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REVIEW

Oral cancer and nutrition in adolescents

Cáncer bucal y nutrición en adolescentes

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ABSTRACT

Oral cancer has been identified as a growing health problem worldwide, in Cuba, and on the Isle of Youth. In recent decades, there has been a progressive increase in cases among adolescents. The objective of this study was to analyze the role of nutrition as a risk or protective factor in the development of oral cancer in adolescents, as well as sociocultural, economic, and epidemiological variables specific to the national context. During the research process, the following methods were used: documentary analysis, systems approach, historical-logical analysis, analytical-synthetic analysis, and inductive-deductive analysis. A total of 19 international, national, and regional bibliographies were reviewed. Citrus and red fruits, oily fish, green tea, green leafy vegetables, and foods containing vitamins A, E, and K have protective effects against oral carcinogenesis. Red meat, processed meat, refined sugars, and fried foods have promoting or risk effects on oral carcinogenesis. Nutrition is an essential determinant in the development of oral cancer, especially in vulnerable populations such as adolescents. However, adolescence is a malleable stage in which adolescents are receptive to change, making it the ideal time to implement educational strategies to provide them with information that will enable them to consciously adopt healthier lifestyles.

Keywords: Oral Cancer; Nutrition; Adolescents; Protective Foods; Promoting Foods; Prevention.

RESUMEN

El cáncer bucal fue identificado como un problema de salud creciente a nivel mundial, en Cuba y en la Isla de la Juventud. En las últimas décadas ha habido un incremento progresivo de casos en adolescentes. Se propuso como objetivo analizar el papel de la nutrición como factor de riesgo o de protección en la aparición de cáncer bucal en adolescentes, así como variables socioculturales, económicas y epidemiológicas propias del contexto nacional. Durante el proceso de investigación se utilizaron los métodos análisis documental, enfoque de sistema, análisis histórico-lógico, analítico-sintético e inductivo-deductivo. Se revisaron un total de 19 bibliografías internacionales, nacionales y territoriales. Las frutas cítricas y rojas, el pescado azul, el té verde, los vegetales de hojas verdes, así como los alimentos que contengan vitaminas A, E y K poseen efectos protectores en la carcinogénesis oral. Las carnes rojas, carnes procesadas, azúcares refinados y los alimentos fritos poseen efectos promotores o de riesgo para la carcinogénesis oral. La nutrición es un determinante esencial en la aparición de cáncer bucal, especialmente en poblaciones vulnerables como los adolescentes, sin embargo, es una etapa maleable donde el adolescente es permeable a cambios; por ello resulta el momento ideal para implementar estrategias educativas a fin de dotarlos de información que les permita adoptar conscientemente estilos de vida más saludables.

Palabras clave: Cáncer Bucal; Nutrición; Adolescentes; Alimentos Protectores; Alimentos Promotores; Prevención.

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INTRODUCTION

Oral diseases are highly prevalent. Worldwide, 3,5 billion people suffer from them, and they are closely related to noncommunicable diseases, thus creating a considerable health, social, and economic burden;[1] and although improvement is seen in some countries, the burden remains, especially among the most vulnerable in society.

The economic burden imposed by poor oral health and the direct and indirect costs of oral diseases amount to US$545 billion worldwide,[2] placing them among the most costly areas of health. In addition to pain, discomfort, and a lack of well-being and quality of life, oral health problems cause absenteeism from school and work,[3] which in turn leads to learning deficits and productivity losses.

Cancer is one of the greatest problems facing humanity, not only for public health, but for other sciences in general. It is a common term for all malignant tumors, derived from the Latin word *cancer* (crab).[4]

It was Hippocrates (469 to 370 BC) who first described it, using the terms carcinos and carcinomas. Other authors have defined it as a tumor process that occurs in all human and animal populations, appearing in tissues composed of cells with the potential for division.[4]

Oral cancer is a disease of multifactorial etiology, with high morbidity and mortality worldwide. When found in the early stages of development, oral cancers have a survival rate of 80 to 90 %. Unfortunately, most are diagnosed at late stages, with an approximate mortality rate of 43 % within five years of diagnosis.[4]

More than 90 % of malignant neoplasms of the oral cavity correspond to oral squamous cell carcinoma (OSCC). Despite advances in diagnostic methods and therapeutic modalities, OSCC has one of the lowest survival rates.[4]

It develops in any part of the oral cavity, including lesions on the lips, tongue, floor of the mouth, inner lining of the cheeks, and palate. Precursor lesions include leukoplakia, erythroplakia, and epithelial dysplasia, which present a risk of malignant transformation if not detected and treated early.

The prevalence of this disease varies across different continents. Globally, oral cancers are among the most prevalent cancers worldwide, causing 180 000 deaths per year and being the leading cause of cancer-related mortality in some countries.[5]

Countries such as India account for nearly one-third of global cases, with more than 77 000 new diagnoses per year. The high numbers are associated with the use of smokeless tobacco (betel, gutka).[5]

The Philippines, Taiwan, and Malaysia also have high rates due to similar cultural habits; in contrast, in most Western countries, rates range from 3 % to 5 %. In Africa, several countries report rates very similar to those in India.[5]

In Latin America, the situation is not very different. The highest incidences are reported in Argentina, southern Brazil, and Uruguay. In the Caribbean, the country with the highest incidence is Puerto Rico, with a rate of 8,6 cases per 100 000 inhabitants.[5]

In Cuba, it is among the ten most common malignant neoplasms, with a predominance in males (around 70 % of cases), according to studies carried out in provinces such as Camagüey, Holguín, and Santiago de Cuba.[6] Although it mainly affects people with an average age of 60, it has begun to be detected more frequently in adolescents. Although this trend is not yet widely reflected in national statistics, regional studies and medical reports suggest an alarming increase in potentially malignant lesions in this age group.[5]

In Cuba, the incidence rate of oral cancer is 39,2 per 100 000 inhabitants. At the provincial level, around 40 new cases are diagnosed annually in Santiago de Cuba, making it the second leading cause of death from malignant tumors in that territory.[6]

In Las Tunas province, 29 deaths from this disease were recorded in 2023, with the tongue and parotid gland being the most affected locations. In Camagüey, between 2018 and 2022, 113 cases were diagnosed, with a predominance of stage IV at the time of diagnosis (53,98 %) and the most frequent involvement of the tongue (30,05 %).[6]

An unbalanced diet, lacking in antioxidants, vitamins, and essential minerals, can act as a determining factor in the development of oral neoplastic processes. In this sense, nutrition has not only preventive value, but also therapeutic and palliative value.[7]

Despite the implementation and progress made by the National Program for Early Detection of Oral Cancer (PDCB), prevention from adolescence onwards is still undervalued. The early identification of dietary imbalances and their relationship with oral carcinogenesis in Cuban adolescents is essential for public health decision-making.[1,8]

For this reason, the authors set out to analyze the role of nutrition as a risk or protective factor in the development of oral cancer in adolescents, as well as sociocultural, economic, and epidemiological variables specific to the national context.

METHOD

A literature review on the subject was conducted in May and June 2025, using databases such as Scopus, Scielo, Dialnet, Redalyc, LILACS, and Google Scholar. A total of 19 bibliographies published in scientific journals or documents issued by international or national institutions or organizations on studies conducted at the international, national, or regional level were reviewed.

Theoretical and empirical methods were used during the research process. The main methods used were documentary analysis, a systems approach, historical-logical analysis, analytical-synthetic analysis, and inductive-deductive analysis.

DEVELOPMENT

For a long time, it was assumed that oral cancer was exclusive to older adults with a long history of exposure to risk factors. However, recent studies have documented cases in people under the age of 20, many of them with dysplastic lesions or carcinomas that went unnoticed for years.[5]

There are multiple factors involved in the manifestation of this disease in adolescents. An analysis of sociocultural, economic, and epidemiological variables must therefore be carried out:

- Early tobacco and alcohol use: both substances act synergistically to induce mutations, persistent inflammation, and epithelial alterations. It has been shown that even five years of early exposure can be sufficient to initiate dysplastic cellular changes in the oral cavity.
- Unprotected sexual practices and lack of knowledge about the Human Papillomavirus (HPV) at an early age are linked to the appearance of premalignant oral lesions. Oncogenic strains such as HPV-16 have been identified in oral and oropharyngeal carcinomas, and their presence in adolescents is increasingly documented in Latin American studies.[7,9]
- Poor oral hygiene: associated with economic limitations, low educational level, or family neglect, promotes the accumulation of bacterial plaque, chronic lesions (ulcers, gingivitis), and an acidic environment that progressively deteriorates the oral mucosa.[10]
- Nutritional deficiencies: malnutrition, whether due to caloric deficiency or a lack of essential micronutrients, weakens the immune system and the regenerative capacity of the mucous membranes.[8,11]
- Studies by Archivo Médico Camagüey and Medisur report cases of dysplastic lesions in adolescents, often without timely diagnosis.[8] This phenomenon requires not only expanding mass screening to include those under 20 years of age,[12] but also designing educational strategies on oral cancer for this age group.

Diet as a preventive factor

According to Cuban scientific literature, approximately 35 % of cancers are related to diet. It has been shown that a diet rich in antioxidants can reduce the risk of oral cancer by up to 30 %.[4] This protective effect is not limited to strengthening the immune system or neutralizing free radicals, but also involves processes at the molecular and epigenetic levels.

Various nutrients are directly involved in the regulation of gene expression, controlled cell proliferation, and DNA repair capacity, which are fundamental mechanisms in preventing the development of malignant lesions in the oral mucosa.[4] Therefore, adequate nutrition is a key tool not only from a functional point of view, but also because of its ability to modulate biological processes deeply involved in carcinogenesis.

Protective foods

- Vitamin A: essential for cell differentiation and mucosal integrity. Its deficiency is associated with metaplasia and abnormal keratinization.[13]
- Vitamin E: boosts immunity, controls disorders associated with free radicals, maintains membrane integrity, and inhibits the growth of cancer cells, although further studies are needed.[13]
- Citrus fruits: contain vitamin C, which acts as an antioxidant, neutralizing free radicals that damage the DNA of oral epithelial cells, and flavonoids, which have anti-inflammatory and antitumor effects; they inhibit the proliferation of cancer cells and promote apoptosis.[14]
- Red fruits: contain ellagic acid, a polyphenol that inhibits carcinogenesis by blocking DNA mutations and stimulating cell death in abnormal cells. There is evidence that red fruit extracts can reduce the progression of precancerous lesions in the oral cavity.[14]
- Oily fish: contain omega-3 fatty acids. They have a systemic anti-inflammatory effect, regulating prostaglandins and cytokines that may be involved in tumor development. They modulate the expression of genes associated with cell growth and can induce apoptosis in oral cancer cells.[13]
- Green tea: catechins are powerful antioxidants that interfere with tumor growth signals and block enzymes that promote metastasis.[13]
- Green leafy vegetables: they contain folate, vitamin K, and carotenoids. Patients with oral cancer, especially those undergoing treatments such as surgery, chemotherapy, or radiation therapy, are at high risk for vitamin K deficiency due to malnutrition, intestinal dysbiosis, and antibiotic use. This deficiency can compromise tissue recovery, increase the risk of bleeding, and hinder the healing of oral mucosa. Folate is key to DNA synthesis and repair, and its deficiency has been linked to an increased risk of mutations. Carotenoids, such as lutein and zeaxanthin, protect cells from oxidative stress and strengthen the immune system in mucous membranes.[7]

Promoting or risky foods

- Refined and ultra-processed sugars: daily consumption of sugary drinks increases the risk of oral cancer in women by 4,87 times, even without smoking or alcohol consumption. This is attributed to chronic inflammation caused by excess sugar.[13]
- Excessive red meat: when subjected to high temperatures, red meat generates heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), both of which are mutagenic compounds that can alter the DNA of oral epithelial cells.[13]
- Processed meats (sausages, ham, cold cuts) contain nitrites and nitrates, which can form nitrosamines in the body, recognized by the International Agency for Research on Cancer (IARC) as potentially carcinogenic to humans. Heme iron, present in large quantities in red meat, can catalyze the formation of free radicals, increasing oxidative stress and cell damage.[5]
- Fried foods: especially when oil is reused, they contain acrylamide, a toxic and potentially carcinogenic compound. Frying generates lipid oxidation products that accumulate in the mucous membranes, promoting chronic inflammation, one of the main environments that promote carcinogenesis.[7]

In Cuba, the dietary pattern among adolescents includes high consumption of flour, soft drinks, and fried foods, with low intake of fruits and vegetables, which increases vulnerability.[15]

Common nutritional deficiencies in Cuba

- Iron deficiency anemia: affects oxygenation and causes atrophy of the oral mucosa, limiting its regenerative capacity in the face of chemical, thermal, or infectious aggressions.[15]
- Hypovitaminosis A, C, and E: compromises the immune and antioxidant response, weakening cellular defenses and facilitating the development of precancerous lesions.[7,11]
- Zinc and selenium deficiency: micronutrients essential for the activity of antioxidant enzymes such as glutathione peroxidase and superoxide dismutase, whose decrease is associated with increased oxidative stress and damage to cellular DNA.[11]

These deficiencies not only increase the risk of oral lesions, but also affect school performance, physical development, and mental health in this age group.[4,11]

The PDCB was created in 1982 by Santana-Garay, a pioneer in Latin America for its national coverage, focused on prevention, early diagnosis, and comprehensive treatment. This program stands out for its community-based and multidisciplinary approach, which has achieved significant advances that have strengthened its effectiveness and reach.[12]

Several important points stand out within its structure, such as:

- Integration of primary, secondary, and tertiary care levels, which facilitates early referral and access to therapies such as surgery (31 % of cases) and chemoradiation (27,6 %).
- Campaigns focused on oral self-assessment and the promotion of healthy habits supported by the media. Oral self-examination is a fundamental preventive tool that allows for the early identification of possible lesions or abnormalities in the oral cavity, such as ulcers that do not heal, any scaly areas inside the mouth, swelling, or persistent bleeding. It consists of a visual inspection and systematic palpation of the lips, gums , cheeks, palate, tongue, floor of the mouth, and neck, which should ideally be performed every 5 to 6 months.[1,13]

Nationwide campaigns against smoking and alcohol use are implemented, targeting young people through the media and interventions in schools.[9,12] Vaccination campaigns against human papillomavirus (HPV) are currently being implemented.[13,15] Although their implementation is primarily to prevent cervical cancer, from a multidisciplinary perspective and the One Health Approach, they would also prevent oropharyngeal cancers associated with the virus.

In addition, educational programs such as “Oral Cancer and Its Risk Factors” have been designed to improve young people’s knowledge and attitudes about cancer prevention, significantly raising the level of knowledge about self-examination and healthy habits.[13,15]

Although this age group is a priority in Cuba, adolescents often do not attend dental appointments. This could lead to difficulties in the timely diagnosis of potentially malignant lesions and oral cancer.

The misperception that oral health is not a priority during adolescence can lead to neglect, which, in the long term, increases the risk of cancer. Education and prevention are essential to promoting healthy lifestyles from an early age.

By integrating oral health education into school curricula through educational strategies, adolescents can be empowered to be proactive about their health. Initiatives involving legal guardians, teachers, and communities are essential to building a support network for adolescents.

Education is the ideal method for raising awareness and risk perception about oral cancer. Primary prevention must first and foremost motivate people through attractive proposals that achieve mass participation and leadership among adolescents.[16,17]

The teaching methodology acts directly on the individual’s motivation to change and influences the reception and assimilation of the message. It should be noted that there are no standard teaching techniques but rather they must be adapted taking into account the objectives and characteristics of the population group with which one wishes to work. Increased knowledge does not automatically lead to changes in lifestyles, but it is an essential step toward that goal.

Changing harmful lifestyles to beneficial ones is a challenge for science. If each adolescent is aware of the risk factors that influence them, they will be able to perceive the risks to themselves, their family, and the community, which can, from their individual role, turn them into a community health promoter.[18]

The development of policies that address oral health in adolescents is essential to improving the situation. These policies should focus on education and the creation of strategies that promote health in adolescence.

Through intersectoral and interministerial efforts, it is possible to have adolescents who are more informed and active in their own health. It is imperative that both the scientific community and society at large continue to work together to meet this challenge and ensure that the voice of adolescents is heard and counted in the fight against oral cancer.

CONCLUSIONS

Nutrition is an essential determinant in the development of oral cancer, especially in vulnerable populations such as adolescents. However, adolescence is a malleable stage in which adolescents are receptive to change, making it the ideal time to implement educational strategies to provide them with information that will enable them to consciously adopt healthy lifestyles.

RECOMMENDATIONS

- Expand PDCB mass screenings to adolescents.
- Design and implement educational strategies that promote healthy nutrition for oral cancer prevention.
- Design educational resources tailored to adolescents on nutrition and oral cancer.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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