Original Article

# A Comparative Analysis of Dominant Dietary Patterns in Patients with and without Oral Squamous Cell Carcinoma

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## Abstract

**Background:** As a modifiable risk factor, nutrition plays a pivotal role in the prevention or delay of oral squamous cell carcinoma (OSCC). This study was aimed to investigate and compare the dominant dietary patterns in the patients with and without OSCC.

**Materials and Methods:** This case-control study evaluated the usual dietary intake of 80 cases and 120 controls during 2019–2020 using the 117-item Food Frequency Questionnaire, with confirmed validity and reliability. Factor analysis was used to detect the dominant dietary patterns. Data analysis was done by SPSS (version 21) using the Chi-square test, ANOVA, logistic regression analysis, and independent *t*-test ($P < 0.05$).

**Results:** Three dietary patterns were identified, including the western dietary pattern, health dietary pattern, and traditional dietary pattern. The odds ratio (OR) = 1.181 and confidence interval (CI) = 0.671 and 2.082 were found for the western dietary pattern, OR = 1.087 and CI = 0.617 and 1.914 were detected for the healthy dietary pattern, and OR = 0.846 and CI = 0.480 and 1.491 were reported for the traditional dietary pattern. No significant difference was found between the study groups in the dietary pattern and the risk of disease. This relationship remained insignificant after adjustment for the energy intake and confounding factors.

**Conclusion:** There was no significant relationship between adherence to healthy, traditional, and western dietary patterns and OSCC. Consumption of vegetables and nuts had a protective role against the disease, but risky behaviors such as smoking and alcohol use were directly associated with the incidence of the disease.

**Keywords:** Diet, head-and-neck squamous cell carcinoma, nutritional sciences, squamous cell carcinoma

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## Introduction

Oral squamous cell carcinoma (OSCC) involves more than 90% of oral cancers.[1] OSCC is one of the major causes of death around the world[2] and the third leading cause of death in Iran.[3] According to the World Health Organization in 2015, cancer is the first or second leading cause of death before the age of 70 in 91 out of 172 countries and is ranked three or four in 22 countries.

With the rapid growth of population and aging worldwide, the growing prominence of cancer as the main cause of death partly shows a remarkable decrease in mortality rate due to stroke and coronary heart disease compared to cancer in many countries.[4]

Oral cancer affects the patients' quality of life because it reduces food and speech efficiency and influences the beauty of the oral cavity.[5] This cancer is caused by interactions between

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genetic and environmental factors.[6] Consumption of tobacco and alcohol is also considered a strong behavioral risk factor for squamous cell carcinoma (SCC).[7,8] Viruses, especially human papillomavirus, and diet have recently been found to be associated with SCC.[8]

Nutrition is a scientific method to study the relationship between living organisms and foodstuffs.[1] Improper or excessive nutrition can be a major risk for the development of chronic diseases, including cancer.[6,9] Dietary patterns reflect the interests and food preferences of people under the influence of genetic, cultural, social, sanitary, environmental, and economic factors as well as lifestyle.[9] They have long been known as a useful tool for the overall and detailed evaluation of major aspects of diet and its role in health and disease because they combine several foodstuffs (foods, food groups, and nutrients). Foods may interfere with the access to nutrients and circulation process and therefore the risk of disease.[10]

A large number of epidemiologic studies on dietary patterns and oral cancer have been conducted in western countries, and few studies have been carried out in this regard in the Asian regions.[1,9] Numerous studies have investigated the relationship between individual foodstuffs and cancer. Yet, studies on individual foodstuffs provide information about a single material and do not involve the complexities of the general diet, which includes interactions between the components of foodstuffs in a diet.[11] The researchers in this study aimed to investigate the relationship between dietary patterns and oral cancer using new methods such as factor analysis.[1]

## Materials and Methods

### Participants

A total of 80 participants in the case group and 120 in the control group were recruited by convenient sampling among the people referring to the dental school of Isfahan University of Medical Sciences, private offices, and private, public, and charitable clinics of Isfahan, Iran. The inclusion criteria consisted of the age 18 or higher, willingness to participate in the study, diagnosis of oral cancer by a physician, and confirmation of biopsy in the case group. The exclusion criteria included unwillingness to participate in the study, suffering from special diseases and use of special drugs, having a special diet or special food bans, lack of response to 25 items of food items in the questionnaire, or reported energy intake out of 800–4200 Kcal.

### Data collection

The data of common Iranian foods with standard consumption were gathered by the 117-item Food Frequency Questionnaire, which its validity and reliability had been examined in prior studies.[11] During the home interviews, the participants were briefed about the project's objectives, and for those who agreed to participate, clinic appointments were scheduled. In addition to the informed consent forms which were completed personally by the participants, all the questionnaires were completed by a trained dietitian. The standard units (g and g/day) were reported using the manuals of domestic scales for four nutritionists. The foodstuffs were classified into food groups based on the similarity of nutrients.

### Data analysis

Extraction of dietary patterns was done by factor analysis. SPSS (version 21) (IBM, Armonk, NY, United States of America) software was sued for the statistical analysis of data. Dietary patterns were determined by factor analysis. A scree plot was used to determine the number of factors (dietary patterns). Kaiser–Meyer–Olkin test and Bartlett's test of sphericity were used to measure the adequacy of samples and the relationship between variables. Varimax rotation was applied to interpret the factors to extract the final factors. The dietary patterns were interpreted based on the factor load of foodstuffs. The score of each individual for a special dietary pattern was calculated by multiplying the amount of foodstuff consumed in that pattern by the estimated parameter and obtaining their sum. The normality of data was evaluated by the Kolmogorov–Smirnov test. Comparison of the means of quantitative variables among the quartiles of each dietary pattern was carried out by one-way ANOVA test. The comparison of qualitative variables among the quartiles was made by the Chi-square test. The adjusted mean dietary intake for age, gender, and energy among the quartiles of the consumed dietary patterns was determined by the ANOVA test. Logistic regression analysis was used to determine the relationship between the identified dietary patterns and OSCC. The independent *t*-test was used to compare the two groups in terms of food intake in the food groups. The significance level in this study was set at $P < 0.05$.

## Results

The mean (standard deviation) age of the healthy participants was 51.18 (15.5) and that of the patients was 55.25 (14.11), indicating no significant difference between the two groups ($P = 0.06$). Further, 66 (55%) participants from the control group and 43 (53.8%) from the case group were female. There was no significant difference between the study groups in terms of gender ($P = 0.862$). There was also no significant difference between the healthy and patient participants in terms of height, weight, energy, marital status, physical activity, disease history, and drug and multivitamin consumption. Family history of cancer, smoking, and alcohol use were significantly more prevalent in the case group than the control group. Moreover, 77% of the healthy participants had high school diploma, bachelor's degree, or higher education degree, but this was reduced to 42.6% in the case group. Hence, the education level was significantly higher in the healthy participants ($P = 0.00$). Furthermore, 58.3% of the healthy participants had an income of more than 30 million rials, while 27.5% of the patients had this amount of income, indicating a significantly higher income in the healthy participants. Based on the data of socioeconomic status (e.g., car ownership, personal computer,

job, and number of family members), the control group had a significantly better socioeconomic status than the case group. Consumption of soft drink, pizza, and processed and red meat in the western dietary pattern and vegetables and nuts in the healthy dietary pattern was significantly higher in the healthy participants. Consumption of tea and coffee in the western diet was significantly higher in the patients. Consumption of other food groups was not significantly different between the healthy and patient groups [Table 1].

The results of factor analysis showed three dominant dietary patterns in the studied patients. A name was chosen for each dietary pattern based on the food group in each factor load. Consumption of processed and red meat, soft drink, unrefined grains, pizza, egg, spices and pickles, tea and coffee, chicken and fish, and potato was higher in the western dietary pattern. In the healthy dietary pattern, consumption of vegetables, fruits and fruit juice, olive, cereal, and nuts was higher. In the traditional dietary pattern, consumption of egg, liquid oil, hydrogenated fats, low-fat dairy, high-fat dairy, refined grains, sweets, and fish and chicken was higher.

In western dietary pattern odds ratios (ORs) was 1.181, with 0.671 and 2.082 for confidence interval (CI), whereas ORs for traditional dietary pattern represented 1.087 with 0.617 CI. These figures for healthy diet were 0.864 and 0.480, 1.491, respectively. There was no significant difference between the study groups (case and control) in the dietary patterns and risk of disease. After adjusting the energy intake and confounding factors, this relationship remained insignificant. There was also no significant association between the medium cuts or medians of the western, traditional, and healthy dietary patterns.

**Table 1: Relationship between dietary groups and case and control groups**

| Dietary groups | Mean (SD) | | *P* |
|---|---|---|---|
| | Control (*n*=120) | Case (*n*=80) | |
| Refined grains | 121.88 (92.48) | 129.98 (114.19) | 0.915 |
| Unrefined grains | 38.81 (.4420) | 41.6668 (35.77) | 0.229 |
| High-fat diary | 123.43 (149.97) | 135.8 (137.09) | 0.931 |
| Low-fat diary | 334.77 (183.862) | 327.79 (201.42) | 0.685 |
| Processed red meat | 31.42 (37.74) | 18.61 (23.55) | 0.040 |
| Fruit, dried fruit, and fruit juice | 467.01 (336.9) | 486.23 (370.07) | 0.802 |
| Vegetables | 460.74 (460.74) | 376.11 (184.55) | 0.003 |
| Potato | 39.93 (44.96) | 36.32 (59.50) | 0.727 |
| Cereal | 91.26 (71.53) | 77.38 (64.08) | 0.110 |
| Liquid oil | 5.06 (5.17) | 7.57 (8.54) | 0.065 |
| Hydrogenated fats | 9.66 (10.89) | 8.45 (9.18) | 0.153 |
| Olive | 1.70 (2.56) | 1.75 (2.94) | 0.657 |
| Egg | 15.87 (13.05) | 20.14 (16.86) | 0.059 |
| Fish and poultry | 32.28 (21.25) | 0.2537 (18.96) | 0.065 |
| Nuts | 10.64 (12.70) | 7.28 (8.16) | 0.001 |
| Spices, salt, and pickles | 50.42 (51.7) | 43.94 (38.31) | 0.129 |
| Sweets | 60.48 (74.28) | 64.27 (61.68) | 0.715 |
| Tea and coffee | 484.08 (395.93) | 562.81 (394.78) | 0.014 |
| Soft drink | 39.25 (74.34) | 23.18 (42.71) | 0.006 |
| Pizza | 28.62 (39.21) | 16.27 (10.55) | 0.002 |

SD: Standard deviation

## Discussion

There is little information about the dietary patterns of the Middle East population. Most studies on the dietary patterns of this region have focused on the metabolic syndrome, obesity, and risk factors of cardiovascular diseases,[12] and there are few studies on the OSCC. The present study is the first study in Iran that investigated the relationship between dietary patterns and OSCC. Previous studies in this regard are rare and merely limited to systematic reviews.

The results of the present study showed that smoking was significantly higher in the case group than in the control group. Patil *et al*. reported that some adjustable risk factors, i.e., smoking, contributed to the development of nasopharyngeal carcinoma and oral lesions.[13] The meta-analysis of Asthana *et al*. also confirmed this relationship for nonfumigated tobacco.[14] Three are more than 60 toxic chemicals in tobacco, which can affect different body systems, alter the epigenetic of oral epithelial cells, inhibit the function of the host immune system, and induce OSCC through oxidative stress on the tissues.[15]

Moreover, alcohol use was significantly higher in the patients than in the healthy individuals. Madani *et al*. showed that the use of alcohol was a risk factor for oral cancer, and a combination of smoking and excessive alcohol use increased the risk of oral cancer. The effect of alcohol dehydration on cell walls increases the penetrability of carcinogenic materials into oral tissues. Further, excessive use of alcohol reduces the natural ability of the body in using antioxidants to prevent the development of cancer.[16] Therefore, despite the presence of good nutrition, excessive use of alcohol inhibits antioxidant activities. This factor can probably explain why, despite proper nutrition, the risk of disease increases in the presence of a risk factor such as alcohol use.

The results of this study also indicated a significant relationship between family history of cancer and risk of OSCC. Garavello *et al*. and Foulkes *et al*. reported that the history of oral cancer and laryngeal cancer was an important risk factor for head-and-neck cancer independent of tobacco and alcohol.[17,18]

Moreover, Goldstein *et al*. reported this relationship to be significant before homogenizing alcohol and smoking, but after homogenizing these two factors, there was no significant increase between oral cancer and history of oral cancer.[19] Following rapid changes in the incidence of some cancers during the past few decades, it has been shown that genetic factors are eliminated as the main determinants of these patterns at the population level, although they may be involved in individual risks.[20] The results highlight the necessity of collecting information about the risk factors of relatives to isolate genetic factors from environmental factors.[19]

The control group in the present study had significantly better socioeconomic status than the case group. Auluck

*et al*. and Johnson *et al*. proposed socioeconomic status as an important and independent factor involved in the survival of oral cancer.[21,22] Greenberg *et al*. reported that education level and job status were independently associated with the risk of oral cancer among men.[23] However, failure to investigate the socioeconomic status of women in this study might have affected this lack of significant relationship. These data confirm the remarkable effect of socioeconomic deprivation on the overall survival of head-and-neck cancers. The reasons for this relationship are multifactorial and include diagnosis and referral stage, education, access to health-care services, diet, environmental factors, and different smoking rates and alcohol use.[24]

The healthy participants consumed a significantly larger amount of multivitamin. Of the patients, 63.85% never consumed multivitamin, while this level was 61.7% for the healthy participants. Lonn *et al*. reported that long-term consumption of Vitamin E supplements prevented cancer.[24] Further, Barone *et al*. indicated that the use of Vitamin E had a protective effect against oral cancer.[25] A combination of essential vitamins and nutrients present in multivitamins may reflect a healthier dietary pattern, like the dietary pattern of vegetables and fruits, which is inversely correlated with the risk of cancer, but the use of multivitamins is not adequate for the early prevention of chronic diseases, including cancer.[26]

Furthermore, the results showed that consumption of tea and coffee was significantly higher in the patients than in the healthy participants. Miranda *et al*. classified coffee as an anticancer material.[27] However, Notani and Jayant reported drinking tea as a risk factor for esophageal cancer, which may be due to the high temperature of the tea, not the tea itself.[28] Thermal damage can be one of the causes of upper gastrointestinal SCC.[29] The possible thermal damage in the present study due to the hot tea and coffee, especially due to the culture of drinking hot tea in Iran, seems to have exerted a more effective role than the antioxidant role of caffeine. Moreover, the higher tendency of Iranians toward sweet tea and coffee and the use of synthetic sweeteners increase the consumption of sugary ingredients and consequently resistance to insulin, which causes carcinogenic effects through reinforcement of cell proliferation, inhibition of basal and oxidative stress-induced autophagy, and reduction of cell death.[30] Hence, the effect of this food group is linked with the dietary habits of individuals, not merely their food intake. Thus, further studies are needed in this regard to explore this issue by adjusting the dietary habits as a confounding factor.

The present study showed that the consumption of processed and red meat was significantly higher in healthy individuals than the patients. Battino *et al*. reported that the use of meat and meat products, which is part of the Mediterranean diet, reduced the risk of cancers.[31] Kumar *et al*. indicated that the use of fresh meat had a protective role against oropharyngeal cancer, but processed meat was a risk factor for this disease.[32] Hence, the type of meat probably has a protective role or can be a risk factor. It seems that limited use of fresh meat is useful for the body, but processed and salted meat, due to the presence of compounds such as nitrates, nitrites, and polycyclic aromatic hydrocarbons, is a risk factor for chronic diseases.[7] In the present study, the processed and red meat came together in the processed and red meat group, so it was not possible to differentiate their effects on the disease. Yet, since the consumption of this food group was higher in the healthy participants, the consumption of fresh meat might have been more in this dietary group.

In the present study, consumption of nuts was significantly higher in the healthy participants. Battino *et al*. also showed that the use of nuts in the Mediterranean diet had a protective role against cancers.[31] Nuts reduce the mediators of chronic diseases owing to the presence of plant proteins, fibers, vitamins, carotenoids, minerals, and antioxidants. However, the current findings of the advantages of nuts for human health have not been discussed clearly.[33] The results of the present study showed that consumption of vegetables was significantly higher in the healthy participants than in the patients. Kumar *et al*. and Bradshaw *et al*. also reported reduced intake of vegetable-induced cancer.[7,32] In general, vegetables reduce carcinogenic activity since they are rich in fibers.[6]

On the other hand, the risk associated with low consumption of vegetables is higher among smokers than nonsmokers.[34,35] The patients in the present study showed a significantly high level of smoking and low level of consumption of vegetables, both of which together probably increased the risk of disease. In line with this result, Toporcov *et al*. reported the protective effects of fruits and vegetables for oropharyngeal cancer differed in the cigarette and alcohol consumers than nonconsumers. The topical effect of diet on oral mucosa may reduce or increase the absorption of carcinogenic agents in tobacco and foodstuffs. In case of lack of early exposure to tobacco, cleaning the oral mucosa with fruits and salads has no significant anticancer effect. This assumption may explain why the protective effects of fruits and vegetables are more effective in smokers.[36]

It is not easy to identify special relationships among dietary patterns, foods, or individual nutrients due to the long latent period for cancer progression, its complicated pathogenesis, and challenging description of multiple dimensions of the diet and life activities.[21] Moreover, it is difficult to accurately determine the food intake due to long-term nutritional behaviors, their changeability, and problems related to remembering diets by individuals in case–control studies.

Different socioeconomic levels and a diet with a wide range of dietary habits, cultural and regional diversities, personal habits and tastes of people in response to various dietary patterns, difference in confounding factors, although controlled in the study, and difference in the composition of nutrients of a dietary pattern are the factors that can change the results of studies. The dietary patterns defined in this

study include the food groups that are consumed more in the Iranian culture. Therefore, other dietary patterns that have been defined according to the nutritional culture of another region may show a significant relationship, which requires further investigations.

## Conclusion

The incidence of cancers, including oral cancer, is associated with environmental and genetic factors. Although a healthy and vegetable-rich diet has a protective effect against the occurrence of OSCC, unhealthy nutrition is not the only cause of the disease. Prospective or cohort studies are required to explore this issue more accurately.

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### Conflicts of interest

There are no conflicts of interest.

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