International Journal of Nutrition Sciences

Journal Home Page: ijns.sums.ac.ir

ORIGINAL ARTICLE

The Relationship between Alternative Healthy Eating Index and Dental Health among Health Care Workers: A Cohort-Based Cross-Sectional Study

Atefehsadat Masoumi[1], Nasim Zeini Jahromi[2], Shimasadat Masoumi[3], Sanaz Jamshidi[4], Atefeh Torabi Ardekani[4], Omid Keshvarzian[5], Seyed Jalil Masoumi[4,6,7*]

1. School of Dentistry, Islamic Azad University, Shiraz Branch, Shiraz, Iran
2. Department of Oral Medicine, School of Dentistry, Shiraz Branch, Islamic Azad University, Shiraz, Iran
3. School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran
4. Center for Cohort Study of Shiraz University of Medical Sciences Employees, Shiraz University of Medical Sciences, Shiraz, Iran
5. Transplant Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
6. Nutrition Research Center, Department of Clinical Nutrition, School of Nutrition and Food Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
7. Gastroenterohepatology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

ARTICLE INFO

Keywords:
Dental caries
Oral health
DMFT
Diet
AHEI

**Corresponding author:*
Seyed Jalil Masoumi, MD, PhD;
Nutrition Research Center,
Department of Clinical Nutrition,
School of Nutrition and Food Sciences, Gastroenterohepatology Research Center,
Center for Cohort Study of Shiraz University of Medical Sciences Employees, Shiraz University of Medical Sciences,
Shiraz, Iran.
Tel: +98 9173150269
Email: masoumi7415@gmail.com
Received: April 10, 2024
Revised: July 1, 2024
Accepted: July 11, 2024

ABSTRACT

Background: Dietary patterns affect different aspects of overall health, especially oral and dental status. This study aimed to explore the relationship between the Decayed, Missing, Filled Teeth (DMFT) index and nutritional status using the Alternative Healthy Eating Index-2010 (AHEI-2010) among health care workers.

Methods: This cross-sectional study was conducted on a population participating in the first phase of the Shiraz University of Medical Sciences Employees' Health Cohort Study (SUMS-EHCS) from August 2018 to the end of March 2019. Demographic data, occupational status, DMFT index, AHEI index using the semi-quantitative food frequency questionnaire (FFQ) were determined. The relationship between DMFT and AHEI-2010 was assessed too.

Results: Totally, 1,116 SUMS-EHCS participants (mean age of 41.55±6.81 years, 52.9% female) were enrolled. The mean DMFT and AHEI-2010 were 10.46±5.45 and 65.23±13.05, respectively. A significant inverse linear relationship between DMFT and AHEI-2010 was observed (Spearman's rho: -0.060; p=0.04). In addition, the multiple linear regression showed that DMFT index to be significantly decreased when AHEI-2010 increased [coefficient: -0.048 (95% confidence interval: -0.088, -0.008); p=0.01]. Moreover, according to multiple quantile regression, the significant inverse relationship between AHEI-2010 and DMFT could be generalized to the 50th quantile of DMFT, in which with every 10-unit increase in AHEI-2010 resulted in a decrease in DMFT by 0.41 teeth (p=0.006).

Conclusion: Greater adherence to AHEI-2010 may improve oral health. Moreover, lower age and sufficient educational level was related to a higher DMFT score.

Please cite this article as: Masoumi A, Zeini Jahromi N, Masoumi S, Jamshidi S, Torabi Ardekani A, Keshvarzian O, Masoumi SJ. The Relationship between Alternative Healthy Eating Index and Dental Health among Health Care Workers: A Cohort-Based Cross-Sectional Study. Int J Nutr Sci. 2024;9(3):227-235. doi: 10.30476/ijns.2024.102706.1325.

Introduction

Dental health has a substantial role on the human well-being, which necessitates periodic evaluation (1). As a non-communicable and chronic condition, dental health is assessed by various tools, particularly the Decayed, Missing, Filled Teeth (DMFT) index, including the number of decayed, missing and filled teeth (1, 2). Since dental status maintains body harmony and balance, it may interfere with general health, systemic diseases, life quality and even mortality (3). Diets are composed of various foods and nutrients with cariogenic and cariostatic properties (4). Diets with high sugar content and poor quality can increase obesity, dyslipidemia, bone loss, and dental complications, caries and development (5). On the other hand, dietary components like fats, proteins, and antioxidants can protect oral cavity by stimulating saliva secretion, restricting bacterial accumulation and balancing the pH (6). People with higher DMFT score were shown to have less chewing ability. Accordingly, nutrient deficiency may occur due to lack of solid food consumption such as meat, nuts, vegetables, and fruits (1).

The Alternative Healthy Eating Index-2010 (AHEI-2010) is an indicator of diet quality and is supported by the evidence-based guidelines to defeat chronic diseases. A high score of AHEI-2010 can promote healthy eating behavior and may reduce inflammation, cancer, cardiovascular diseases, type 2 diabetes and potentially all-cause mortalities and morbidities (7). Also, diet quality as an environmental factor may alter bacterial colonization, dysbiosis and consequently may affect the DMFT score (8). Since food and beverages are consumed in a combined and complex manner, and assessing the effect of individual food items on a disease is difficult due to multicollinearity, the relationship between the overall diet and oral health should be evaluated instead of focusing on a single dietary component (9). Information has been insufficient to date (10). As a result, it could be advisable to determine the relationship between DMFT and adherence to healthy dietary guidelines. While dietary pattern indicators can impact overall health, less is known about their impact on dental status, so we aimed to investigate the possible relationship between the DMFT and nutritional status based on AHEI-2010 among Iranian adults participating in the Shiraz University of Medical Sciences (SUMS) Employees' Health Cohort Study (EHCS).

Materials and Methods

This cross-sectional study was conducted based on the first phase of SUMS-EHCS. SUMS-EHCS is one of the branches of Persian Cohort (PERSIAN), which aims to monitor and follow up long-term health status of employees in Shiraz University of Medical Sciences aged between 20 and 70 years since August 2018 (11). The description of the study protocol and the procedures were explained to each participant and their satisfaction to participate in the study was obtained through a written consent. The Shiraz Islamic Azad University Ethics Committee approved the study (Ethics Code: IR.IAU.SHIRAZ.REC.1402.155). The target population for the present study was the health workers who recruited into the SUMS-EHCS during recruitment phase that commenced on August 9, 2018. Using the census method, both academic and non-academic personnel of Shiraz University of Medical Sciences, who were evaluated from August 2018 to the end of March 2019 and met the criteria, were included in our study. Criteria for entering the study were participating in SUMS-EHCS and completed dietary assessment. Those with incomplete general information, without DMFT score, or going on a special diet were excluded. In total, about 1,400 individuals were eligible to participate in the present study.

Qualified employees were subjected to a comprehensive baseline health assessment by trained personnel during one working day. Participants were evaluated based on a predetermined schedule by referring to the cohort office at the Shahid Mottahari Clinic of Shiraz University of Medical Sciences located in Shiraz, Iran. The evaluation included a general questionnaire for demographic data (including age, gender, race, and marital status), occupational status (including education level, employed health sector, work experience, contractual status, and secondary employment/work), dental health status (DMFT), and nutrition assessment through food frequency questionnaire (FFQ).

To calculate AHEI-2010, the data were obtained from the semi-quantitative FFQ questionnaire with 121 items, which its' validity and reliability were confirmed in a previous study (12). On the first day of participant's attendance, they were asked to indicate the amount and frequency of daily, weekly, monthly and annual consumption of the food items during the past year, through face-to-face interviews by four trained and experienced nutritionists stationed at SUMS-EHCS center. The Iranian Food Composition Table (IFCT) was used to obtain the amount of food portions. In addition, since the IFCT was not complete for all food items, the United States Department of Agriculture (USDA) food table was also utilized to complete the required information. Finally, the obtained information was converted to

grams by Nutritionist IV software.

The total score of AHEI-2010 was estimated according to the method provided by Chiuve *et al.* (13). AHEI-2010 consisted of 11 components, including [i] fruits, [ii] vegetables, [iii] whole grains, [iv] legumes and nuts, [v] long-chain omega-3 fatty acids (docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), [vi] polyunsaturated fatty acids (PUFA) which were recommended to be consumed; [vii] alcohol as a component with ideal moderate intake; and other components which were recommended to be avoided including [viii] fruit juices and sugar-sweetened beverages, [ix] red and processed meat, [x] sodium and finally [xi] trans fatty acids.

The score of each mentioned components ranged from 0 to 10, while a score of zero indicated non-consumption of recommended amounts per day; a score of 10 demonstrated consumption of recommended amounts per day; and finally the score between 2 and 9 illustrated the proportion of consumption between these two ranges. In addition, each group's score was adjusted based on the amount of energy intake. Finally, adherence to the AHEI-2010 was calculated in the range of 0 (i.e., non-adherence) to 10 (i.e., perfect adherence) (14). By removing the alcohol consumption group in this study, the final score ranged between 0 and 100. The standard WHO form was used to calculate the DMFT index, which is a well-known indicator of oral health status. DMFT score was measured as the summation of the decayed, missing and filled teeth by trained personnel in sufficient room light (15). It should be noticed that for confirming tooth decay, the participants were asked to provide the dental graph documents or the description of the dentist's report and to be examined by a dentist of the cohort center.

The SPSS statistical software (version 22.0, SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Qualitative and quantitative variables were reported by frequency (percentage) and mean [standard deviation (SD)] or median [interquartile range (IQR)], respectively. The normality of the distribution of quantitative variables was checked with the Kolmogorov-Smirnov test and visual inspection of histogram and Q-Q plots. The linear uni-variable relationship between DMFT and its components with AHEI-2010 was investigated using Pearson's correlation coefficient or Spearman's rho. For further investigation, multiple linear regression tests were performed. Furthermore, in case of non-normal distribution of dependent variables (DMFT), quantile regression was utilized at 25 (Q1), 50 (Q2) and 75 (Q3) quantiles. A p value less than 0.05 was considered statistically significant.

Table 1: Demographic characteristics, occupational status, AHEI-2010, and oral health indicators observed in SUMS EHCS participants.

Variable	Value
Age category (year)	
20-34	157 (14.1)[1]
35-39	314 (28.1)
40-44	302 (27.1)
45-49	199 (17.8)
≥50	144 (12.9)
Gender	
Male	526 (47.1)
Female	590 (52.9)
Race	
Fars	910 (81.5)
Other	206 (18.5)
Marital status	
Married	896 (80.3)
Single	177 (15.9)
Divorced/Widow	43 (3.8)
Educational level	
Up to high school	91 (8.2)
Diploma	190 (17.0)
Associate degree	123 (11.0)
Bachelor	415 (37.2)
Master and higher	297 (26.6)
Employed health sector	
Administrative	659 (59.1)
Clinical therapeutic	180 (16.1)
Public service	116 (10.4)
Other	161 (14.4)
Work experience (year)	
0-10	228 (20.4)
11-15	352 (31.5)
16-20	282 (25.4)
≥20	254 (22.7)
Contractual status	
Official	437 (39.2)
Contractual	611 (54.7)
Corporate/Treaty	68 (6.1)
Secondary employment/work	
Yes	154 (13.8)
No	962 (86.2)
AHEI-2010	
Mean±SD	65.23±13.05
Median [IQR]	67.84 (63.26-71.66)
Teeth brushing/day	
Mean±SD	1.81±1.23
Median [IQR]	1 (1-2)
Decayed teeth	
Mean±SD	1.53±2.33
Median [IQR]	1 (0-2)
Missing teeth	
Mean±SD	2.83±4.51
Median [IQR]	1 (0-4)
Filled teeth	
Mean±SD	6.10±4.28
Median [IQR]	6 (2-9)
DMFT	
Mean±SD	10.46±5.45
Median [IQR]	10 (7-14)

1: Frequency (%). AHEI: Alternative Healthy Eating Index; DMFT: Decayed, Missing, and Filled Teeth; SD: Standard deviation; IQR: Interquartile range.

Results

Totally, 1,116 SUMS-EHCS participants were included in the study. The average age was 41.55±6.81 years and more than half of the participants were female (52.9%). In terms of racial distribution, the majority of the participants were Fars (81.5%) and most of the participants were married (80.3%). Moreover, only 8.2% of the participants held an education degree less than diploma (Table 1). The mean AHEI-2010 was 65.23±13.05, ranged from 0 to 88.91. The mean of DMFT index was 10.46±5.45, which ranged from 0 to 32. Additionally, health workers brushed their teeth 1.81±1.23 times per day (Table 1).

A significant inverse linear relationship was observed between DMFT and AHEI-2010 (Spearman's rho: -0.060; p=0.044). However, no significant relationship was observed between any of the components of DMFT and AHEI-2010. This linear relationship was further investigated using multiple linear regressions, which showed that age, educational level and AHEI-2010 index were significantly correlated with DMFT. That is, younger age group, higher educational level and higher AHEI-2010, were significantly correlated with a decrease in DMFT. Specifically, with every 10-unit increase in AHEI-2010, the DMFT index decreased significantly by 0.48 units (95%CI: 0.008, 0.088; p=0.018) (Table 2). Other independent variables did not show a significant relationship with DMFT.

Due to a non-normal distribution of DMFT in our cohort, multiple quantile regression was also carried out. It was observed that significant relationship between AHEI-2010 and DMFT can only be generalized to the 50th quantile (i.e., 7≤ DMFT ≥14), as no significant relationship between AHEI-2010 and DMFT was noticed at the 25th (i.e., 7> DMFT) and 75th quantile (i.e., 14< DMFT). In other words, a DMFT less than 7 or more than 14 was statistically related to the variables other than AHEI-2010, particularly the age. Worth noting, at the 50th quantile, with every 10-unit increase in AHEI-2010, the amount of DMFT decreased significantly by 0.41 units (p=0.006). Additionally, age showed an inverse significant association with DMFT, irrespective of its category or DMFT quantile (p<0.05 for all). Moreover, participants with bachelor degree at 25th quantile of DMFT and participants who educated till high school degree at 75th quantile had remarkably a lower (p=0.03) and a higher DMFT score (p=0.013), respectively. No significant relationship was found between DMFT and gender, race, marital status, employee of health sector, work experience, contractual status, or secondary employment (Table 3).

Discussion

This cohort-based cross-sectional study was one of the limited investigations to evaluate the relationship between AHEI-2010 and oral health among health workers in southern Iran. According to our findings, there was an inverse relationship between DMFT and AHEI-2010, revealing that elevation of ten units of AHEI-2010 could decrease DMFT by 0.48 percent. Also, lower age and higher educational level was correlated with DMFT reduction. The average DMFT index and its components (decayed, missing, and filled teeth) in SUMS-EHCS cohort health workers were 10.46, 1.53, 2.83 and 6.10, respectively. In the study of Najafi *et al.*, which included DMFT data from 17 branches of the Persian cohort, the mean DMFT score, decayed, missing, and filled teeth for adults was 18.0, 3.3, 12.6, and 2, respectively. Based on these findings and comparison to the average national as well as 14 provinces of Iran, DMFT and its components of decayed and missing teeth were lower and the filled teeth component was higher (Figure 1).

It appears that these lower values indicate a higher level of health status, knowledge about oral health care, and a higher level of education, while a higher level of filled teeth reveals better access to oral and dental health services, probably due to better economic status among health workers (16).

Table 2: Independent variables significantly affecting DMFT in SUMS-EHCS according to multiple linear regressions.

Variable	B	95%CI	*P* value
Age category (year)			
20-34	-5.946	-7.587, -4.305	<0.001
35-39	-4.528	-5.931, -3.124	<0.001
40-44	-3.638	-4.995, -2.280	<0.001
45-49	-2.456	-3.633, -1.290	<0.001
≥50 [reference group]	-	-	-
Educational level			
Less than diploma	1.740	0.558, 2.922	0.004
Diploma to bachelor	0.646	-0.195, 1.487	0.132
Master and higher [reference group]	-	-	-
AHEI-2010	-0.048	-0.088, -0.008	0.018

AHEI-2010: Alternative Healthy Eating Index-2010; CI: Confidence interval.

Table 3: Multiple quantile regression to investigate variables affecting DMFT in SUMS-EHCS.

Variable	Q25		Q50		Q75	
	B	*P* value	B	*P* value	B	*P* value
Gender						
Male	-0.840	0.073	-0.458	0.296	-0.162	0.700
Female [reference group]	-	-	-	-	-	-
Age category (year)						
20-34	-4.939	<0.001	-6.739	<0.001	-6.632	<0.001
35-39	-3.205	0.001	-4.173	<0.001	-5.231	<0.001
40-44	-2.660	0.003	-3.564	<0.001	-3.878	<0.001
45-49	-1.892	0.013	-2.583	<0.001	-3.409	<0.001
≥50 [reference group]	-	-	-	-	-	-
Race						
Fars	-0.317	0.548	-0.392	0.429	0.093	0.845
Other [reference group]	-	-	-	-	-	-
Educational level						
Up to high school	-0.132	0.370	0.404	0.733	2.855	0.013
Diploma	-0.355	0.653	-0.510	0.465	0.088	0.896
Associate degree	-0.372	0.632	-0.267	0.715	-0.064	0.927
Bachelor	-.1.123	0.037	-0.475	0.347	0.097	0.841
Master and higher [reference group]	-	-	-	-	-	-
Marital status						
Married	-1.781	0.134	-1.509	0.176	-1.017	0.344
Single	-0.657	0.548	-0.446	0.664	-0.102	0.918
Divorced/Widow [reference group]	-	-	-	-	-	-
Employee of health sector						
Administrative	-0.765	0.225	-0.800	0.176	-0.522	0.359
Clinical or therapeutic	0.078	0.927	0.216	0.787	0.114	0.882
Public services	0.754	0.476	0.103	0.917	-0.848	0.375
Other [reference group]	-	-	-	-	-	-
Work experience (year)						
0-10	1.355	0.171	1.446	0.119	1.172	0.190
11-15	0.884	0.290	0.862	0.271	1.055	0.162
16-20	0.176	0.813	0.619	0.375	0.784	0.244
≥20 [reference group]	-	-	-	-	-	-
Contractual status						
Official	0.450	0.429	0.303	0.570	-0.455	0.376
Contractual	-0.762	0.395	0.133	0.874	-0.119	0.883
Corporate/Treaty [reference group]	-	-	-	-	-	-
Secondary employment/work						
Yes	-0.573	0.345	-0.182	0.750	0.154	0.779
No [reference group]	-	-	-	-	-	-
AHEI-2010	-0.017	0.283	-0.041	0.006	-0.025	0.079

AHEI-2010: Alternative Healthy Eating Index-2010.

It is noteworthy to state that the average DMFT among the age groups of 35-44 years was shown to be equal to 16.1 in Germany (17), 15.4 in Hungary (18), 14.7 in Austria (19), 12.28 in Japan, 12.10 in Malaysia, 5.2 in South Korea and 10.8 in Turkey (20). Accordingly, the average DMFT among Iranian health workers was lower than general population in various developed countries.

We observed a significant inverse linear relationship between DMFT and AHEI-2010. This finding is broadly consistent with previous studies. A study by Blostein *et al.* on data from 4,467 adults participated in the US National Health and Nutrition Examination Survey showed that among people older than 30 years, a higher DMFT was visible that was associated with unhealthy dietary patterns (1). Another study in relation to immigrants living in United States, it was shown that the risk of dental caries decreased with the increase in AHEI-2010 (21). Furthermore, Kaye *et al.* reported an inverse association between the likelihood of untreated dental caries with HEI-2015, but the trend was not the same across racial or ethnic groups (7). Sachdev *et al.* have also shown a significant inverse relationship between diet quality measured by HEI-2015 and DMFT scores among women aged 18-50 years with low income (10).

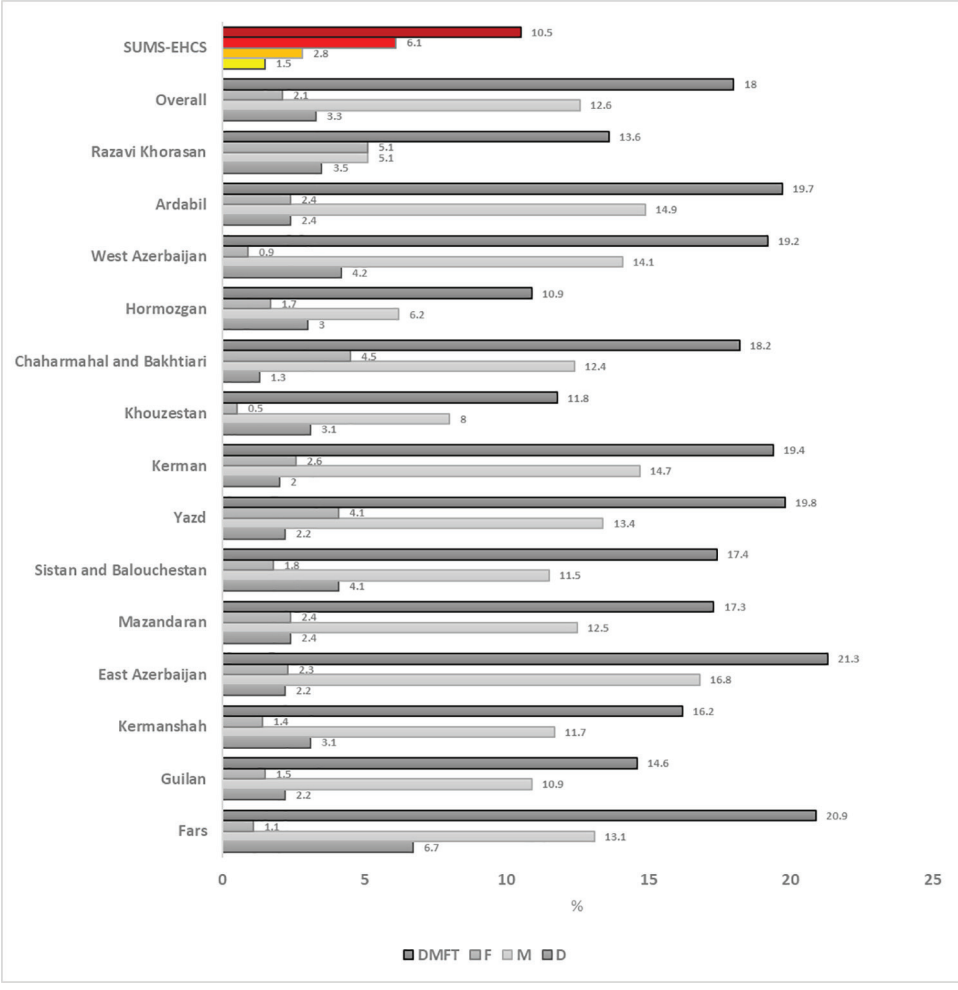

Figure 1: Comparison of DMFT index status between SUMS-EHCS and other branches of the PERSIAN cohort in Iran.

It is worth mentioning that in our study, with every 10-unit increase in AHEI-2010, the DMFT index decreased significantly by 0.48 units. Similarly, in the study of Sachdev *et al.*, in women aged 18 to 50 years, DMFT score decreased by 0.569 with every ten-unit increase in HEI-2015 (10). Sanders *et al.* have also reported that every 10-unit increase in AHEI-2010 score decreased DMFT by 2.5 units based on analysis of data from 14,517 participants in the Hispanic Community Health Study of Latinos (HCHS/SOL) study (21). It is notable that dietary components of AHEI-2010 are associated with odds of decay. In this regard, more sugar consumption increase caries progression, while various food groups such as vegetables and whole grain restrict dental plaques, due to nutrient contents such as isothionates and polyphenols. Additionally, dairy intake has potential to decrease dental caries (1).

We have also observed that DMFT has significantly been higher in older age groups. In general, the number of decayed, missing, and filled teeth was typically increased with age. Respectively, WHO has determined a higher DMFT index cut-off value for older people (22). In this regard, WHO has defined acceptable dental health status as 6, based on the DMFT index for adults aged 35-44 years (23). A meta-analysis on the Iranian reports confirmed that the rate of DMFT increased with age, and this trend was observed in most groups over time (24). Furthermore, a review by Al-Ansari showed that adults in Saudi Arabia had the highest prevalence of dental caries and the elderly population had the highest DMFT score compared to other age groups (25). In line with these findings, a significant direct relationship was found between age and DMFT among adults in the Persian cohort (16, 26, 27).

A study by Ditmyer *et al.* has also revealed that DMFT scores were higher in women and older age (28). In a meta-analysis, Zhang *et al.* found that older people, smokers, and people with lower socioeconomic status were at higher risk for caries (29). Other previous studies on dental caries have also shown that with increasing age, dental caries and the average DMFT increased (30, 31). A plausible explanation for this finding is that the elderly people are exposed to a carious diet for a longer period of time (31). In addition, elderly population are at a higher risk of caries due to higher underlying

diseases and drug use (32). Moreover, this difference in age groups may be due to metabolism changes including changes in calcium absorption and caries-causing microbiome dysbiosis due to aging (1).

Another finding of our study was that by increasing education level, DMFT index decreased significantly. In general, level of higher education was reported as one of the main factors in adopting healthier habits and dietary behaviors that could improve oral and dental health (33, 34). Generally, people with higher educational level are wealthier and well informed about the importance of brushing and flossing for oral health (35), which in turn leads to greater adherence to preventive oral health behaviors (36). Soofi *et al.* in a study that included cumulative data of a total of 130,016 people aged 35 years and older from 17 branches of the Persian cohort showed that after economic status, the level of education was the main socioeconomic inequality factor of dental caries (37). Also, in the study of Rezaei *et al.* on the data of Household Expenditure and Income Survey (HEIS-2017), it was shown that the economic status of households, age and educational level were the main factors involved in the inequality in the use of dental services in Iran (27).

A meta-analysis study has shown that an increase in educational level and income had a remarkable positive effect on the use of dental care (38). In particular, it was shown that health literacy, which is expected to be higher in health workers was associated with the adoption of oral health-promoting behaviors as well as a better oral health status (39, 40). In this regard, Ueno *et al.* reported a significant relationship between oral health literacy, status and behaviors (40). Interestingly, in Chung *et al.*'s study, low-income individuals with a higher level of education reported better oral and dental hygiene behaviors, including brushing teeth and visiting the dentist, than high-income individuals with a lower educational level (36).

Although, the strength of our study was its considerable sample size, but there were still limitations in our study. First, since this study had a cross-sectional design, we were unable to confirm a cause-effect relationship between AHEI-2010 and DMFT; therefore, it is recommended that longitudinal studies to be conducted in future to confirm the relationship between AHEI-2020 and DMFT. Second, the generalizability of our results to other provinces and other age groups is somewhat limited. Third, the DMFT index is a visual examination technique and does not use radiography; as a result, the prevalence of caries in the samples may be underestimated, or it may be difficult to detect missing teeth due to caries or periodontal disease; However, DMFT has already been used extensively in numerous population-based studies.

Conclusion

According to our findings, a better diet quality, lower age and higher educational level were factors associated with a decrease in DMFT score. Therefore, greater adherence to AHEI-2010 may improve oral health. However, future longitudinal studies after the completion of SUMS-EHCS follow-ups would elucidate this relationship. Additionally, it would be advised that dietary assessments are integrated in oral health screenings. Furthermore, the oral health status based on the DMFT index in Iranian health workers was better than the national level; but still fell short of the recommended level by WHO for adults.

Acknowledgment

The authors are thankful to the participants for their invaluable cooperation in SUMS-EHCS.

Authors' Contribution

AM and ShM were responsible for research idea, study design, and data collecting. NJ was responsible for research idea and study design. SJ was responsible for data interpretation and manuscript writing. AT was responsible for data collecting and data interpretation. OK and SJM were responsible for study design and critical revision of the manuscript.

Conflict of Interest

None declared.

References

1 Blostein FA, Jansen EC, Jones AD, et al. Dietary patterns associated with dental caries in adults in the United States. *Community Dent Oral Epidemiol*. 2020;48:119-29. DOI: 10.1111/cdoe.12509. PMID: 31809561.

2 Mehrabani D, Mahdiyar P, Torabi K, et al. Growth kinetics and characterization of human dental pulp stem cells: Comparison between third molar and first premolar teeth. *J Clin Exp Dent.* 2017;9:e172-e177. DOI: 10.4317/jced.52824. PMID: 28210430.

3 Sholehvar F, Mehrabani D, Yaghmaei P, et al. The effect of Aloe vera gel on viability of dental pulp stem cells. *Dent Traumatol.* 2016;32:390-6. DOI: 10.1111/edt.12272. PMID: 27126516.

4 Mehrabani D, Masoumi SJ, Masoumi AS, et al. Role of Diet in Mesenchymal Stem Cells' Function: A Review. Int J Nutr Sci. 2023;8:9-19. DOI: 10.30476/ijns.2023.97788.1221

5 Mohit M, Mousavinezhad H, Karami E, et al. The Effect of Different Types of Dietary Fatty Acids on Body Fat: A Review. Int J Nutr Sci. 2022;7:125-130. DOI: 10.30476/ijns.2022.95602.1190.
6 Hassanshahi N, Masoumi SJ. The Effect of Omega-3 Fatty Acids in Ulcerative Colitis: A Systematic Review. Int J Nutr Sci. 2018;3:58-64.
7 Kaye EA, Sohn W, Garcia RI. The healthy eating index and coronal dental caries in US adults: National Health and Nutrition Examination Survey 2011-2014. *J Am Dent Assoc*. 2020;151:78-86. DOI: 10.1016/j.adaj.2019.09.009. PMID: 31837744
8 Karğin D, Korkmaz Bo, Mungan NC, et al. Evaluation of healthy Nutrition Index-2015, Dental health and oral flora relationship in school-age children. *Clin Exp Health Sci.* 2021;11:642-7. DOI: 10.33808/clinexphealthsci.938353.
9 Ahmadijoo P, Eftekhari MH, Masoumi SJ, et al. The possible relationship between the healthy eating index-2015 and the 10-year risk of cardiovascular diseases. *BMC Nutr.* 2023;9:76. DOI: 10.1186/s40795-023-00735-8. PMID: 37370157.
10 Sachdev PK, Freeland-Graves J, Babaei M, Sanjeevi N, Zamora AB, Wright GJ. Associations between diet quality and dental caries in low-income women. *J Acad Nutr Diet.* 2021;121:2251-9. DOI: 10.1016/j.jand.2021.04.015. PMID: 33992584.
11 Poustchi H, Eghtesad S, Kamangar F, et al. Prospective epidemiological research studies in Iran (the PERSIAN Cohort Study): rationale, objectives, and design. *Am J Epidemiol.* 2018;187:647-55. DOI: 10.1093/aje/kwx314. PMID: 29145581.
12 Eghtesad S, Hekmatdoost A, Faramarzi E, et al. Validity and reproducibility of a food frequency questionnaire assessing food group intake in the PERSIAN Cohort Study. *Front Nutr.* 2023;10:1059870. DOI: 10.3389/fnut.2023.1059870. PMID: 37599697.
13 Chiuve SE, Fung TT, Rimm EB, et al. Alternative dietary indices both strongly predict risk of chronic disease. *J Nutr.* 2012;142:1009-18. DOI: 10.3945/jn.111.157222. PMID: 22513989.
14 Asadi Z, Ghaffarian Zirak R, Yaghooti Khorasani M, et al. Dietary inflammatory index is associated with healthy eating index, alternative healthy eating index, and dietary patterns among Iranian adults. *J Clin Lab Anal.* 2020;34:e23523. DOI: 10.1002/jcla.23523.
15 Akarslan ZZ, Sadik B, Sadik E, et al. Dietary habits and oral health related behaviors in relation to DMFT indexes of a group of young adult patients attending a dental school. *Med Oral Patol Oral Cir Bucal.* 2008;13:E800-7. PMID: 19047971.
16 Najafi F, Rezaei S, Hajizadeh M, et al. Decomposing socioeconomic inequality in dental caries in Iran: cross-sectional results from the PERSIAN cohort study. *Arch Public Health.* 2020;78:75. DOI: 10.1186/s13690-020-00457-4. PMID: 32832079.
17 Schiffner U, Reich E. Caries in adolescents, adults and seniors in Germany. *Caries Res.* 1999;33:286-7.
18 Madléna M, Hermann P, Jáhn M, et al. Caries prevalence and tooth loss in Hungarian adult population: results of a national survey. *BMC Public Health*. 2008;8:364. DOI: 10.1186/1471-2458-8-364. PMID: 18939981.
19 Städtler P, Bodenwinkler A, Sax G. Caries prevalence in a 35–44 and 65–74 year-old Austrian population. *Caries Res.* 2002;36:207.
20 Bernabé E, Sheiham A. Extent of differences in dental caries in permanent teeth between childhood and adulthood in 26 countries. *Int Dent J.* 2014;64:241-5. DOI: 10.1111/idj.12113. PMID: 24863963
21 Sanders A, Cardel M, Laniado N, et al. Diet quality and dental caries in the Hispanic Community Health Study/Study of Latinos. *J Public Health Dent*. 2020;80:140-9. DOI: 10.1111/jphd.12358. PMID: 32031253.
22 Organization WH. Oral health surveys: basic methods: World Health Organization; 2013.
23 Organization WH, editor A review of current recommendations for the organization and administration of community oral health services in Northern and Western Europe: report on a WHO workshop: Oslo, 24-28 May 1982. A review of current recommendations for the organization and administration of community oral health services in Northern and Western Europe: report on a WHO workshop: Oslo, 24-28 May 1982; 1983.
24 Müller A, Hussein K. Meta-analysis of teeth from European populations before and after the 18th century reveals a shift towards increased prevalence of caries and tooth loss. *Arch Oral Biol*. 2017;73:7-15. DOI: 10.1016/j.archoralbio.2016.08.018. PMID: 27816793.
25 Al-Ansari AA. Prevalence, severity, and secular trends of dental caries among various Saudi populations: a literature review. *Saudi J Med Med Sci*. 2014;2:142-50. DOI: 10.4103/1658-631x.142496.
26 Soofi M, Karami-Matin B, Kazemi-Karyani A, et al. Socioeconomic inequality in dental caries

experience expressed by the significant caries index: cross-sectional results from the RaNCD Cohort Study. *Int Dent J.* 2021;71:153-9. DOI: 10.1111/idj.12612. PMID: 32944969.

27 Rezaei S, Hajizadeh M, Irandoost SF, et al. Socioeconomic inequality in dental care utilization in Iran: a decomposition approach. *Int J Equity Health*. 2019;18:161. DOI: 10.1186/s12939-019-1072-5. PMID: 31640703.

28 Ditmyer M, Dounis G, Mobley C, et al. Inequalities of caries experience in Nevada youth expressed by DMFT index vs. Significant Caries Index (SiC) over time. *BMC Oral Health.* 2011;11:12. DOI: 10.1186/1472-6831-11-12. PMID: 21466692.

29 Zhang J, Lo ECM. Epidemiology of dental root caries: a review of risk factors. Frontiers of Oral and Maxillofacial Medicine. 2020.

30 Mendes DC, de Oliveira Poswar F, de Oliveira MVM, et al. Analysis of socio-demographic and systemic health factors and the normative conditions of oral health care in a population of the Brazilian elderly. *Gerodontology*. 2012;29:e206-14. DOI: 10.1111/j.1741-2358.2010.00446.x. PMID: 21083742.

31 Eslamipour F, Borzabadi-Farahani A, Asgari I. The relationship between aging and oral health inequalities assessed by the DMFT index. *Eur J Paediatr Dent*. 2010;11:193-9. PMID: 21250771.

32 Mazurkiewicz D, Pustułka M, Ambrozik-Haba J, Bienkiewicz M. Dietary Habits and Oral Hygiene as Determinants of the Incidence and Intensity of Dental Caries—A Pilot Study. *Nutrients*. 2023;15:4833. DOI: 10.3390/nu15224833. PMID: 38004227.

33 Hakeem FF, Sabbah W. Is there socioeconomic inequality in periodontal disease among adults with optimal behaviours. *Acta Odontol Scand.* 2019;77:400-7. DOI: 10.1080/00016357.2019.1582795. PMID: 30919709.

34 Sabbah W, Sheiham A. The relationships between cognitive ability and dental status in a national sample of USA adults. *Intelligence*. 2010;38:605-10.

35 Perera I, Ekanayake L. Influence of oral health-related behaviours on income inequalities in oral health among adolescents. *Community Dent Oral Epidemiol*. 2011;39:345-51. DOI: 10.1111/j.1600-0528.2010.00606.x. PMID: 21241348.

36 Chung SY, Chung SY, Hwang YH, et al. Socioeconomic inequalities in dental behaviors among Korean adults. *Dent Med Prob*. 2017;54:235-40. DOI: 10.17219/dmp/76082.

37 Soofi M, Pasdar Y, Karami Matin B, et al. Socioeconomic-related inequalities in oral hygiene behaviors: a cross-sectional analysis of the PERSIAN cohort study. *BMC Oral Health.* 2020;20:63. DOI: 10.1186/s12903-020-1036-6. PMID: 32111212.

38 Reda SF, Reda SM, Thomson WM, et al. Inequality in utilization of dental services: a systematic review and meta-analysis. *Am J Public Health*. 2018;108:e1-e7. PMID: 29267052.

39 Baskaradoss JK. Relationship between oral health literacy and oral health status. *BMC Oral Health*. 2018;18:172. DOI: 10.1186/s12903-018-0640-1. PMID: 30355347.

40 Ueno M, Takeuchi S, Oshiro A, et al. Relationship between oral health literacy and oral health behaviors and clinical status in Japanese adults. *J Dent Sci.* 2013;8:170-6.