of quitting smoking (Bittoun, 1995). It is a nicotine effect unrelated to inhaled particulate matter. Nicotine may suppress a cough reflex (Sitkauskiene & Dicpinigaitis, 2010) and reduce the impact of a capsaicin challenge, a common test for asthma (Dicpinigaitis, 2017).

3. Nicotine and Respiratory Cilian Mucosa

Nicotine harms cilia activity. It impairs the primary function of cilia to clear noxious agents up and out of the respiratory tree (Ballenger et al., 1965; Moses et al., 2017). Using epithelial cells from the ferrets' trachea, Hahn et al. (1992) have shown that nicotine increases ciliary beat frequency compared to control tissue through a direct effect on respiratory cilia.

4. Nicotine and Respiratory Immunity

Bai et al. (2017) have shown that nicotine impairs macrophage functioning, leading to dysfunctional immunity. Other studies (Comer et al., 2014) have shown that nicotine has cytotoxic properties and modulates innate immune responses (Valdez-Miramontes et al., 2020). The negative effect on the immune system may lead to a lack of vital immune cells needed to fight infection, as we see in smokers and patients with chronic obstructive pulmonary disease (COPD) (Eapen et al., 2017). It appears that both respiratory mucosa and immunity are affected.

5. Nicotine and Infant Lung Health

Adverse effects on the lung development of infants are linked to maternal nicotine use during pregnancy (McEvoy & Spindel, 2017) and breastfeeding (Primo et al., 2013).

6. Nicotine and COVID-19

Smoking (Brake et al., 2020; Eapen et al., 2021) and vaping (McAlinden et al., 2021; Russo et al., 2020) are risk factors for COVID-19 and nicotine may be the missing link. This may also be true for other infections, such as pneumococcus in the airways (Miyashita et al., 2018).

7. Nicotine and Passive Vaping

Nicotine-containing vapes risk respiratory symptoms in bystanders (Islam et al., 2022).

8. Nicotine, Vaping and EVALI

Complex respiratory symptoms and test characteristics are criteria for diagnosing EVALI and other lung injuries from vaping (Garg et al., 2022).

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