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# The Association between Carbohydrate Intake and Periodontal Health in the Elderly

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## ABSTRACT

**Background and Objective:** Periodontal disease is one of the most common chronic oral diseases worldwide. A variety of foods may affect periodontal health. Due to the importance of periodontal health in the old age, this study was designed to investigate the association between carbohydrate intake and periodontal health in the elderly in Amirkola, northern Iran.

**Methods:** This cross-sectional study is part of the second phase of the Amirkola Health and Ageing Project (AHAP). The evaluated participants included 400 elderly people (200 men and 200 women). Socio-demographic data of all subjects were recorded in the information form. Periodontal status, including plaque index (PI), periodontal disease index (PDI) and Oral Hygiene Index (OHI) were evaluated. Then, the Semi-Quantitative Food Frequency Questionnaire (SQFFQ) was completed in order to receive daily carbohydrates in grams per day for all Participants. Then, the relationship between carbohydrate intake and periodontal health was evaluated.

**Findings:** The participants consumed an average of 316±102.4 gr/day carbohydrates. The mean range of PI, OHI, PDI and in the high carbohydrate intake (>300 gr) group were 2.18±1.39, 2.84±1.51 and 1.51±0.86, respectively, and this rate was lower than the group with low carbohydrate intake (<300 gr) (1.96±1.52, 2.56±1.53 and 1.37±0.91), but the difference between the two groups was not significant.

**Conclusion:** In the present study, there was no relationship between periodontal health indices and carbohydrate intake.

**Keywords:** *Periodontal Disease, Carbohydrate, Nutrition, The Elderly.*

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## Introduction

Periodontal disease is one of the most common chronic inflammatory diseases worldwide, and its prevalence has been reported from 20% to 50% worldwide. One of the most critical complications of periodontal disease is tooth loss which can jeopardize beauty, confidence and quality of life (1). Improving social living conditions and health care has led to an increase in life expectancy around the world, which in turn has led to an increase in periodontal disease in the society. A moderate reduction in the periodontal ligament and alveolar bone resorption is expected in the elderly (2). Periodontal diseases are multifactorial. The onset and progression of them are influenced by a variety of local and systemic factors. Poor oral hygiene is the most important local factor that causes dental plaque. Systemic risk factors, including heart disease, diabetes mellitus, pregnancy, etc., are associated with periodontitis (2).

The relationship between nutrition and periodontal health is very complex. That's because the consumption of a specific macronutrient or micronutrient cannot prevent or cause periodontal disease entirely (3). Nutrition may be related to periodontal health both systemically and locally (4). Some studies have shown that a balanced diet can play a role in maintaining periodontal health. A low-carbohydrate diet high in omega-3 fatty acids, vitamins C, vitamin D, and fiber can reduce gingivitis and periodontitis (5, 6). Carbohydrates are part of macronutrients and as a source of energy, they have the highest nutritional ratio of 50 to 55% (7).

The role of carbohydrate intake on periodontal health is diverse. Many studies have shown that a high-sugar diet increases plaque formation and can cause bleeding gums and increase periodontitis (8) The study of Hwangs et al. showed that carbohydrates was associated with periodontitis (9). In addition, according to the study of Martinson et al. and another studies, a diet rich in fiber and legumes can have a protective effect on periodontal tissue (10). Salazar et al. concluded that there was an inverse association between periodontal disease and higher consumption of whole-grains and fruits (11).

Although the association between plaque formation and carbohydrate intake has been shown in numerous studies, the number of studies that have directly addressed that the role of carbohydrate intake in the occurrence of periodontal disease is very limited. Considering that periodontal health and adequate nutrition in old age is important and Amirkola Health and Ageing Project was carried out in Amirkola city (12), this study was designed to investigate the association between carbohydrate intake and periodontal health in the elderly in Amirkola.

## Methods

This cross-sectional study is a part of the second phase of the Amirkola Health and Ageing Project which is an ongoing cohort project started in 2011 on elderly residents of Amirkola, northern Iran (12). The research was approved by the ethics committee of Babol University of Medical Sciences with ethics code IR.MUBABOL.HRI.REC.1398.284, and 400 elderly residents of Amirkola entered the study after obtaining informed consent.

With 95% confidence level and 80% power and assuming r=0.15 for the correlation between carbohydrate intake and periodontal indices, about 350 samples were estimated. To increase the accuracy of the study, 400 patients, including 200 men and 200 women, were considered. The inclusion criteria were elderly people aged 60 years and older, and edentulous subjects were excluded from the study. Socio-demographic information of all subjects, including age, sex, level of education and income satisfaction was recorded in the information form. Education was divided into four categories (illiterate, elementary, middle school to high school and university) and income satisfaction was divided into two categories (low and

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medium to high). Periodontal health status was evaluated using indicators: Plaque Index (PI) (13), periodontal Disease Index (PDI) (14) and Oral Hygiene Index (OHI) which includes Debris Index (DI) and Calculus Index (CI) (15). Periodontal indices of the subjects were performed through dental examinations by nine dental specialists. In the absence of RamfJord teeth, opposite and adjacent teeth were selected.

The Semi-quantitative Food Frequency Questionnaire (SQFFQ) was completed for all study participants. This questionnaire contains 136 items related to the average amount of different foods received during the twelve months in terms of frequency of consumption and the amount of consumption each time. Then, using N4 nutrition software, the amount of carbohydrate intake and the share of carbohydrates in daily energy were calculated and the amount of carbohydrate intake of each person was categorized based on grams per day (4). The validity and reliability of this questionnaire have been proven in the study of Bijani et al. (16). Finally, the data were analyzed using SPSS 17 software, quantitative and qualitative variables were compared using Student T test and $X^2$ statistical methods, respectively. Pearson coefficient was used for correlation between variables. p-value<0.05 was considered statistically significant.

## Results

In the present study, 400 people were studied, including 200 men (50%) and 200 women (50%). Forty-four participants in the study were smokers (11%) and all were male. Data related to age, carbohydrate intake, number of teeth and periodontal indices in the subjects are shown in Tables 1-3.

**Table 1. Evaluation of mean periodontal indices, carbohydrate intake, age and number of teeth in both genders**

| Variable | Number | Mean±SD | p-value* |
|---|---|---|---|
| **Age** | | | |
| Female | 200 | 66.61±5.10 | 0.005 |
| Male | 200 | 68.32±6.81 | |
| Total | 400 | 67.46±5.95 | |
| **Carbohydrate Intake** | | | |
| female | 200 | 271.47±90.14 | 0.000 |
| male | 200 | 362.30±114.65 | |
| Total | 400 | 316.88±102.40 | |
| **Number of Teeth** | | | |
| Female | 200 | 19.10±7.28 | 0.000 |
| Male | 200 | 16.21±8.06 | |
| Total | 400 | 17.65±7.81 | |
| **PDI**** | | | |
| Female | 200 | 2.46±1.40 | 0.002 |
| Male | 200 | 2.93±1.60 | |
| Total | 400 | 2.70±1.52 | |
| **PI***** | | | |
| Female | 200 | 1.36±0.88 | 0.061 |
| Male | 200 | 1.53±0.90 | |
| Total | 400 | 1.44±0.89 | |
| **OHI****** | | | |
| Female | 200 | 1.89±1.43 | 0.015 |
| Male | 200 | 2.25±1.49 | |
| Total | 400 | 2.07±1.46 | |

*T-test, **Periodontal Disease Index, ***Plaque Index, ****Oral Health Index

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**Table 2. Relationship between carbohydrate intake and periodontal indices**

| Index / Variable | PDI** | PI*** | OHI**** | Number of teeth |
|---|---|---|---|---|
| Carbohydrate Intake (p-value*) | 0.370 | 0.317 | 0.340 | 0.795 |
| Carbohydrate Intake in Males (p-value*) | 0.462 | 0.976 | 0.701 | 0.045 |
| Carbohydrate Intake in Females (p-value*) | 0.684 | 0.633 | 0.576 | 0.620 |

*Pearson Correlation, **Periodontal Disease Index, ***Plaque Index, ****Oral Health Index

**Table 3. Comparison between carbohydrate intake and periodontal indices and the number of teeth**

| Index | Carbohydrate Intake | Number | Mean±SD | p-value* |
|---|---|---|---|---|
| OHI** | ≤300 gr<br>>300 gr | 198<br>202 | 2.18±1.39<br>1.96±1.52 | 0.120 |
| PDI*** | ≤300 gr<br>>300 gr | 198<br>202 | 2.84±1.51<br>2.56±1.53 | 0.071 |
| PI**** | ≤300 gr<br>>300 gr | 198<br>202 | 1.51±0.86<br>1.37±0.91 | 0.115 |
| Number of Teeth | ≤300 gr<br>>300 gr | 198<br>202 | 17.55±7.69<br>17.76±7.94 | 0.787 |

*Independent Samples T-test, **Oral Health Index, ***Periodontal Disease Index, ****Plaque Index

The average daily carbohydrate intake in men was higher than in women (p=0.000). Carbohydrate intake had an inverse relationship with age, meaning that by the increase in age, carbohydrate intake decreased (p=0.042) and this inverse relationship was also true for both men and women (p=0.033 and p=0.007, respectively) (Figure 1).

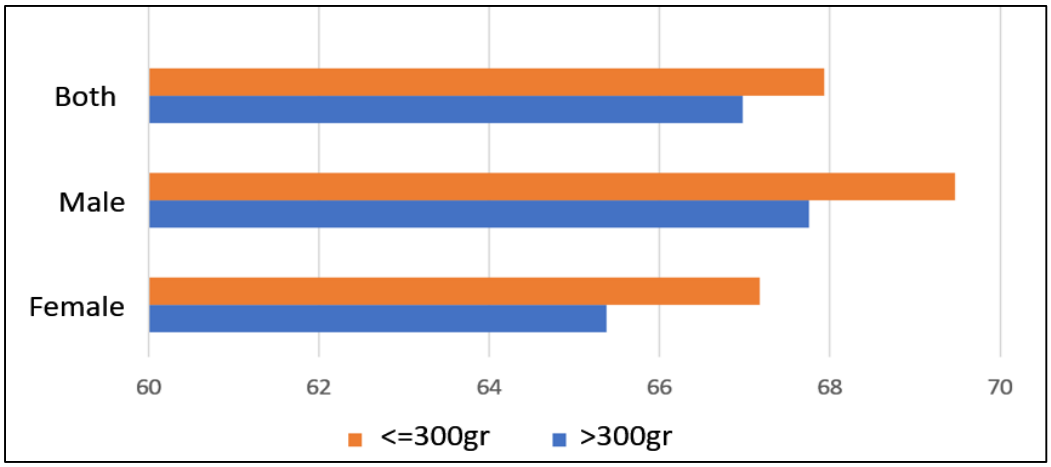


**Figure 1. Comparison between carbohydrate intake and age**

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Carbohydrate intake was significantly higher in people with higher income and better economic level (p=0.008). Also, OHI (p=0.019), PDI (p=0.003) and PI (p=0.016) indices had a better status in people with higher incomes (Figure 2). In this study, there was no significant correlation between carbohydrate intake and periodontal indices such as OHI, PDI, PI and the number of teeth (Table 2). Patients were divided into two groups with a carbohydrate intake of more than 300 g/day and less than 300 g/day and periodontal indices were assessed. In this study, no significant difference was found between periodontal indices based on carbohydrate intake (Table 3).

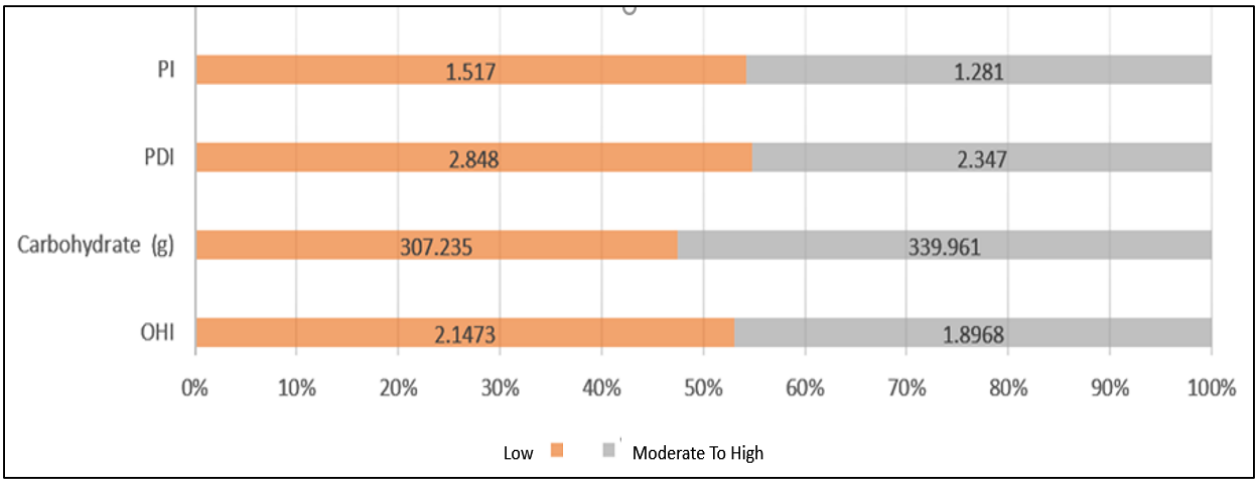


**Figure 2. Carbohydrate intake and periodontal indices based on income**

## Discussion

In the present study, there was no association between carbohydrate intake in the elderly and periodontal indices. Although in this study, in people with less carbohydrate intake, periodontal indices such as OHI, PDI, PI had better and more teeth, but this relationship was not statistically significant. A study by Woelber et al. showed that consuming a low-carbohydrate diet can reduce gingivitis (17). In this study, only 30 people were studied. In another study, Hwang et al. found that consuming carbohydrates and proteins was associated with the risk of periodontitis (9). This study was performed only on women. Sidi et al. showed that repeated intake of sugar can cause gingivitis and BOP. This study was performed on only 22 male dental students (18).

In the present study, carbohydrate intake was calculated in general and carbohydrate components such as fibers and sugars, etc., were not examined separately to determine the ratio of fiber to sugar in the carbohydrate diet. However, given the results of the research, it can be anticipated that the ratio of fiber to sugar is high in these people. According to some studies, sugar can be associated with an exacerbation of periodontal inflammatory conditions, while an increase in dietary fiber can be associated with a reduction in periodontal disease as the prevalence of diseases such as diabetes is very high in the elderly. Medical advice to reduce sugar intake can be one of the reasons for lower sugar intake in these people and thus shows less carbohydrate intake in this group.

In this study, a significant relationship was found between higher income levels and improved periodontal index. Numerous articles have examined the impact of socioeconomic factors on periodontal disease and it has been shown that lower income and lower literacy levels can be associated with an increased chance of developing plaque and periodontal disease (19, 20). According to the present study,

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people with better economic status, despite consuming more carbohydrates, still had better periodontal indices. Explaining this finding, it can be said that people with better economic status have higher levels of personal hygiene and more regular medical and dental visits. Thus, a higher level of periodontal health in these people is justified. Sugars are a major cause of plaque and periodontal disease, and a carbohydrate-free diet has been shown to reduce dental plaque (5). Bacteria in oral biofilm cause carbohydrate fermentation and acid production, and the acid produced demineralizes tooth structures, causing plaque and periodontal disease (8). On the other hand, some articles have shown that consumption of grains and fiber can reduce the prevalence of the periodontal disease (21). Consumption of fiber and vegetables can reduce periodontal disease by reducing systemic diseases such as diabetes and hypertension as well as reducing inflammatory factors in the body (22).

Periodontal disease is one of the multifactorial diseases and many factors, such as oral habits, smoking, diet, systemic diseases, etc. are involved in its development. However, showing the cause-and-effect relationship between one of these factors and periodontitis can be very difficult due to the interaction and overlap of other factors. Thus, it requires studies to eliminate other confounding factors.

In our study, no significant relationship was observed between periodontal disease and daily carbohydrate intake. Although a strong relationship between carbohydrate intake and plaque formation has been shown in many studies, there is no independent relationship between carbohydrate intake and periodontal disease. On the other hand, this issue is affected by the overlap of other factors affecting periodontal diseases such as systemic diseases, personal habits and consumption of other nutrients such as vitamins, antioxidants, proteins and so on. Also, the frequency of consumption of carbohydrates and their consistency may be one of the factors affecting periodontal disease. Therefore, it is suggested that studies be performed in different populations with different diets to determine the effect of other nutrients. Also, by conducting clinical trial studies, while controlling other distorted factors, more accurate results can be achieved.

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