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REVIEW

Environmental Determinants of Oral Cancer Development: An Overview

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Abstract

Overview: This review article delves into the influence of environmental factors on the onset of oral cancer. It examines the crucial part played by air pollution, occupational exposure and sun exposure in the initiation of oral cancer. **Methods:** For this extensive literature survey, we examined relevant publications centered on environmental causes of oral cancer, taking into account case-control research and environmental exposure appraisals. Our selection consisted of works chosen for alignment with our topic areas, robust methodologies, and recent publishing timelines. **Results:** Our investigation revealed that air pollution, occupational exposure and sun exposure are significant factors contributing to the development of oral cancer. When present together, they pose an even greater risk. In other words, the combination of these three environmental elements significantly increases the likelihood of oral cancer occurrence. It is crucial to take measures to reduce exposure to occupational exposure, air pollution and UV rays from the sun to mitigate this risk. **Conclusion:** The emergence of oral cancer arises from an intricate relationship encompassing hereditary and ecological variables. Efforts devoted to prevention ought to prioritize diminishing direct exposure to established threats, refining general wellbeing guidelines, and informing individuals prone to elevated risk circumstances. Expanded exploration stays imperative for illuminating contributions made by obscured ecological facets, notably pollution, plus devising groundbreaking precautionary tactics.

Keywords: Oral cancer- Environmental Factors- Air pollution- Sun exposure- occupational exposure

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Introduction

There are numerous fields within various disciplines of medicine and industry, including chemistry (analytical, organic, and inorganic), biochemistry, bioinformatics, biomedical sciences, biology, pharmacology, nanotechnology (nanoparticles, nanostructures, Nanotubes), medicinal chemistry, dentistry, medicine, chemical engineering, mechanical engineering, psychology and others [1-48]. Technological progress and increased understanding in various industries fuel initiatives to improve the quality of operations and products. Service-based companies are striving to elevate their service delivery and performance indicators while manufacturing sectors aim to enhance the quality of their offerings. For example, the electronics industry is committed to prolonging the lifespan of its products, thereby increasing their reliability and capabilities. Similarly, in the healthcare and medical sectors, efforts are being made to refine treatments and find cures for cancer

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[49-54]. Cancer is a multifaceted and pernicious disease characterized by the exponential growth of abnormal cells, which can affect various parts of the body, including the stomach, breast, gastric, brain, lungs, mouth, pancreas, uterus, and others. The uncontrolled proliferation of these cells not only damages adjacent tissues but also disrupts the body's homeostasis, giving rise to a broad spectrum of severe symptoms and potentially life-threatening complications. The various types of cancer differ in their underlying causes, development, and manifestations, making it a challenging and heterogeneous disease to tackle [55-64]. The vast majority of oral cancers are classified as squamous cell carcinomas (OSCCs), representing over 90% of cases. Other types of tumors affecting the oral cavity include those arising from the salivary minor glands, melanomas, and lymphomas. OSCCs can display variable degrees of differentiation and frequently result in metastasis to adjacent lymph nodes. The likelihood of lymphatic spreading to the neck is directly correlated with the T stage, depth of invasion, and tumor thickness [65-68]. Every year, around 300,000 people globally are diagnosed with cancer of the mouth, lips, or throat, resulting in about 145,000 fatalities [69]. The five-year survival rate for oral cancer is around 40%, which is relatively low. However, early detection during stages I and II can significantly improve survival rates, exceeding 80%. Unfortunately, half of all oral cancers are not diagnosed until a later stage (III and IV), often due to a lack of noticeable symptoms until the cancer has advanced, such as pain, bleeding, or a mass in the mouth or neck. A delay in diagnosis of more than a month increases the likelihood of an advanced-stage cancer. The patient is often responsible for this delay, but misdiagnosis or failure to suspect oral cancer can also contribute. As cancer progresses and the location of the tumor becomes harder to reach, survival rates tend to decrease. Lip cancer generally has a better prognosis compared to oropharyngeal cancer. Early detection and diagnosis are essential for improving outcomes and survival rates, while also minimizing the severity of treatment-related complications [70-76]. Risk factors for oral cancer include the use of both smoked and smokeless tobacco products, betel quid chewing, alcohol consumption, and chronic inflammation. The incidence of oral and oropharyngeal cancer associated with HPV, particularly type 16, has increased in recent years, mainly among young people. Research has also indicated that the oral microbiome, mucosal inflammation, and oral mucosal trauma caused by teeth or prosthetics may contribute to the development of oral cancer. Additionally, exposure to UV radiation, specifically UV-B, is a risk factor for lip cancer [75, 77-85]. Oral cancer can be seen as a largely preventable illness since most risk factors can be avoided. Nevertheless, it can still affect individuals who do not fall into risk groups. Preventing oral cancer involves two main strategies: primary prevention and secondary prevention. Primary prevention focuses on educating people about behaviors that can reduce their risk, such as avoiding tobacco and excessive alcohol consumption and encouraging HPV vaccination. Secondary prevention concentrates on identifying and treating oral premalignancies and early-stage cancers through screening. Although there has been greater awareness about oral cancer in recent years, the proportion of patients seeking medical attention for advanced disease has remained unchanged over the past four decades [86]. Unlike other prevalent cancers, implementing a universal screening program for oral cancer is not financially feasible and cannot be recommended. Nonetheless, focusing screening efforts on high-risk populations, such as heavy smokers and drinkers or those with a history of cancer outside the head and neck area, may be advantageous. There is evidence from a randomized controlled trial in India demonstrating the benefits of such programs. Furthermore, taking advantage of opportunities to screen for oral mucosal lesions during routine dental check-ups in countries with strong dental care attendance could also help diminish diagnostic delays [87-90].

The environmental factors for oral cancer

-Air pollution

The search results suggest a correlation between oral cancer and air pollution. Exposure to air pollution has been linked to an increased risk of developing mouth cancer [91]. The potential connection between oral cancer and indoor air pollution has been examined, revealing possible associations [92]. The correlation between outdoor air pollution and oral cancer has been thoroughly scrutinized, emphasizing the necessity of comprehending the influence of air pollution on the development of oral cancer [93]. A forecasting model utilizing the MERRA-2 aerosol diagnostic model has been created to evaluate the likelihood of oral, oropharyngeal, and laryngeal cancer due to air pollution among the Thai populace [94]. The link between human behaviors and the onset of oral cancer is widely acknowledged. Lifestyle habits such as tobacco smoking, betel quid or tobacco chewing, alcohol consumption, and deficiencies in micronutrients are regarded as contributing factors to oral cancer [95]. These lifestyle elements and behaviors are shaped by environmental factors at the community level, industrial pollution, access to healthcare services, health insurance, and the quality of healthcare, all of which are contingent on an individual's socioeconomic status. Thus, tackling air pollution and altering lifestyle habits can aid in averting the onset of oral cancer and enhancing patient outcomes.

-Sun Exposure

Extended exposure to the sun, particularly to the lips, can elevate the likelihood of developing lip cancer, a form of oral cancer [96]. Prolonged exposure to the sun's ultraviolet (UV) radiation can increase the risk of developing lip cancer, a type of oral cancer, by damaging the DNA in the cells of the lips and potentially leading to mutations that promote cancerous growth [97]. In Brazil, where oral cancer is a major public health concern, sun exposure is recognized as one of the contributory risk factors for the disease. Excessive sun exposure is listed as a risk factor along with tobacco use, excessive alcohol

consumption, and HPV infection in the development of oral cancer, particularly squamous cell carcinoma (SCC) [97]. Therefore, guarding the lips against excessive sun exposure by utilizing lip balms with UV protection and following safe sun practices can aid in decreasing the likelihood of developing lip cancer and other types of oral cancer linked to sun exposure.

Occupational exposure

The most common occupational exposures to carcinogens that can lead to oral cancer include asbestos, formaldehyde, ionizing radiation, and wood dust. Exposure to these substances has been identified as a significant risk factor for oral cancer development. For instance, asbestos, widely known for its carcinogenic properties, increases the risk of oral cancer. Similarly, formaldehyde, which is commonly used in various industries, is another occupational carcinogen linked to oral cancer. Moreover, ionizing radiation, frequently encountered in specific occupations, is also a well-established risk factor for oral cancer. Furthermore, exposure to wood dust has been acknowledged as a potential occupational hazard contributing to the development of oral cancer. It is essential to minimize exposure to these carcinogens to reduce the risk of developing oral cancer [98, 99]. Asbestos exposure, often encountered in industries like construction and mining, has been associated with a significantly elevated risk of oral cancer. Formaldehyde, commonly used in various manufacturing processes, is another occupational carcinogen that can contribute to oral cancer development [98]. Ionizing radiation, encountered in certain occupations, is linked to the highest number of cancer sites, including oral cancer. Wood dust exposure, prevalent in industries like furniture manufacturing, has also been recognized as a potential occupational hazard for oral cancer [98]. The most common symptoms of oral cancer caused by occupational exposure to carcinogens include: A sore or irritation in the mouth that does not heal; A white or red patch on the gums, tongue, tonsil, or lining of the mouth; A lump or thickening in the cheek; Difficulty chewing or swallowing; Difficulty moving the jaw or tongue; Numbness of the tongue or other area of the mouth; Swelling of the jaw that causes dentures to fit poorly or become uncomfortable; Pain in one ear without a cause [100].

Prevent Oral Cancer

Ways to Prevent Oral Cancer:

-Air Pollution

The search findings suggest that mitigating exposure to air pollution, especially in regions with elevated levels of outdoor and indoor air pollution, is essential for preventing oral cancer and enhancing overall oral health outcomes [92-93]. Efforts and regulations in public health targeting the reduction of air pollution can aid in preventing oral cancer and enhancing oral health. Additional contributors to the onset of oral cancer encompass tobacco usage, alcohol consumption, and dietary patterns [101]. The World Health Organization advises against tobacco use, moderating alcohol intake, safeguarding skin from the sun, minimizing exposure to air pollution, adopting a diet abundant in fruits and vegetables, maintaining a healthy weight, preventing infections, and leading a physically active and stress-free lifestyle to lower the likelihood of cancer [101]. Therefore, addressing air pollution and other lifestyle factors is essential for preventing oral cancer and improving overall health outcomes.

-Sun Protection

Guarding the lips against extreme sun exposure by applying lip balms with UV protection and observing safe sun practices can aid in preventing lip cancer that is linked to sun exposure [97, 102].

-Occupational exposure

Reducing Exposure: Minimizing exposure to occupational carcinogens like formaldehyde, wood dust, coal dust, asbestos, and welding fumes is crucial in preventing oral cancer [100].

Protective Equipment: Ensuring the use of appropriate personal protective equipment (PPE) such as masks, gloves, and ventilation systems can help reduce exposure to carcinogens in the workplace [100].

Regulatory Compliance: Adhering to occupational safety regulations and guidelines set by authorities can help create a safer work environment and reduce the risk of oral cancer due to occupational exposure [100].

Health Monitoring: Regular health monitoring and screening programs for workers exposed to carcinogens can aid in early detection of oral cancer or precancerous conditions, allowing for timely intervention [100].

Education and Training: Providing comprehensive education and training on occupational hazards, safe work practices, and the importance of early detection can raise awareness and empower workers to protect themselves from potential risks [100].

Diagnosis of Oral Cancer

According to the provided sources, early diagnosis of oral cancer is critical for achieving optimal patient outcomes and boosting survival rates. Some essential points related to the diagnosis of oral cancer include:

-Challenges in Early Diagnosis

The survival rate for oral cancer is only 50%, underscoring the significance of early detection and treatment. Clinicians face diagnostic challenges in certain cases of oral cancer, particularly in the early stages, as they can be deceiving and mistaken for other conditions. Shifting demographics and causes of oral cancer add to these challenges, stressing the importance of staying informed about these trends to facilitate timely diagnosis [103].

-Importance of Early Detection

Early identification of lesions is critical for enhancing long-term survival rates in oral cancer patients. Certain factors, including elderly age, tobacco and/or alcohol

usage, prolonged sun exposure, and a history of cancer, can serve as red flags for clinicians to suspect patients may develop oral cancer [104].

-*Strategies for Improvement*

Steps such as regularly scheduled oral cancer screening tests and educating patients on the early warning signs can assist in lowering the probability of developing oral cancer in individuals who are at high risk [104]. Recognizing deficiencies in current knowledge, suggesting areas for further investigation, and developing plans to address them are indispensable steps towards improving the early detection of oral cancer [105].

Treatment of Oral Cancer

According to the given sources, the management of oral cancer employs a multi-faceted strategy that may encompass surgery, radiation therapy, chemotherapy, targeted therapy, and immunotherapy, contingent upon the stage and site of the cancer. Timely detection and swift treatment are pivotal in enhancing patient results and survival rates.

-*Surgery*

Surgical intervention is often the first line of treatment for oral cancer, particularly in the early stages when the cancer is localized. The surgical procedure may involve removing the tumor and surrounding tissue, followed by reconstruction to restore the patient's appearance and function.

-*Radiation Therapy*

Radiation therapy uses high-energy rays to target and obliterate cancer cells. It may be employed alone or in conjunction with surgery, depending on the cancer stage and location. Postoperative radiation therapy helps eliminate any residual cancer cells.

-*Chemotherapy*

Chemotherapy is used in cases where the cancer has metastasized to other parts of the body or to shrink tumors before surgery or radiation therapy. This modality employs drugs that travel through the bloodstream to kill cancer cells.

-*Targeted Therapy*

Targeted therapy focuses on specific molecules involved in cancer cell growth and proliferation, thereby minimizing harm to healthy cells. Drugs used in targeted therapy selectively block these molecules, inhibiting cancer cell growth.

-*Immunotherapy*

Immunotherapy stimulates the body's immune system to recognize and combat cancer cells. This approach can be used independently or in combination with other treatments, depending on the type of oral cancer.

-*Follow-Up Care*

After treatment, regular follow-up care is crucial to monitor for signs of recurrence and manage any adverse effects of treatment. Patients may also undergo rehabilitation to regain normal speech, swallowing, and overall quality of life.

The treatment of oral cancer requires a coordinated effort among various medical professionals, tailoring a personalized plan for each patient. The goal is to achieve optimal outcomes, improve the patient's quality of life, and ensure long-term recovery [106-113].

In summary, Technology and knowledge have greatly contributed to developing and improving various products in different fields, including surgery [114-116], medicine, and dentistry [117-119], oil industry [120, 121], and connections [122]. A complex interplay of genetic and environmental elements influences the development of oral cancer. Our analysis highlights the significant impact of occupational exposure, air pollution and sun exposure in initiating oral cancer, especially when they occur together, heightening the risk. Mitigating this risk necessitates concerted actions to decrease exposure to occupation, air pollution and UV radiation from the sun. Going forward, preventive efforts should prioritize reducing direct exposure to known dangers, refining public health recommendations, and educating individuals at higher risk. Additionally, further research is crucial to uncover the roles of less understood environmental factors like pollution and to devise innovative prevention tactics.

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Approved by any scientific Body

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Ethical issue and approval

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Consent for publication

All authors have given consent for publication.

Conflict of interest

The authors declare no potential conflict of interest.

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