

Frequency of fruit and vegetable consumption and oral health-related quality of life among the elderly in Amirkola (Babol, Iran)

Fatemeh Ghasemian Gorji¹, Reza Ghadimi², Seyed Reza Hosseini², Ali Bijani³, Atena Shirzad⁴,
 Fatemeh Sayadi⁴, Fatemeh Baladi⁴, Elham Mahmoodi⁴, Niloofar Jenabian⁵, Mohammadmehdi Naghibi⁴,
 Mahsa Mehryari⁴, Zahrasadat Madani⁶, Mina Motallebnejad^{5*}

1. Dental Student, Student Research Committee, Babol University of Medical Sciences, Babol, Iran.
2. Professor, Social Determinants of Health Research Centre, Health Research Institute. Babol University of Medical Sciences, Babol, Iran.
3. Assistant Professor, Social Determinants of Health Research Centre, Health Research Institute. Babol University of Medical Sciences, Babol, Iran.
4. Assistant Professor, Oral Health Research Center, Health Research Institute. Babol University of Medical Sciences, Babol, Iran.
5. Professor, Oral Health Research Center, Health Research Institute. Babol University of Medical Sciences, Babol, Iran.
6. Associate Professor, Dental Materials Research Center, Health Research Institute. Babol University of Medical Sciences, Babol, Iran.

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ABSTRACT

Introduction: Considering that nutrition plays a prominent role in the health of the elderly, oral health and the associated quality of life are very important for a healthy diet. The aim of this study was to investigate the association between the frequency of fruit and vegetable consumption and oral health-related quality of life (OHRQoL) among the elderly in Amirkola.

Materials & Methods: This study was part of the second phase of the Amirkola elderly cohort study conducted on 750 older people who underwent a special oral and dental examination in 2016-2020 using the Oral Health Questionnaire. The frequency of fruit and vegetable consumption was assessed with the Semi-Quantitative Food Frequency Questionnaire (SQFFQ), OHRQoL was assessed with the General Oral Health Assessment Index (GOHAI), and information on age, sex, history of systemic diseases, and the number of teeth was extracted from the full data set completed by specialists for each patient. Data were analyzed with SPSS 20 using the chi-square statistical test, ANOVA, and Pearson correlation coefficient. A value of $p < 0.05$ was considered significant.

Results: Non-smokers and people with a higher level of education had a better OHRQoL ($P=0.022$ and $P=0.036$, respectively). There was no significant relationship between the frequency of fruit and vegetable consumption and OHRQoL, but a significant relationship was found between the frequency of fresh herb consumption and OHRQoL ($p=0.005$). In men, there was a significant relationship between the number of teeth and frequency of vegetable consumption as well as between OHRQoL and frequency of fresh herb consumption in men ($P=0.048$, $r=0.096$). In women, a significant relationship was observed between the frequency of total vegetable consumption and OHRQoL ($p=0.021$, $r=0.129$).

Conclusion: According to the results of the present study, it was found that the amount of fruit and vegetable consumption has no effect on improving the OHRQoL among the elderly of Amirkola city.

Keywords: Vegetables, Fruit, Quality of Life, Oral Health, Aged

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*Corresponding Author: Mina Motallebnejad, Department of Oral Medicine, Faculty of Dentistry, Babol University of Medical Sciences, Babol, Iran.

Tel: +98 1132291408

E-mail: mmotallebnejad@yahoo.com

Introduction

Oral health is an essential component of overall health, and oral diseases are among the most common chronic conditions that have a significant impact on individuals and society. Many studies have linked poor oral health, such as tooth loss and periodontal disease, to a higher risk of cancer, cardiovascular disease, and stroke. ^[1-4] Poor oral and dental health is associated with an increased risk of aspiration pneumonia, weakness, cognitive impairment, decreased food intake, and dementia, especially in the elderly. ^[5,6] As a result, poor oral hygiene and oral health in the elderly are major public health problems. According to recent epidemiological studies, the assessment of oral health-related quality of life (OHRQoL) is as important as the assessment of the objective state of oral health. ^[7] OHRQoL is defined as an assessment of personal well-being that includes functional, psychosocial, and pain/comfort factors. ^[8,9] Previous studies found a lower association between OHRQoL and dietary changes due to decreased chewing ability and a negative effect on dietary intake, ^[10,11] and they suggested that inadequate dietary intake (e.g., calcium, vitamin C, vitamin D, and acid) and polyunsaturated fatty acids (PUFA) are associated with an increased risk of various diseases. ^[12,13] Consequently, high OHRQoL contributes to the protection of oral health and general health in middle-aged and elderly people.

Dietary fiber is commonly found in fruits and vegetables and has been shown to reduce the risk of cardiovascular disease and obesity. Vitamins and minerals are found in fruits and vegetables and act as antioxidants and anti-inflammatory agents. ^[14] Because of their anti-inflammatory properties, numerous cohort studies have indicated that fruits and vegetables help prevent cancer and cardiovascular disease. ^[15-18] Numerous epidemiological studies have demonstrated that the consumption of vegetables, ^[19-21] antioxidant-rich foods, ^[22-24] and dietary fiber ^[25] may reduce the risk of periodontal disease and tooth loss. However, no association has been found between the frequency of fruit consumption and tooth loss. Fruits and vegetables are rich in vitamins. Periodontal tissues, alveolar bone, and oral mucosa are altered by vitamin deficiency. Vitamin deficiencies do not cause gingivitis; however, they may increase tissue responses to topical agents and ultimately decrease oral health-related quality of life. ^[26] Considering the above content, as well as the fact that OHRQoL varies according to culture and society, the aim of this study was to investigate the association between the frequency of fruit and vegetable consumption and OHRQoL among the elderly in Amirkola.

Materials & Methods

The present study was approved by the Ethics Committee of Babol University of Medical Sciences (Code: IR.MU....HRI.REC.1398.301). This study was part of the second phase of the Amirkola elderly cohort study ^[7] conducted on 750 older people who underwent a special oral and dental examination in 2016-2020 using the Oral Health Questionnaire. Frequency of fruit and vegetable consumption was assessed with the Semi-Quantitative Food Frequency Questionnaire (SQFFQ), OHRQoL was assessed with the General Oral Health Assessment Index (GOHAI), and information on age, sex, history of systemic diseases, and number of teeth was extracted from the full data set completed by specialists for each patient. ^[27]

The older participants were divided into three groups (n=250) based on their GOHAI scores: GOHAI 1 (28-49), GOHAI 2 (50-55) and GOHAI 3 (56-60). Fruit and vegetable consumption in grams per day was compared among these three groups. With a 95% confidence interval and 80% power for the study and assuming $\sigma_1 - \sigma_2 = 40$ g for fruit and vegetable consumption per day in each oral health group, 250 samples were estimated for each group to determine a difference of 10 g in consumption in the different groups. The GOHAI questionnaire assesses 12 indicators in three domains. Physical function includes eating, speaking and swallowing behaviors, pain and discomfort due to taking medications for pain relief and oral discomfort, and psychological function includes dissatisfaction with appearance and avoidance of social contact, etc. The scoring system of GOHAI is as follows:

Always (1), often (2), sometimes (3), rarely (4), and never (5), with the total score ranging from 12 to 60. A lower total score indicates lower OHRQoL, and a higher total score demonstrates better OHRQoL. [28] The modified SQFFQ developed for the Amirkola Health and Aging Project (AHAP) was found to be reliable for assessing the intake of several food groups, energy content, and micro-and macronutrients. In this questionnaire, some units were used for better measurement such as pictures, some kitchen utensils including bottles, plates, and spoons, ... for rice, milk, and juice... and sizes (small, medium and large) for different fruits and vegetables. All fruits and vegetables were measured on the basis of grams. [29] Data were analyzed with SPSS 20 using the chi-square statistical test, ANOVA, and Pearson correlation coefficient. A value of $p < 0.05$ was considered significant.

Results

Of the 750 participants, 427 (56.9%) were male, 411 (54.8%) had a removable prosthesis, 126 (16.8%) were smokers, and 428 (57.1%) were illiterate (Table 1). Nonsmokers had a higher GOHAI score than smokers ($p = 0.022$). Furthermore, those with a higher level of education had a higher GOHAI score ($p = 0.036$). Additional patient demographic information is illustrated in Table 2, including age, number of teeth, total energy consumption (KCal/day), number of medications, number of chronic diseases, and BMI. As can be seen in this table, people with more chronic diseases have worse OHRQoL ($p = 0.002$) (Table 2). The frequency of consumption of different fruits and vegetables is shown in Table 3. There was no significant relationship between the frequency of fruit and vegetable consumption and GOHAI score, but a significant relationship was observed between the frequency of vegetable consumption and GOHAI score, i.e., individuals with better OHRQoL consume more vegetables ($p < 0.005$). However, this relationship was found only in women ($p = 0.033$) and not in men ($p = 0.144$).

Table 4 displays the results of fruit and vegetable diet, age and number of teeth by sex in different GOHAI groups. After sex separation, it was found that there was a significant relationship between the frequency of vegetable consumption and OHRQoL in women ($p = 0.033$), but not in men ($p = 0.141$). Table 5 shows the correlation between OHRQoL of all individuals and each variable, as well as this correlation by gender and number of teeth present; however, there is no correlation between the frequency of fruit and vegetable consumption and OHRQoL (Figure 1). A significant correlation was found only between the frequency of fresh herb consumption and OHRQoL (Figure 2). There was a relationship between the frequency of vegetable consumption and number of teeth in men, but not in women. A relationship was seen between OHRQoL and fresh herb consumption in men ($P = 0.048$) and a correlation was revealed between OHRQoL and total vegetable consumption in women ($P = 0.021$).

Table 6 represents the mean and standard deviation, minimum and maximum of the domains of the GOHAI questionnaire for 750 subjects. Table 7 shows the correlation between the domains of the GOHAI questionnaire with fruit and vegetable consumption and only fresh herb consumption. There was no relationship between any domain of the GOHAI questionnaire and total consumption of fruits and vegetables; there was a correlation only between physical function and psychosocial domain of the GOHAI questionnaire and fresh herb consumption. There was no relationship between the frequency of fruit and vegetable consumption and OHRQoL (Figure 1). Only a significant correlation was found between the frequency of fresh herb consumption and OHRQoL (Figure 2).

Table 1. Frequency and relative frequency of gender, removable prosthesis, smoking, and education level by GOHAI groups

Variable	GOHAI 1* N(%)	GOHAI 2* N(%)	GOHAI 3* N(%)	Total N(%)	P value*
Male	140(32.8)	140(32.8)	140(32.8)	427(56.9)	
Female	110(34.1)	110(34.1)	110(34.1)	323(43.1)	
Yes	132(32.1)	145(35.3)	132(32.1)	411(54.8)	
NO	118(34.8)	105(31)	118(34.8)	339(45.2)	
Yes	54(42.9)	31(24.6)	54(42.9)	126(16.8)	
NO	196(31.4)	219(35.1)	196(31.4)	624(83.2)	
Illiterate	164(38.3)	135(31.5)	164(38.3)	428(57.1)	
Elementary	49(26.9)	60(33)	49(26.9)	182(24.3)	
Diploma	27(27.8)	37(38.1)	27(27.8)	97(12.9)	
College education	10(23.3)	18(41.9)	10(23.3)	43(5.7)	

Pearson, Chi-Square ($p < 0.05$ Significant)*

GOHAI 1*: had low of General Oral Health Assessment Index

GOHAI2*: moderate of General Oral Health Assessment Index

GOHAI3*: had the higher score of General Oral Health Assessment Index

Table 2. Mean and SD of age, number of teeth, number of medications, number of chronic diseases, caloric intake and BMI by GOHAI groups

Variable	GOHAI 1 Mean±SD	GOHAI 2 Mean±SD	GOHAI 3 Mean±SD	GOHAI Mean±SD	P value*
Age	69.40± 6.97	70.27± 7.81	69.81± 7.31	69.83±7.37	0.420
Number of teeth	8.63± 8.83	10.12± 10.37	10.56± 16.11	9.77± 10.19	0.085
Caloric intake	1692.14±616.03	1723.72± 642.17	1756.62± 627.40	1724.16±628.34	0.518
Number of medicines	3.77 ± 3.24	3.88 ± 3.04	3.38 ± 2.96	3.68 ± 3.09	0.165
Numerous chronic diseases	4.00 ± 2.37	3.69 ± 2.12	3.30 ± 2.20	3.67 ± 2.24	0.002
BMI (kg/m ²)	27.81 ± 4.80	28.49 ± 4.71	28.72 ± 4.44	28.34 ± 4.67	0.077

ANOVA ($p < 0.05$ Significant)*

Table 3. Frequency of fruit and vegetable consumption by GOHAI groups

variable	GOHAI 1	GOHAI 2	GOHAI 3	Total	P value*
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Total vegetable	110.69±60.84	117.70±69.53	116.78±61.65	115.06± 64.12	0.414
Total fruits	150.51 ±84.76	143.07±76.56	146.19±90.97	146.59± 84.25	0.612
Fresh herbs	5.12 ±7.07	7.47±10.53	7.01±7.71	6.53±8.62	0.005
Stewed vegetables	6.19 ±7.08	6.19±7.75	6.49±6.85	6.29±7.23	0.867
Dried Fruit	5.75 ± 9.09	7.14±10.44	6.91±11.12	6.60± 10.25	0.266
Juice	10.87 ± 16.51	10.08±13.88	10.72±13.25	10.56± 14.60	0.815

ANOVA (p<0.05 Significant)*

Table 4. Frequency of fruit and vegetable consumption, age, and number of teeth present by sex, according to GOHAI groups

Variable	Sex	GOHAI 1*	GOHAI 2*	GOHAI 3*	Mean±SD	P value*
	Male	6.00±7.62	7.76±9.15	7.63±8.03	7.13±8.30	0.141
	Female	4.00±6.16	7.10±12.11	6.13±7.17	5.74±8.97	0.032
	Male	7.82±8.27	6.67±8.76	6.80±7.05	7.09±8.04	0.423
	Female	4.11±4.42	5.58±6.23	6.06±6.57	5.23±5.84	0.039
	Male	12171±69.82	126.95±75.65	121.32±65.39	123.30±70.21	0.754
	Female	96.66±43.42	105.92±59.13	110.30±55.54	104.16±53.21	0.159
	Male	148.30±78.7	142.55±74.83	144.29±91.07	145.03±81.86	0.835
	Female	153.33±92.10	143.73±79.05	148.90±91.22	148.65±87.40	0.718
	Male	6.03±9.63	7.26±10.71	7.44±12.09	6.92±10.87	0.494
	Female	5.39±8.38	6.98±10.13	6.16±9.57	6.17±9.38	0.453
	Male	10.48±12.48	8.81±10.30	10.46±12.69	9.93±11.88	0.401
	Female	11.36±20.58	11.70±17.33	11.09±14.07	11.39±17.54	0.968
	Male	69.98±7.61	70.91±8.13	70.83±7.664	70.58±7.79	0.541
	Female	68.66±6.01	69.45±7.33	68.36±6.57	68.84±6.66	0.461
	Male	8.79±8.50	10.35±10.39	6.80±7.05	9.78±10.03	0.363
	Female	8.43±9.27	9.83±10.38	11.13±11.43	9.77±10.40	0.166

ANOVA (p<0.05 significant)*

GOHAI 1*: had low of General Oral Health Assessment Index

GOHAI2*: moderate of General Oral Health Assessment Index

GOHAI3*: had the higher score of General Oral Health Assessment Index

Table 5. Correlation between GOHAI* factors with the frequency of fruit and vegetable consumption and number of teeth

Variable	r	P value*
Total vegetable	0.044	0.233
Fresh herbs	0.102	0.005
Stewed vegetables	0.019	0.599
Dried Fruit	0.050	0.168
Juice	- 0.009	0.809
Age	0.032	0.389
Total fruits	- 0.018	0.613
Number of teeth	0.069	0.059
Total vegetable	- 0.011	0.813
Fresh herbs	0.096	0.048
Stewed vegetables	-0.032	0.512
Dried Fruit	0.028	0.570
Total fruits	-0.036	0.460
GOHAI	0.066	0.172
Total vegetable	0.101	0.037
Fresh herbs	0.192	< 0.001
Stewed vegetables	0.116	0.017
Total fruits	-0.046	0.347
Total vegetable	0.129	0.021
Fresh herbs	0.104	0.062
Stewed vegetables	0.102	0.068
Dried Fruit	0.083	0.136
Total fruits	0.005	0.929
GOHAI	0.073	0.191
Total vegetable	0.013	0.814
Fresh herbs	0.091	0.101
Stewed vegetables	0.006	0.918
Total fruits	0.025	0.661

Pearson correlation (p<0.05 significant; r[0,1]²)*

GOHAI*(General Oral Health Assessment Index)

Table6. Mean and SD, minimum and maximum range of GOHAI

Domain of GOHAI	Mean±SD	Minimum	Maximum
Physical function	24/09 ± 4/60	7	30
Psychosocial impact	18/07 ± 2/64	7	20
Pain and Discomfort	9/24 ± 1/40	4	10

Table 7. Correlation between the frequency of fruit and vegetable consumption and GOHAI* factors

Domain of GOHAI	r	P value*
Total vegetable	0/051	0/166
Total fruits	-0/025	0/501
Fresh herbs	0/119	0/001
Total vegetable	-0/039	0/281
Total fruits	-0/004	0/919
Fresh herbs	0/082	0/026
Total vegetable	-0/025	0/498
Total fruits	-0/004	0/921
Fines herbs	-0/041	0/262

ANOVA (p<0.05 significant)*

GOHAI*(General Oral Health Assessment Index)

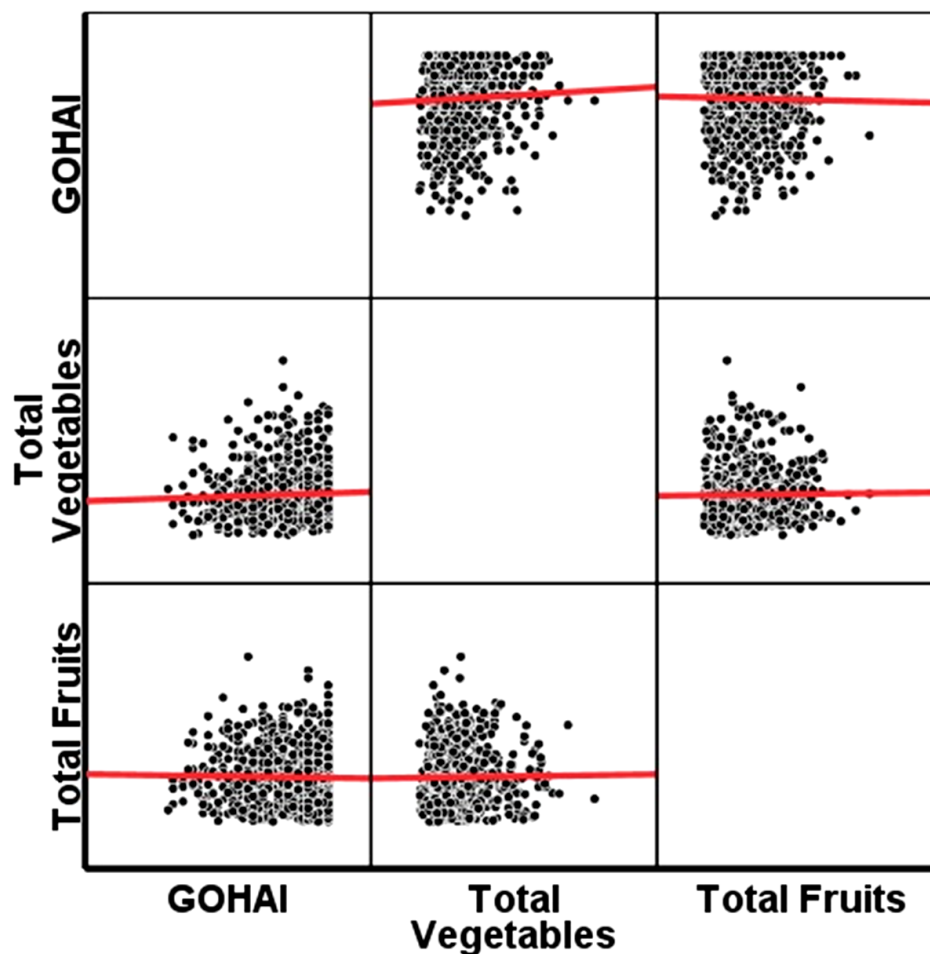


Figure 1. Correlation between the frequency of fruit and vegetable consumption and GOHAI factors

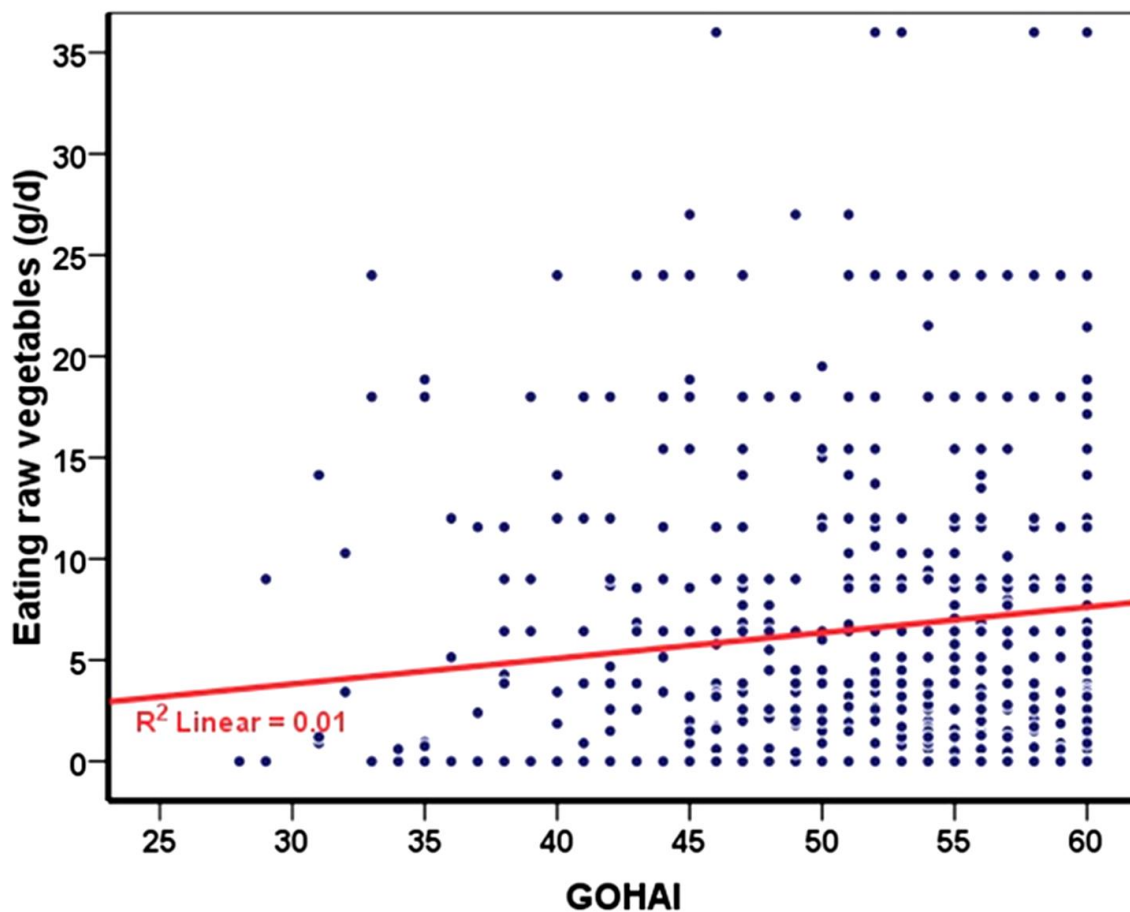


Figure 2. Correlation between the frequency of fresh herb consumption and GOHAI factors

Discussion

This study revealed that fruit and vegetable consumption had no effect on the elderly's OHRQoL. In the elderly, eating only vegetables improved the OHRQoL. There was a relationship between men's dental health quality of life and the frequency of their vegetable consumption, suggesting that people with better oral health may consume more vegetables. Moreover, there was a relationship between the frequency of total vegetable consumption and OHRQoL in women. According to the findings of Nanri et al., increased fruit and vegetable consumption is strongly associated with OHRQoL in both men and women.^[7] The results of the previous study contradict the findings of the current study, which indicated that there was no significant association between increased fruit and vegetable consumption and OHRQoL in the most recent study. The reason for this conflict could, of course, lie in the different socio-cultural factors and lifestyles of the two societies.

The results of a study by Kshetrimayum et al. show that lower quality of life related to dental health is associated with nutritional deficiencies and that better coordination between dentists and dietitians is needed to improve the health of the elderly.^[11] They have no teeth or a small number of teeth, but their dietary quality is not affected; yet their bodies and the way they consume fruits and vegetables have

changed. According to a study by Brennan et al.,^[19] dental caries is associated with lower consumption of various fruits and vegetables, and dental disease leads to impaired chewing ability, which may have unintended consequences for adult food consumption in Australia. A similar argument was noted in the current study regarding the frequency of fresh herbs, with the elderly with fewer teeth being less able to eat vegetables because people cannot change their bodies or the way they eat vegetables to make them usable.

The results of various studies (Heydecke et al., Steele et al.) show that demographic characteristics such as gender, age, education level, and financial status, as well as cultural factors have a varying influence on oral health.^[30, 31] Personal expectations and perceptions of oral health status vary among patients in other societies and are due to cultural differences between communities. The inconsistencies found in this study may be due to cultural differences and personal perceptions of oral health status. In this society, compared to other organizations studied. Ervin et al. stated that factors such as lower food intake might contribute to poor OHRQoL in edentulous older people.^[32] However, although the elderly have fewer teeth, they are more likely to consume the fruits and vegetables they need with the help of dentures, according to the current study.

Furthermore, according to Botelho et al., the number of missing teeth and male gender have a significant impact on the elderly's OHRQoL.^[33] In a study by Iwasaki et al, consumption of vegetables, fish, and oily tones was shown to be significantly lower in individuals with defective dentures or groups with vulnerable teeth in a study by Iwasaki et al.,^[10] but this was not the case in the study. People already procure the materials they need by changing the physics of the food. In a study conducted by Nanri et al., smoking was found to be associated with poor OHRQoL among the elderly in Japan.^[7] In this study, the quality of life related to dental health was investigated in the elderly. They did not smoke; smokers were mainly elderly people. Older adults with a higher level of education also had a better OHRQoL.

In their study, Ekanayake et al. found that the educational level of older people had a favorable impact on their quality of life related to dental health.^[34] The results of the previous study are consistent with those of the current study. However, in a study by Khatami Nasab et al., no relationship was found between educational level and OHRQoL.^[35] The different results seem to be due to differences in diet, environmental and cultural factors, personal beliefs about oral health status, or genetics of people in different areas. Although Maghsoudi et al. revealed that some health-promoting behaviors, such as consumption of low-salt foods, fruits and vegetables, and low-fat foods, were significantly associated with improved quality of life in the elderly,^[36] others, such as consumption of fruits and vegetables, did not affect OHRQoL.

According to Salehi et al., the main factors limiting the consumption of fruits and vegetables were financial barriers, while the essential element that promotes consumption is easy availability. It is also possible to increase the consumption of fruits and vegetables among the elderly by improving their knowledge and attitude and removing barriers. Older adults who are better able to change their fruit and vegetable behaviors consume more of these nutrients. In the current study, many factors influenced older adults' fruit and vegetable consumption. Educators and other health care professionals will be better able to construct suitable intervention programs if they are aware of these characteristics.^[37]

It is worth noting that various foods, especially fruits and vegetables, provide most of the vitamins needed by the body.^[38] Individuals who have a daily job, are poor, and simultaneously take several medications that negatively affect the normal physiology of the salivary glands and the amount of saliva

in the oral cavity have poorer oral health. [39] The number of accessible teeth and dentures in this cohort study was known, but a functional dental unit was not. An available dental unit should be used in future studies to assess the effectiveness of the masticatory system and the quality of the patients' removable prostheses.

Conclusion

According to the results of the present study, the consumption of fruits and vegetables did not influence OHRQoL in general, while a significant relationship was seen between the frequency of fresh herb consumption and OHRQoL, as people with better oral OHRQoL ate more fresh herbs. In addition, a correlation was observed between the frequency of total vegetable consumption and OHRQoL in women, and a correlation was found between the frequency of consumption of fresh herbs and OHRQoL in men.

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Conflicts of Interest

There is no conflict of interest to declare.

Author's Contribution

The study was designed by Mina Motallebnejad and Fatemeh Ghasemian. The study data were collected by Atena Shirzad, Fatemeh Sayadi, Fatemeh Baladi, Elham Mahmoodi, Niloofer Jenabian, Mohammadmehdi Naghibi, Mahsa Mehryari and Zahra Sadat Madani. Statistical analysis and interpretation of the data were done by Ali Bijani and Seyed Reza Hosseini. The preparation of the manuscript was done by Fatemeh Ghasemian. The study was supervised by Mina Motallebnejad, Seyed Reza Hosseini and Reza Ghadimi.

References

1. Cotti E, Dessì C, Piras A, Mercurio G. Can a chronic dental infection be considered a cause of cardiovascular disease? A review of the literature. *Int J Cardiol* 2011; 148: 4-10.
2. Epstein JB, Murphy BA. Late effects of cancer and cancer therapy on oral health and quality of life. *J Mass Dent Soc* 2010; 59: 22-7.
3. Kothari M, Pillai RS, Kothari SF, Spin-Neto R, Kumar A, Nielsen JF. Oral health status in patients with acquired brain injury: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2017; 123: 205-19 e7.

4. Nguyen CM, Kim JW, Quan VH, Nguyen BH, Tran SD. Periodontal associations in cardiovascular diseases: The latest evidence and understanding. *J Oral Biol Craniofac Res* 2015; 5: 203-6.
5. Gil-Montoya JA, de Mello AL, Barrios R, Gonzalez-Moles MA, Bravo M. Oral health in the elderly patient and its impact on general well-being: a nonsystematic review. *Clin Interv Aging* 2015; 10: 461-7.
6. van der Maarel-Wierink CD, Vanobbergen JN, Bronkhorst EM, Schols JM, de Baat C. Oral health care and aspiration pneumonia in frail older people: a systematic literature review. *Gerodontology* 2013; 30: 3-9.
7. Nanri H, Yamada Y, Itoi A, Yamagata E, Watanabe Y, Yoshida T. Frequency of Fruit and Vegetable Consumption and the Oral Health-Related Quality of Life among Japanese Elderly: A Cross-Sectional Study from the Kyoto-Kameoka Study. *Nutrients* 2017; 9:1362.
8. Moriya S, Miura H. Oral health and general health at the early stage of ageing: A review of contemporary studies. *Jpn Dent Sci Rev* 2014; 50: 15-20.
9. Sischo L, Broder HL. Broder. Oral health-related quality of life: what, why, how, and future implications. *J Dent Res* 2011; 90: 1264-70.
10. Iwasaki M, Taylor GW, Manz MC, Yoshihara A, Sato M, Muramatsu K. Oral health status: relationship to nutrient and food intake among 80-year-old Japanese adults. *Community Dent Oral Epidemiol* 2014; 42: 441-50.
11. Kshetrimayum N, Reddy CV, Siddhana S, Manjunath M, Rudraswamy S, Sulavai S. Oral health-related quality of life and nutritional status of institutionalized elderly population aged 60 years and above in Mysore City, India. *Gerodontology* 2013; 30: 119-25.
12. Asemi Z, Saneei P, Sabihi SS, Feizi A, Esmailzadeh A. Total, dietary, and supplemental calcium intake and mortality from all-causes, cardiovascular disease, and cancer: A meta-analysis of observational studies. *Nutr Metab Cardiovasc Dis* 2015; 25: 623-34.
13. Wang Y, Chun OK, Song WO. Plasma and dietary antioxidant status as cardiovascular disease risk factors: a review of human studies. *Nutrients* 2013; 5: 2969-3004.
14. Slavin JL, Lloyd B. Health benefits of fruits and vegetables. *Adv Nutr* 2012; 3: 506-16.
15. Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol* 2017; 46: 1029-56.
16. Hazavehei SM, Afshari M. The role of nutritional interventions in increasing fruit and vegetable intake in the elderly: a systematic review. *Aging Clin Exp Res* 2016; 28: 583-98.
17. Woodside JV, Young IS, McKinley MC. Fruit and vegetable intake and risk of cardiovascular disease. *Proc Nutr Soc* 2013; 72: 399-406.
18. Zheng J, Zhou Y, Li S, Zhang P, Zhou T, Xu DP, et al., Effects and Mechanisms of Fruit and Vegetable Juices on Cardiovascular Diseases. *Int J Mol Sci* 2017; 18:555.
19. Brennan DS, Singh KA, Liu P, Spencer A. Fruit and vegetable consumption among older adults by tooth loss and socio-economic status. *Aust Dent J* 2010; 55: 143-9.
20. Wakai K, Naito M, Naito T, Kojima M, Nakagaki H, Umemura O, et al. Tooth loss and intakes of nutrients and foods: a nationwide survey of Japanese dentists. *Community Dent Oral Epidemiol* 2010; 38: 43-9.
21. Yoshihara A, Watanabe R, Hanada N, Miyazaki H. A longitudinal study of the relationship between diet intake and dental caries and periodontal disease in elderly Japanese subjects. *Gerodontology* 2009; 26: 130-6.
22. Helmersson J, Arnlöv J, Larsson A, Basu S. Low dietary intake of beta-carotene, alpha-tocopherol and ascorbic acid is associated with increased inflammatory and oxidative stress status in a Swedish cohort. *Br J Nutr* 2009; 101: 1775-82.
23. Iwasaki M, Moynihan P, Manz MC, Taylor GW, Yoshihara A, Muramatsu K, et al. Dietary antioxidants and periodontal disease in community-based older Japanese: a 2-year follow-up study. *Public Health Nutr* 2013; 16: 330-8.
24. Nishida M, Grossi SG, Dunford RG, Ho AW, Trevisan M, Genco RJ. Dietary vitamin C and the risk for periodontal disease. *J Periodontol* 2000; 71: 1215-23.

25. Kondo K, Ishikado A, Morino K, Nishio Y, Ugi S, Kajiwara S ,et al. A high-fiber, low-fat diet improves periodontal disease markers in high-risk subjects: a pilot study. *Nutr Res* 2014; 34: 491-8.
26. Newman M, Takei H, Klokkevold, P. Carranza F. *Clinical Periodontology*. 13th ed. Philadelphia: Elsevier Health Sciences; 2019. p. 279.
27. Bijani A, Ghadimi R, Mikaniki E, Kheirkhah F, Mozaffarpur SA, Motalebnejad M ,et al. Cohort Profile Update: The Amirkola Health and Ageing Project (AHAP). *Caspian J Intern Med* 2017; 8: 205-12.
28. Motalebnejad M, Mottaghi K, Mehdizadeh S, Alaeddini F, Bijani A. Reliability and validity of the persian version of the General Oral Health Assessment Index (GOHAI). *Caspian J Dent Res* 2013; 2: 8-17.
29. Bijani A, Esmaili H, Ghadimi R, Babazadeh A, Rezaei R, G Cumming R, et al., Development and validation of a Semi-quantitative food frequency questionnaire among older people in north of Iran. *Caspian J Intern Med* 2018; 9: 78-86.
30. Heydecke G, Tedesco LA, Kowalski C, Inglehart MR. Complete dentures and oral health-related quality of life -- do coping styles matter? *Community Dent Oral Epidemiol* 2004; 32: 297-306.
31. Steele JG, Sanders AE, Slade GD, Allen PF, Lahti S, Nuttall N, et al. How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. *Community Dent Oral Epidemiol* 2004; 32: 107-14.
32. Ervin RB, Dye BA. The effect of functional dentition on Healthy Eating Index scores and nutrient intakes in a nationally representative sample of older adults. *J Public Health Dent* 2009; 69: 207-16.
33. Botelho J, Machado V, Proença L, Oliveira MJ, Cavacas MA, Amaro L, et al. Perceived xerostomia, stress and periodontal status impact on elderly oral health-related quality of life: findings from a cross-sectional survey. *BMC Oral Health* 2020; 20: 199.
34. Ekanayake L, Perera I. The association between clinical oral health status and oral impacts experienced by older individuals in Sri Lanka. *J Oral Rehabil* 2004; 31: 831-6.
35. Khatmi Nasab N, Shamshiri M, Zamani U. The Study of Oral Health Status and Its Related Quality of Life in Elderly People Supported by Welfare Organization in Ardabil City. *J Healthc* 2019; 21: 308-18. [In Persian]
36. Maghsoudi A, Mohammadi Bavariani F, Salim S ,Nejad-Haghighi, E, Arabi H ,Foruzanfar, Z. The association between health promoting behaviors and quality of life in the elderly people of Ewaz, 2014-2015. *Navid* 2016; 19: 16-23. [In Persian]
37. Salehi L, Eftekhar Ardebili H, Mohammad K, Taghdisi MH, Shogaei Zadeh D. Some Factors Affecting Consumption of Fruit and Vegetable by Elderly People in Tehran. *Salmand: Iran J Ageing* 2010; 4:34-44. [In Persian]
38. Talebi M , Saraf Shirazi AR, Esmaili H. The relationship between diet and oral hygiene and gingival status in private preschool children in the city of Mashhad. *J Mashad Dent Sch* 2006; 29: 223-34. [In Persian]
39. Ahmadi M, Noudehi M, Esmaili M, Sadrollahi A. Comparing the Quality of Life Between Active and Non-Active Elderly Women With an Emphasis on Physical Activity. *Salmand: Iran J Ageing* 2017; 12: 262-75. [In Persian]