GRADUATION PROJECT

Degree in Dentistry

CORRELATION BETWEEN ORAL CANCER AND DIET

Madrid, academic year 2025/2026

Identification number: 183

RESUMEN

Introducción: El cáncer oral es un importante problema de salud global que se asocia comúnmente con el consumo de tabaco, alcohol y una mala higiene bucal. Sin embargo, recientemente los hábitos dietéticos han comenzado a generar mayor interés, siendo reconocidos como un posible factor modificador en su desarrollo. **Objetivo**: Este estudio examina la relación entre la dieta y el riesgo de cáncer oral, centrándose tanto en patrones dietéticos protectores como perjudiciales. **Material y Métodos:** Tras establecer la pregunta de investigación, se llevó a cabo la búsqueda bibliográfica a través de Medline, PubMed y Google Scholar. Dicha búsqueda se limitó a estudios en humanos, publicados entre 2020 y 2025, y redactados en lengua inglesa. **Resultados:** Los estudios de casos y controles y los estudios de cohortes han demostrado una asociación significativa entre ciertos tipos de alimentos y el desarrollo de cáncer oral. Los hallazgos destacan el efecto protector de la dieta mediterránea (especialmente el aceite de oliva, el pescado, las legumbres, las frutas y las verduras), de ciertos tipos de vitaminas, de una dieta antioxidante y antiinflamatoria, y de determinados tipos de lípidos. Por otro lado, el alto consumo de azúcar, alimentos ultra procesados y dietas proinflamatorias se asocian con un mayor riesgo de desarrollar cáncer oral. **Conclusión:** podemos afirmar que la dieta desempeña un papel importante en el desarrollo del cáncer oral. Promover hábitos alimentarios saludables puede ayudar a reducir su incidencia, sin embargo, se necesitan más investigaciones para reforzar estos hallazgos.

PALABRAS CLAVE

Odontología; Cancer oral; Nutrición; Dieta

ABSTRACT

Introduction: Oral cancer is a major global health problem which is commonly associated with tobacco, alcohol consumption and poor oral hygiene. However, recently the dietary habits have been raising awareness among, being recognized as a potential modifying factor in its development. **Objective:** This study examines the relationship between diet and oral cancer risk focusing on both protective and harmful dietary patterns. **Material and Methods:** After establishing the research question, the research performed through Medline, PubMed and Google Scholar. The search was limited to humans' studies, between 2020 and 2025 and in English. **Results:** Case controls and cohort studies showed the significant association between certain type of foods and the development of oral cancer. The findings highlighted the protective effect of the mediterranean diet (mostly speaking about olive oil, fish, legumes, fruits and vegetables), of certain types of vitamins, of and antioxidant and anti-inflammatory diet and certain types of lipids. The high consumption of sugar, ultra-processed food, and pro-inflammatory diets were resulting in a higher risk of developing an oral cancer. **Conclusion:** In conclusion, we can state that diet plays a significant role in the development of oral cancer. Promoting healthy eating habits may help reduce the incidence however, further research should be performed to strengthen those findings.

KEYWORDS

Dentistry; Oral cancer; Nutrition; Diet

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1. INTRODUCTION

Oral cancer is a worldwide recognized pathology ranked as the 13th most prevalent cancer according to the World Health Organization (WHO). Including the cancer of the lip and oropharyngeal cancer, it can also affect the anterior two/third of the tongue, the oral mucosa, the floor of the mouth, the palate (soft and hard) and the gums (1). According to the WHO, the incidence of new oral cancer cases is around 389 846 and 188 438 deaths in the year 2022. Oral cancer is included in head and neck cancer which are ranked as the 7th most prevalent cancer (2). In the past years the incidence of oral cancer has significantly increased, implying an emergency in the situation as a global public health issue (3)

Cancers are not inherited but the development of a cancer goes through a change in the DNA for a cell to go from normal to cancerous (4). A single gene mutation is not enough, several genes must undergo a mutation for a cancer to develop and several years might pass before the cancer is detected (4). Those small alterations end up in localized lesions in the mucosal membranes of the oral area (4). If not treated, those malignancies can spread to the nearby tissues affecting other parts of the body worsening the outcomes (1). Away from the physical aspect, oral cancer can also affect the social life of the patient by leading to improper way of speaking, chewing and swallowing, having an impact on the psychological aspect (1).

The most common oral cancer is the Squamous Cell Carcinoma, representing about 90% of all oral cancers (5), seen as an abnormal overgrowth of the epithelium and an invasion of the surrounding tissues (6). They are defined as a group of malignancies arising from the squamous cells lining tissues (2). The most common site for oral cancer is said to be the floor of the mouth, the tongue and the palate (7).

Some part of the population is more prone to develop oral cancer such as men and elder people, elderly being a determinant aspect in the worsening of survival rate (2,7). The WHO shows that in 2022, 130 808 men died from oral cancer against 57 630 for female. In 2020, it was shown that in the United States there was 38 380 new cases of oral cancer in men and 14 880 in women and over 10 750 deaths only 3/10 were females (8).

From a demographic point of view, the consumption of some chewing tobacco and nuts in Southeast Asia increases the incidence of oral cancer, adding the economic differences with other more developed countries (2,6).

1.1. Risk factors for oral cancer

According to the WHO alcohol and tobacco are part of the main risk factors for oral cancer and “human papillomavirus infections are responsible for a growing percentage of oral cancers among young people”. It has been shown that about 90% of the oral cancers were due to the consumption of either alcohol or tobacco, or even the combination of both proven to enhance the risk on developing an oral cancer (9,10). As risk factors we can also find many new products as such as the chewed betel quid which is having a high impact in the incidence of oral cancer in the Southeast Asia country such as India (11)

1.1.1. Tobacco

In 2007, the consumption of tobacco was the most important factor in oral cancer development and remains the leading cause after the years, worsening the outcomes of the disease (7,9,11,12). It is stated that smoking could enhance the risk of developing an oral cancer by 5 to 10 times (11). Over sixty toxic chemicals compose tobacco, such as cariogenic substances, which could invade the body’s system and cause harm and damage to the body (13). Tobacco has the capacity to shut down multiple immune system functions preventing the correct body function (13).

In 2019 studies were conducted showing that the intake of tobacco from an early age would increase the risk of developing an oral cancer showing an Odd Ratio doubling when starting the habit of smoking before the age of 25 years old (12). The development of various forms for the consumption of tobacco doesn’t help to reduce the incidence of oral cancer (12).

Increasing the frequency and the quantity of tobacco would increase the risk of developing oral cancer (11)

Other studies demonstrated that the cancer suppressor gene p53 would suffer from abnormal expression and mutations in the case of tobacco consumption and would stop its tumour suppressor action (11,13). Significant associations were seen with the development of potentially malignant lesions into malignant ones due to the intake of tobacco (7). The survival time of a smoker decreased by 30 months compared to non-smokers (7).

1.1.2. Alcohol

Studies were conducted and proved that the consumption of alcohol has a significant effect on the development of oral cancers. All types of alcoholic drinks (wine, beer, whiskeys) were proven to have a positive OR on the development of oral cancer however, the type of

alcohol consumed has an impact, as spirits alcohols such as whiskeys and vodkas would increase the risks (2,14). Alcoholic drinks containing ethanol were also increasing the risk of developing an oral cancer due to the acetaldehyde produced which was proven to be a mutagenic agent suppressing the tumour-suppressor genes (2,14,15). The intake of 10g of alcohol per day was proven to increase the risk of oral cancer around 15% (15) consequently drinks with a higher amount of alcohol concentration would have a more negative effect, however this evidence is only hypothetical (10). Plus the intake of alcohol has various negative effect on the immune system (15). In 2004, studies had the results that drinking every day, even a small amount was enough to increase the risk of oral cancer, which refers as chronic drinking (14). Quitting alcohol would not directly have an effect. At least 3 years of non-alcohol consumption should be achieved for a significant reductio in the risk but after 14 years it was proven that the risk would be close to a non-alcohol consumer (14).

1.1.3. HPV

As stated earlier, Human Papilloma Virus (HPV) is part of the most important leading cause of oral cancer. The first research about the link between HPV and oral affectation were done in the 90s (16). In 2021 more than 450 different types of HPV have been detected (17). This virus affects the skin and mucous membranes causing pre-cancerous or cancerous lesions (17). HPV 1,2,3,4,6,7,10,11,13 were proven to cause benign lesions in the oral cavity in contrary of HPV 16 and HPV 18 are stated to be the most common type of HPV affecting the oral mucosa, leading to malignant lesions at this site (16–19). There is a higher prevalence of HPV in male than female (18). Various publications have detected HPV16 in 10-25% of the tumours of the oral cavity, and in 35.6% of oropharyngeal malignancies, leading to the testing of the genotype 16 specifically for the detection of HPV in oral tumours (18,19). HPV seems to affect mostly the floor of the mouth and the tongue rather than other sites (18). In two decades the presence of HPV in Oral cancer detection have increased form 20% to 70% in most developed countries, mostly due to an exposure of 90% of HPV during sexual practice (19). The relation between poor oral health and HPV infection if still uncertain nowadays (19). However, it was proven that periodontitis, causing inflammation, would lead to an increase in the viral load on the oral cavity due to the proliferation of basal cells from the gingival mucosa (18). In younger generation the prevalence of oral cancer caused by HPV had a significant increase of 113%, highlighting the urgency of the situation in developed countries(19).

1.1.4. Areca nut

The last decade the areca nut, also known as the betel quid or smokeless tobacco, has shown a rising prevalence in the cause of oral cancer. In south-east Asia, chewing betel quid account for half of the oral cancer (2). Nowadays over 600 million people consume areca nut leading it as the 5th most used psychoactive drug in the world (2). In India alone, one in four adult chews betel quid giving an amount of about 223 million consumers (20). In 2014 it was shown that chewing betel quid would increase the risk of having oral ulcers later developing into cancer (21). Starting this habits early in age has a significant impact on the risk of oral cancer as equal as chewing this drug regularly for a long time (21). Conducted studies showed that the consumption of betel quid would have an odd ratio of 2.82 showing a strong association in the incidence of oral cancer (22). 10% of areca nut consumers mix it with tobacco increasing their risk of developing an oral cancer (20). This increase consumption of drug in Asia should raise the public health awareness as younger people such as teenagers are now exposed to this drugs which could, in the future, lead to an increase incidence of oral cancer in this region (20).

1.2. Diet

"Diet" refers to the food and drink an individual consumes, as well as the mental and physical circumstances (frequency and methods of intake) related to eating" not taking into account vitamins, nutrients, fat which are more enveloped in the nutrition (23). Diet has an impact on oral health, but also on general from gestation until the very end of life (24) playing a role in the development of dental caries, periodontal diseases, tooth wear and oral cancer (23). Some food type could have a good impact in the prevention of oral cancer but other food types could in the contrary benefit the development of oral cancer (25). In the 20th century it was shown that most of the oral cancer cases were have a low diet of fruits and vegetables (26). Studies were conducted over fruits and vegetables, meat and fish, nutrients, vitamins, dairy products, and spices looking for their effect on the development or on the prevention of oral cancer. It has been shown multiple types that fruits and vegetables intake would protective effect against oral cancer where on the contrary, red meat, sugary food and processed food would contribute to the development of future oral cancer (4,24,26,27). In elderly it is more difficult to follow an appropriate diet as they lose their taste buds, the functional activity and their salivary gland suffer atrophy (23).

It is, therefore, important to understand the impact of diet on oral health and how raising awareness of this correlation can help and guide people into adopting preventive habits which would significantly reduce their risk of developing a cancer.

2. OBJECTIVE

2.1. Main objective

To analyse the association between lifestyle habits in nutrition and its impact in the development of oral cancer.

2.2. Specific objectives

- To identify food groups that may increase the risk of developing an oral cancer.
- To identify the main foods which have a positive impact on oral cancer incidence.
- To identify potentially dietary components or nutritional strategies to be integrated into a public health guideline for oral cancer prevention.

3. MATERIAL AND METHODS

In this documentary research, the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) methodology was used.

3.1. Search strategy

3.1.1. Electronic search

The research was performed using 3 databases, Medline, PubMed and Google Scholar without any time restrictions. The research was based on the following combinations of keywords [(“oral cancer” OR “cancer of head and neck”) AND (“diet” OR “food” OR “nutrition” OR “food habits” OR “eating habits” OR “lifestyle”) AND “cancer prevention”]; [(“oral cancer” OR “head and neck cancer”) AND (“fruit” OR “vegetable” OR “fish” OR “meat” OR “vitamins” OR “sugar” OR “nutrients”)].

During the research, no data restrictions were applied.

The first search was performed on October 3rd, 2025, and the last search was conducted on November 6th, 2025.

3.1.2. Manual search

In addition to the electronic search, a manual search was conducted though the included references of multiples articles.

3.2. Study selection and data extraction

The studies found were exported in “ris” format to Rayyan website. This website was first used to detect the duplicate copies. Then these inclusion criteria were used for the eligibility of the paper:

- Articles published in English
- Articles will full text accessibility.
- Articles published between January 2020 to nowadays.
- Human studies

The selection was then enhanced using the following exclusion criteria:

- Article in other language than English
- Meta-analysis articles and systematic reviews
- Articles published before 2019
- Animal studies

The meta-analysis and systematic reviews were excluded for the PRISMA diagram results but might be use for the discussion section (to be change after the discussion is done). Studies focusing mainly on alcohol consumption were also excluded, as its role as a major risk factor for oral cancer is already well-established. This choice allows the research to focus on less documented nutritional patterns.

3.3. Formulation of the research question

The search question of this study has been developed using the PICO tool, mainly focusing on (PIO). The “C” component was omitted in this research as we are going to focus on many different diet types rather than focusing in a single one.

- P = patient with oral cancer or at risk of developing oral cancer.
- I = identify studies searching the link of diet with oral cancer.
- O = understanding the possible link between food groups and oral cancer.

4. RESULTS

4.1. Study selection

A total of 112 articles were identified. Ninety of them were identified by electronic search and twenty-two others were identified by manual search. Seven duplicates were removed, and eight articles were eliminated by an automatic tool (ZOTERO in this case). Of the ninety-seven remaining articles, fifty-seven were removed after the lecture of titles and abstracts. Out of the forty remaining, ten were eliminated due to no access to the full paper. Then, due to the exclusion criteria (language, age of the paper and type of paper), twenty-four papers were excluded giving a total of six final scientific papers.

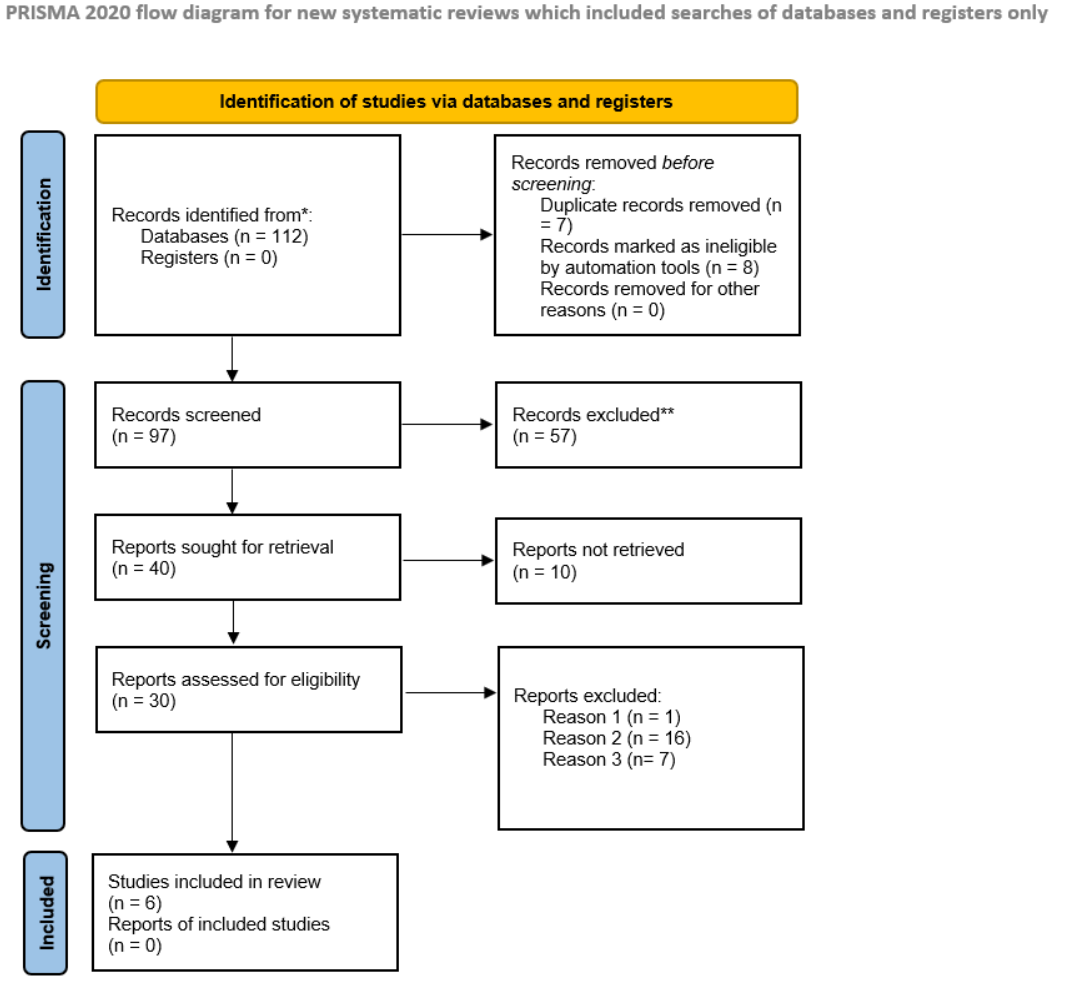


Figure 1. PRISMA flowchart of the study selection (28)

4.2. Geographic pattern

These studies were performed among various countries such as China, Spain, Iran and United States.

4.3. Gender disparities

In all these studies, both sex were examined, except for one study which only examined females.

4.4. Diet and oral cancer

Different diets were studied among these studies: the mediterranean diet (30,32), inflammatory diet (29), diet's antioxidant capacity (31), fat intake diet (34)and high sweetened beverage (33).

The studies were mostly focusing on oral cancer and head and neck cancer.

The largest observed size of relation to cancer was associated with inflammatory diet mixed with alcoholic drinks (OR: 4.35, 95% CI/ 1.54, 12.25) (29). These results implying a strong association between inflammatory diet and alcohol in the development or oral cancer.

4.5. Case-control studies

Regarding case-control studies, 4 were answering to the inclusion criteria.

4.5.1.Inflammatory diet

In this study Bao et al. (29) worked on the association between head and neck cancer and the mediterranean in a sample population of 720 including males and females. Taking place in a south-east province of China the study was conducted for 8 years. The highest OR regarding association between inflammatory diet and oral cancer was of OR: 2.57; 95% CI: 1.54 - 4.29, p = 0.0013 (29). The association with inflammatory diet and cancer was also studied within subgroups showing different added criteria. Male subjects had shown a higher correlation (OR: 2.94 95% CI: 1.44 - 6.00) and patients older than 60 years had an even higher association

(OR:3.13, 95% CI: 1.19 - 8.27) (29). Subjects who never smoke showed a decreased association (OR:2.47, 95% CI: 1.25 - 4.86) contrary to alcohol drinkers subjects who showed the highest correlation within the subgroups (OR:4.35, 95% CI: 1.54 - 12.25). Subjects with poor oral hygiene showed one of the highest associations of inflammatory diet with oral cancer (OR:4.23, 95% CI: 1.83 - 9.81) (29).

Table 1 Characteristics of articles included in the research (28-33). OR = Odd Ratio, HNC = Head and Neck Cancer, FRAP = Ferric Reducing Antioxidant Power, TRAP = Total Radical-trapping Antioxidant Parameters, HEI = Healthy Eating Index, MDS = Mediterranean Diet Score, SSB = Sugar-Sweetened Beverage, LCFA = Long Chains Fatty Acids, FA = Fatty Acids

First author	Study design	Sample group	Cancer type	Diet type	Effect size
Xiaodan Bao (29)	Type of study: case-control study Setting: China Period: September 2010 to June 2018 Data collection: interview-based questionnaire	Case: 295 Controls: 425 Total: 720 Gender included: male & female Age: mean of case 58 years and mean of controls 61 years	Oral cancer	Inflammatory diet	- Adjusted OR = 2.25 - P<0.05 - Male subjects OR=2.94 - >60 years subjects OR=3.13 - Never smoking subjects OR=2.47 - Alcohol drinkers subjects OR=4.35 - Poor oral hygiene OR=4.23
Constanza Saka-Herran (30)	Type of study: case-control study Setting: Spain Period: not reported Data collection: survey	Case: 101 Controls: 101 Total: 202 Gender included: male & female Age: mean 65.8 years	Head and neck cancer	Mediterranean diet and vitamin C	Mediterranean diet adjusted OR= 0.88 (0.79-0.98) P>0.001
Fatemeh Toorang (31)	Type of study: case-control Setting: Iran Period: not reported Data collection: interview-based questionnaire	Case: 879 Controls: 3409 Total: 4288 Gender included: male & female Age: >30 years	Head and neck, lip, oral cavity cancer	Diet antioxidant capacity	For HNC: FRAP OR=0.49 (0.39-0.61) TRAP OR=0.49 (0.39-0.62) For lips and oral cavity: FRAP OR=0.51 TRAP OR=0.59
Veeral Saraiya (32)	Type of study: case-control Setting: United States Period: not reported Data collection: questionnaire	Case: 1170 Controls: 1303 Total: 2473 Gender included: male & female Age: 20 to 80 years	Head and neck cancer	Healthy and mediterranean diets	HEI OR=1.35 (1.21-1.50) and p=0.0552 MDS OR=1.13 (1.02-1.25) and p=0.8933
Luis Gomez-Castillo (33)	Type of study: cohort Setting: not reported Period: HNS 1979-2016 and HNSII 1989-2017 Data analysis: July 2023 to June 2024 Data collection: follow-up questionnaire	Sample: 162602 Gender included: female Age: mean 43 years	Oral cavity	High sugar-sweetened beverage	>1 SSB daily HR=4.87 2 to 6 SSB weekly HR=1.82
Hania M Taha (34)	Type of study: cohort study Setting: United States Period: November 2008 to October 2014 Data analysis: Data collection: surveys	Sample: 476 Gender included: male & female Age: mean 61 years	Head and neck squamous cell carcinoma	Fat intake	-LCFA intake HR=0.55 P=0.02 -unsaturated FA intake HR=0.62 P=0.04

4.5.2.Mediterranean diet

Saka-Herran et al. (30) studied the link between mediterranean diet and head and neck cancer in a sample population of 202 including both males and females. This study was conducted in Spain. Subject with the highest adherence to the mediterranean diet had shown the low risk of association (OR: 0.88, 95% CI: 0.79-0.98). However, the adherence to a healthy diet rather than the mediterranean one has shown to have the lowest risk association to head and neck cancer (OR: 0.29, 95% CI: 0.10-0.84). within the mediterranean diet, the type of food consumed was also studied individually showing that a moderate intake of eggs has the lowest association (OR: 0.26, 95% CI: 0.08 – 0.81) where the intake of legumes has the highest association with head and neck cancer (OR: 2.98, 95% CI: 0.96 – 9.28) (30).

The study performed by Saraiya et al. (32) also showed the correlation between the mediterranean diet and head and neck cancer. The study was performed on 1303 subjects in the United States including both males and females. They showed an OR of 1.08 (1.01 – 1.14) for the adherence to the mediterranean diet with 13% greater odds for head and neck cancer. On the other hand, the adherence to a healthy diet showed an association slightly lower (OR: 1.04 (1.02 – 1.05) but with 35% of greater odds for head and neck cancer (32).

4.5.3.Vitamin C

Saka-Herran et al. (30) also studied the link between vitamin C and head and neck cancer again in a sample population of 202 including males and females. The intake of vitamin C through daily life natural sources and intake of supplements of vitamin, was showing a significant association (OR: 0.25, 95% CI: 0.10 – 0.62) compared to subjects without daily intake of vitamin C taking only supplements (OR: 2.33, 95% CI: 0.44 – 12.3) (30).

4.5.4.Diet antioxidant capacity

In this research, Toorang et al. (31) studied the effect of an antioxidant diet over the development of head and neck cancers. The study was performed in Iran with a sample population of 4288 including males and females. They studied the Total Antioxidant Capacity of a diet (dTAC) of different food groups, the Ferric Reducing Antioxidant Power (FRAP) and the Total Radical-trapping Antioxidant Parameters (TRAP). It was showed an association with FRAP (OR:0.49, 95% CI: 0.36 – 0.71) and with TRAP (OR: 0.49, 95% CI: 0.39 – 0.62). A study for lip and

oral cavity was also performed showing for FRAP (OR: 0.51, 95% CI: 0.36 – 0.71) and for TRAP (OR: 0.59, 95% CI: 0.44 – 0.82), implying that an antioxidant rich diet could decrease the risk of head and neck cancer development (31).

4.6. Cohort studies

Regarding cohort studies, only two were selected, the first one conducted from 1979 to 2017 (33) and the second one from 2008 to 2014 (34).

4.6.1.High-sugar sweetened beverages

The largest sample size was from Gomez-Castillo et al. (33) with 162602 women in total in a period of 37 years. They performed two samples study one from 1979 to 2016 and the second one from 1989 to 2017. They reported a positive association between high-sugar sweetened beverage and the development of oral cavity cancers (HR:4.87).

4.6.2.Fat consumption

The second cohort study conducted by Taha et al. (34) in the United States, included 476 individuals, with both male and females during a period of 6 years. It was shown, through various fat intake that its consumption has a positive protective association in regards with the recurrence of oral cancer and mortality in severe cases. Unsaturated fatty acids were examined as much as the long-chain fatty acids, both showing a positive association. In terms of disease recurrence, the long-chain fatty acids showed reduced risk of recurrence (HR: 0.60, 95% CI: 0.36 – 1.01), P-trend = 0.05). In terms of mortality, the long-chain fatty acids showed a higher association of protection (HR: 0.55, 95% CI: 0.34 – 0.91, P-trend = 0.02). The unsaturated fatty acids also showed a reduction in head and neck mortality (HR: 0.62, 95% CI: 0.40 – 0.97, P-trend = 0.04) (34).

5. DISCUSSION

5.1. Summary of the findings

The primary objective of this study was to analyse the association between different diets and oral cancer. Through the results we can confirm a significant correlation between these two factors. This review has highlighted how various types of diets such as the mediterranean ones or the ones rich in sugar, or fat could impact the cancer development and outcomes. The data found suggest a strong association in the prevention of oral cancer through the consumption of a Mediterranean diet, of vitamin C, of food rich in antioxidant capacity. Those finding will be particularly relevant in the implementation of public health guidelines focusing on the prevention of cancer. However, diet is not always a protection for the development of cancer. We have seen that pro-inflammatory diet high consumption of sweet in various drink resulted in higher Odds Ratio showing that poor nutrition has a negative impact on the prevalence of oral cancer.

Let's not forget that the diet is never alone. High consumption of tobacco, alcohol and poor lifestyle habits also impact negatively the prevalence of cancer enhancing the cariogenic effect of some poor diet.

5.2. Diet with cariogenic effect

5.2.1.Sugar

As the study of Gomez-Castillo et al. (33) showed the consumption of sweetened drink had an significant impact on the development of cancer. It showed that women drinking a sweetened beverage once a day would present a risk multiplied by 4.87 compared to the women drinking only sweetened beverage once a month. This value is even more significant when it is confirmed that tobacco and alcohol, as the major risk factors of oral cancer, have no link to it.

It is important to note that nowadays, eating sugar is easier than before, with an easier access to it. We can find sugar in most of the drinks (except for water), in the processed food as the food industry is using it as marketing product using the inexpensive cost and the ability of increasing sweetness, so increasing flavour for some products (35). It was shown that the consumption of sugar was leading to a weakness of the mucosal barrier easing mutations of the buccal epithelium (35) easing the development of cancerous cells in the epithelium of the buccal mucosa. The excessive intake of sugar has been leading the past years to an increase of diabetes, which, in some cases, end up in the development of some malignancies such as oesophageal and oral cancer (35).

Other studies focused on the high consumption of sugar (36) and obesity (35) which were leading to a state of chronic systemic inflammation leading us to the dietary inflammatory index.

5.2.2.Dietary Inflammatory Index

The study of Bao et al. (29) has highlighted the fact that inflammatory index of food could have an impact in the development of oral cancer. It is also known that inflammation can lead to oxidative stress increasing the chance of cancer development (36). Some meta-analysis proved that a pro-inflammatory diet would significantly increase the risk of head and neck cancer with an Odd Ratio of 2.27 (37).

We can also state a positive correlation between the dietary inflammatory index and oral cancer risk, as reported by Bao et al. (29) finding a strong link in what is described by Anil et al (35). Specifically speaking again of sugar, here as the primary component of a pro-inflammatory nutrient, its high intake would promote a state of chronic inflammation. And by the triggering of some hormones, such as insulin in diabetic patients, there is an enhance of cancerous cell survival and an inhibition of apoptosis in oral epithelial cells as previously stated (35).

5.3. Diet with protective effect

5.3.1.Mediterranean diet

From the results we were able to determine the protective effect of the mediterranean diet in the prevention of oral cancer. However, as the study of Saka-Herran et al.(30) showed an Odd Ratio lower than 1 the study of Saraiya et al.(32) nuances these results. This leads us to a more specific point of view of the origin of the products and even the type of product daily eaten in this diet. As some studies already explained, the quality of the products and their accessibility depending of the region of the world would have an impact in the adherence and the effect of the mediterranean diet over people's health (38).

A new study showed a positive association between the adherence to the mediterranean diet and oral cancer with an Odd Ratio of 0.565 (39), highlighting the results from Saka-Herran et al. (30). Additionally, people closely adhering to this diet would have 60% reduced risk of developing an oral cancer compared to people showing low adherence to this diet (39).

As part of the mediterranean diet we can find olive oil which was proven by the mean of hydroxytyrosol would act against the malignant cells thanks to its ability of autooxidation, and to its anti-proliferation mechanism (40). Through other studies we can again highlight that olive oil has a significant protective effect on the development of oral cancer with an Odd Ratio of 0.4 (41).

Fish as one of the primary components of the mediterranean diet has proven its correlation with oral cancer prevention through some studies showing an Odd Ratio of 0.71 (42). Other studies done in 2016, found no association between fish intake and the appearance of oral cancer, showing here that fish alone is not enough as a mediterranean diet to have effect on malignancies appearance. However, another source of protein, as red meat, which is part of the mediterranean diet but not a central food of it, has shown a significant correlation showing an overall Odd Ratio of 1.46 (43).

Some studies focused on the power of vegetables showing that eating them raw or cooked could have a consequence on the results (44). The Odd Ratio of raw vegetables (0.64) was proven to be higher than the one from cooked vegetables (0.44) for oropharyngeal cancer. However in a study released a year after, the raw vegetables were showing an Odd Ratio lower than the cooked vegetables (0.4 and 0.5) (41). This difference could be explained by the type of vegetables consumed during the studies, which could lead to a new study to be performed focusing on the different vegetables available for the mediterranean diet.

It is important to understand that the adherence to the mediterranean diet could play a role in the prevention of oral cancer, but the quality of the food and the amount consumed should highly be taken into account.

5.3.2.Antioxidant capacity of the diet

Our results show the positive impact of the implementation of antioxidant food in our diet in the prevention of oral cancer (31). Moreover other authors studied the antioxidant capacity of specific food such as garlic and cinnamon (45). They proved that garlic has a potent antioxidant activity through lipid peroxidation. By this mechanism, fats are broke down resulting into secondary products which could act as signalling molecules resulting in the activation of protective genes, ending in the inhibition of oral cancer on the buccal mucosa (46). The cinnamon showed an anti-proliferation activity on oral cancer cells and an inhibition of tumour cells, leading to the decrease of tumour growth (45). They also proved hat basil, which is also part of the mediterranean diet, has a significant impact in the prevention of oral malignancies.

It was proven that having an antioxidant diet would reduce the oxidative stress caused by chemotherapeutic agents however, the excess of those antioxidants would have a negative impact and enhance the chances of recidivism of cancer (47).

An other study from 2013 showed a “clear protective effect” of antioxidant and fibers (48). Moreover, a study from 2024 explained that fruits, legumes and vegetables, which are again part of the mediterranean diet, had a significant antioxidant capacity, having a deleterious

effect on the development of oral cancer and would have a role in the prevention of chemotherapy treatment (49).

5.3.3.Lipids in diet

As we have seen in our results lipids can be efficient in the prevention of recurrence of cancer and even in the mortality rate of cancerous people (34). But it is important to understand that there are different types of lipids in food that would play different role in the development of cancers. Taha et al. (49,50) showed that saturated fats would increase the global mortality in patient with a cancer in the head and neck however, they proved that unsaturated fat taken before a chemotherapy treatment would increase the diminution of recurrence of cancer.

For example, olive oil, which is a monounsaturated fat showed an Odd Ratio of 0.4 showing a diminution of 60% in the risk of oral cancer. The study explained that due to high amount of oleic acid in olive oil and polyphenols, there will be a mechanism of anti-inflammation and antioxidation leading to anti-cancerous properties (5).

The consequence of lipids on a cancerous cell was shown through different studies, explaining that lipid would induce a mechanism of autophagia of the cancerous cells of the body (51) adding also that lipid could play a role in the signalling of cancerous cells in the body (36).

5.3.4.Vitamins in diet

Our results showed the role of vitamin C in the prevention of cancer, mostly for natural sources than complements alone (30). Through studies it was proved that vitamins were protecting body cells from tumours transformation by modulating the body's immune response (52). A diet rich in various vitamins is associated with a reduced risk of developing an oral cancer (26). We previously studied vitamins C but there are many more types of vitamins that could play a role in the prevention of oral cancer. Some researchers found that a vitamin D deficiency was significantly associated with an increased risk of oral cancer development (52). Vitamin D also plays a role in the prevention of inflammation by an immune system regulation preventing the oral carcinogenesis process in the body (52). We can also find vitamin B9 as an important factor in the prevention of oral and pharyngeal cancers. However, its deficiency added to the consumption of alcohol would end up as a risk factor for the development of oral cancer (52). Studies worked on vitamins E showing that its antioxidant action would block the activation of pro-carcinogens blocking the process causing chromosomal abnormalities in cells (52,53). With Odd Ratio of 0.26 we can state that vitamin E plays a significant role in the prevention or oral cancer (26). However, as some vitamins play a preventive role in the development of cancers,

some other could in the contrary increase the chance of developing one. For example, vitamins A, which are essential for the normal cellular growth, taken in excess would be directly associated in the increase of oral cancer risk (OR = 1.88) (26).

5.4. Diet and the other risk factors

Most of the results found can be impacted by many other factors such as age, gender, and lifestyle habits. People with lower socioeconomic status would be more prone to consume alcohol and tobacco thus enhancing their chances of developing oral cancers(36). Pro-inflammatory diet (such as processed food of highly sweetened food) is also the consequence of lower socioeconomic status, and having a poor diet is estimated to be responsible for 10 to 15% of oral cancer cases(36). Moreover, through studies, it was proven that women tend to adhere more easily to an healthy lifestyle and diet than men, reducing their risk of developing oral cancers (54). However, we also saw through the results that having an anti-inflammatory diet would not be sufficient if alcohol and tobacco consumption are added to it. As known, they can increase the permeability of the oral mucosa consequently easing the absorption of harmful components of tobacco, alcohol and even from certain food like processed meat (5,36). A diet rich in antioxidant and vitamins would help to reduce the oxidative stress induce by the consumption of alcohol and tobacco, but again alone it would not be as efficient as needed (5,36).

5.5. Implications for a public health guideline

The finding of this study highlights the role of dietary habits in the prevention of oral cancer therefore specifying the importance of integrating nutritional strategies into public health guidelines. Promoting specific dietary patterns could be very effective in preventing approach, specifically combined with the reduction of bad habits such as tobacco and alcohol. Public health guidelines should encourage consumption of fruits, vegetables, legumes, food rich in antioxidants, specific vitamins and anti-inflammatory compounds (30,31,39). The implementation of the mediterranean diet should also be encourage as it was associated with a protective effect against the development of oral cancers (9,30,38–40). As public health guidelines should focus on the protective dietary habits, they should also recommend the reduction of certain type of eating habits. They should promote the reduction of sweetened food, beverages and ultra-processed food characterized by high inflammatory potentials (29,33,35). Consequently, future health programs should highly focus on the diet approach as it has proven its various effects on the overall development of cancers.

5.6. Limitations and strength of this study

All studies include limitations of their work and here even if the proofed found are solids there are some limitations that should be highlighted. The small number of articles used in the results of this study, after the selection done through the eligibility criteria, could impact the overall conclusion of the study. Moreover, the majority of the articles used questionnaires as data collection which could certainly include bias from the participants as they can forget the fill them or lie about their real food consumption during the studies.

However, as limitations can be found, strength can also follow. The use of the PRISMA chart state of a total reproducibility of the selection of the articles, implying that selection bias should not be found for this study. The use of a study implying around 160000 women over multiple decades gives a powerful result about sweetened beverages. The 6 studies were conducted over different geographical regions such as China, Iran, Spain and the United States giving consequently a big diversity for the results of our study. Finally, the data currency, we focused on very recent publications, from 2020 to 2025 using the latest information about our topic.

6. CONCLUSIONS

In conclusion, this review highlights a clear association between the diet and the risk of developing an oral cancer. The results gathered from the different studies showed multiple dietary habits which play a role, either of protection or of harm in the development of carcinogenic cells.

1. However, the high consumption of sugar, sweetened beverages, processed foods and inflammatory nutrients would increase the risk of oral cancer development. Moreover, this risk is to be amplified if it is combined with habits already well-known such as smoking, alcohol consumption, and bad oral hygiene.
2. Diet rich in antioxidants, anti-inflammatory diets, mediterranean diet were proved to reduce the risk of oral cancer. The addition of specific natural nutrients such as vitamin C help in the reduction of inflammation and oxidative stress induced by certain type of food.
3. Finally, all these findings help us to understand the overall importance of a controlled diet during life. This is why it is important to promote good habits through health programs, helping the population in the understanding of the consequences of bad life habits.

Additionally other studies could be conducted to clarify better the link between diet and oral cancer development through specific aliments, specifying the outcomes through the amount consumed. Another question that may arise is whether people who tends to follow a mediterranean diet also tend to be more attentive to their overall body health, consequently contributing to a reduced risk of any cancer development.

7. SUSTAINABILITY

It will be important here to highlight that dietary habits don't only influence the individual health outcomes but also the environmental and social aspects. Promoting healthy and balanced diet rich in fruits, vegetables, legumes, olive oil and vitamins, and the mediterranean diet would increase the consumption of plant-based foods, a moderate consumption of fish and dairy products and a very limited consumption of red meat. The type of diet would be associated to a low environmental impact compared to diet rich in sugar or ultra-processed foods. Encouraging this type of lifestyle habits would benefit the human health as much as the environment protection. Moreover, the reduction of highly processed food and sugar would decrease the demand of industrial production ending in a significant and positive impact on the environment pollution. Thus, the promotion of healthy dietary habits would increase the local productions and the consumption of seasonal food supporting local agricultures and reducing the carbon footprint linked to food transportations.

Consequently, the integration of these dietary patterns in oral health program would not only benefit the prevention of oral cancers but also improve the environmental outcomes due to this food system.

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9. ANNEXES