The Healthy Eating Index and Oral Health among Adults: A finding from a Prospective Cohort Study in Iran

Arash Mohammadi
Kermanshah University of Medical Sciences
Mitra Darbandi
Kermanshah University of Medical Sciences
Yahya Pasdar
Kermanshah University of Medical Sciences
Mahsa Mohebi
Kermanshah University of Medical Sciences
Narges Ziaei
Kermanshah University of Medical Sciences
Farid Najafi (fnajafi@kums.ac.ir)
Kermanshah University of Medical Sciences

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Abstract

Background: This study was conducted to investigate the association between decayed, missing, and filled teeth (DMFT) index and nutritional status based on Healthy Eating Index (HEI), in Iranian adults.

Methods: In this cross-sectional study, data from the Ravansar Non-Communicable Diseases (RaNCD) cohort study were analyzed. DMFT index was employed as a measurement of oral health. The HEI-2015 score was calculated based on data obtained from Food Frequency Questionnaire (FFQ) and categorized into quartiles to best separate those with better quality diets (Q4), mixed quality diets (Q2-Q3), and poor quality diets (Q1). Linear regression models were used to assess the association between HEI-2015 and DMFT.

Results: 7,549 participants with the mean age of 45.65 ± 7.70, 3741 of which were female (49.56%), were evaluated. The mean of DMFT in Q4 of HEI-2015 was significantly lower than the Q1 (12.64± 7.04 vs. 14.29± 7.54, P<0.001). The mean of DMFT in higher SES was significantly lower than low SES (P<0.001). The increasing DMFT in the Q1 of HEI-2015 was significantly 0.11 times lower than in the Q4, after adjusting for confounding variables (β= -0.11; 95% CI: -0.54, -0.30). The increasing dairy intake (β= -0.08, 95% CI: -0.13, -0.03) was significantly associated with decreasing DMFT score and increasing refined grains (β= 0.20, 95% CI: 0.02, 0.35) and sodium (β= 0.06, 95% CI: 0.01, 0.11) intake was significantly associated with increasing DMFT score.

Conclusions: A healthy diet was significantly associated with a decrease in DMFT score in the studied population.

Background

The status of teeth and the digestive system have an essential role in the body's health status, which requires regular evaluation. One of the most common methods for assessing dental caries and dental treatment needs is DMFT index. Such index has been used for about 75 years and counts the number of decayed, missing and restored teeth [1]. A meta-analysis study in 2018, indicated that the DMFT index of Iranian children and adults is 2.30 and 8.60, respectively [2]. Many studies have shown that there is association between tooth loss and chronic diseases such as obesity, type 2 diabetes mellitus (T2DM), cardiovascular diseases (CVDs), some kinds of cancers and all-cause mortality [3–6].

Nutrition, is a factor that has a significant correlation with DMFT [7, 8]. The ability to chew is reduced in people who lose more natural teeth. Therefore, there may be changes in their dietary choices, such as reduced consumption of solid foods such as fruits and vegetables, nuts, and cooked meats. This can lead to a lack of essential nutrients in the body [9–13].

The Healthy Eating Index (HEI) is a valid method for measurement of diet quality. This index was developed by the US Department of Agriculture to monitor the intakes of the US population. The reference base for the HEI-2015 scoring algorithm is the 2015–2020 Dietary Guidelines for Americans (DGA), based

on recommended intakes for food groups and nutrient, which are related to health [14]. The HEI 2015 index measures two important aspects of nutrition: First, adequacy, by measuring 9 foods items; and second, moderation for dietary intakes by measuring 4 food items [14, 15]. Since there are few investigations about DMFT and nutritional status in Iran, this study was conducted to investigate the association between DMFT index and nutritional status based on HEI 2015 among Iranian adults.

Methods

Study design and participants

This cross-sectional study was conducted in 2021 using data from the baseline phase of the Ravansar Non-Communicable Disease (RaNCD) cohort study in Ravansar, Kermanshah province, western Iran. The RaNCD study is part of a Prospective Epidemiological Research Studies in Iran (PERSIAN), which has started by enrolling 10,047 adults aged from 35 to 65 since 2014. Ravansar is a district with urban and rural areas located Kermanshah province in the west of Iran and holds a population of about 50,000. The detailed methodology and design of the RaNCD study has been published 2019 [16]. Participants included all subjects from the baseline phase of the RaNCD study (n = 10,047). Participants with dentures (n = 2,457) and missing data (n = 41) were excluded. Finally, 7,549 subjects were examined.

Data Collection

Using a validated questionnaire, all required information was collected by well-trained personnel of the cohort center through face-to-face interviews. Demographic information including age, sex, marital status, socio-economic status (SES) and smoking, was recorded online in an electronic data collection form. The SES is categorized into three groups classified into three groups from the lowest to the highest. Smoking status is presented in three groups (current smoker, former smoker and never smoker).

The standard Persian cohort questionnaire was used to assess the level of physical activity. This questionnaire has 22 questions about sport, work, and leisure - related activities on an average weekday and has been completed as a self-report. Physical activity was classified into three group including, low (24–36.5 MET/hour per day), moderate (36.6–44.4 MET/hour per day) and high (≥ 44.5 MET/hour per day).

Dmft Score Measurements

The DMFT index was employed as a measurement of oral health in this study. The DMFT score was measured as the total number of teeth that were decayed (D), missing (M), and filled (F). Whether the participant uses dental floss or not was asked using "yes" and "no". The number of times a participant brushed their teeth was asked using a question with three options, including "once or twice daily", " three times ≤ a day" and "Doesn’t brush".

Healthy Eating Index 2015

Nutritional information extracted from the Food Frequency Questionnaire (FFQ) was applied to calculate the HEI-2015 scores. The HEI- 2015 was calculated based on the method described by Krebs-Smith et al. (2018) [15] HEI-2015 which encompasses 13 food items. Nine of these 13 items are emphasized to be consumed in adequate quantities which include whole fruits, total fruits, total protein foods, seafood and plant proteins, greens and beans, total vegetables, whole grains, dairy products, and fatty acids. Therefore, participants with the highest intake were given the highest point.

The refined grains, sodium, added sugars and saturated fats should be consumed in moderation, and participants with the lowest intake were given the highest point. Finally, the score of all items is added together and the final score is calculated as a number from 0 and 100 [15] (Table 1).

Table 1. Healthy eating index – 2015 (Intakes between the minimum and maximum

standards are scored proportionately)

Component	Standard for maximum score	Standard for minimum score of zero	Maximum points
Adequacy:			
Total Fruits [1]	≥0.8 cup equivalent per 1,000 kcal	No Fruit	5
Whole Fruits[2]	≥0.4 cup equivalent per 1,000 kcal	No Whole Fruit	5
Total Vegetables	≥1.1 cup equivalent per 1,000 kcal	No Vegetables	5
Greens and Beans	≥0.2 cup equivalent per 1,000 kcal	No Dark-Green Vegetables or Legumes	5
Whole Grains	≥1.5 cup equivalent per 1,000 kcal	No Whole Grains	10
Dairy[3]	≥1.3 cup equivalent per 1,000 kcal	No Dairy	10
Total Protein Foods[4]	≥2.5 cup equivalent per 1,000 kcal	No Protein Foods	5
Seafood and Plant Proteins [4,5]	≥0.8 cup equivalent per 1,000 kcal	No Seafood or Plant Proteins	5
Fatty Acids[6]	(PUFAs + MUFAs)/SFAs ≥2.5	(PUFAs + MUFAs)/SFAs ≤1.2	10
Moderation:			
Refined Grains	≤1.8 ounce equivalent per 1,000 kcal	≥4.3 ounce equivalent per 1,000 kcal	10
Sodium	≤1.1 grams per 1,000 kcal	≥2.0 grams per 1,000 kcal	10
Added Sugars	≤6.5% of energy	≥26% of energy	10
Saturated Fats	≤8% of energy	≥16% of energy	10
Total score			100

[1] Includes 100% fruit juice.

[2] Includes all forms except juice.

[3] Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages

[4] Includes legumes (beans and peas)

[4,5] Includes seafood, nuts, seeds, soy products (other than beverages), and legumes (beans and peas)

[6] Ratio of poly- and mono-unsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs)

Statistical Analysis

Data were analyzed using Stata software, version 14.2 (Stata Corp, College Station, TX, USA). Basic characteristics of participants across quartiles of the HEI-2015 and DMFT score were reported as mean ± standard deviation for continuous variables and as percentages for qualitative variables. To compare differences across HEI-2015 quartiles and DMFT, we used the one-way ANOVA and Chi square test. Linear regression models were applied to determine associations between HEI-2015 and DMFT score. All statistical analyzes were considered significant according to P-value of < 0.05 with 95% confidence intervals (CIs).

Results

A total 7,549 participants, with a mean age of 45.65 ± 7.70 years were enrolled. The mean of DMFT was 13.33 ± 7.28. Compared with those in the lowest quartile, participants in the highest quartile of HEI-2015 were younger (P < 0.001). Overall, 3808 (%50.44) were male, 6851 (%90.75) were married and 858 (%11.47) were current smokers. The highest HEI-2015 quartile had fewer current smokers compared to the lowest quartile (Q1=%40.44 vs. Q4=%11.42, P < 0.001). The average DMFT was 13.33 ± 7.28, while in the higher HEI-2015 quartile, this score was significantly lower (P < 0.001) (Table 2).

Table 2
Baseline characteristics according to the healthy eating index- 2015 quartiles

Variables	Total (n = 7549)	HEI 2015 quartiles				P value
		Q1 (n = 2152)	Q2 (n = 1947)	Q3 (n = 1847)	Q4 (n = 1603)	
Age (year), mean ± SD	45.65 ± 7.70	46.65 ± 7.87	45.36 ± 7.53	45.29 ± 7.75	45.10 ± 7.46	< 0.001
Gender (%)						
Male	3808 (50.44)	1097 (28.81)	994 (26.10)	953 (25.03)	764 (20.06)	0.090
Female	3741 (49.56)	1055 (28.20)	953 (25.47)	894 (23.90)	839 (22.43)	
Marital status, n (%)						
Married	6851 (90.75)	1917 (27.98)	1771 (25.85)	1707 (24.92)	1456 (21.25)	< 0.001
Single	370 (4.90)	123 (33.24)	100 (27.03)	88 (23.78)	59 (15.95)	
Widowed/Divorced	328 (4.34)	112 (34.15)	76 (23.17)	52 (15.85)	88 (26.83)	
Socio-economic status, n (%)						
1(lowest)	2404 (31.86)	997 (41.47)	645 (26.83)	448 (18.64)	314 (13.06)	< 0.001
2	2573 (34.10)	697 (27.09)	670 (26.04)	657 (25.53)	549 (21.34)	
3(Highest)	2569 (34.04)	458 (17.83)	629 (24.48)	742 (28.88)	740 (28.80)	
Physical activity (Met-h/week), n (%)						
Light	2225 (29.47)	534 (24.00)	607 (27.28)	565 (25.39)	519 (23.33)	< 0.001
Moderate	3557 (47.12)	976 (27.44)	894 (25.13)	884 (24.85)	803 (22.58)	
High	1767 (23.41)	642 (36.33)	446 (25.24)	398 (22.52)	281 (15.90)	
Smoking, n (%)						

* P- value was obtained one-way ANOVA and Chi square tests.

Variables	Total (n = 7549)	HEI 2015 quartiles				P value
		Q1 (n = 2152)	Q2 (n = 1947)	Q3 (n = 1847)	Q4 (n = 1603)	
Current	858 (11.47)	347 (40.44)	206 (24.01)	207 (24.03)	98 (11.42)	< 0.001
Former	577 (7.71)	184 (31.89)	156 (27.04)	128 (22.18)	109 (18.89)	
Never	6048 (80.82)	1605 (26.54)	1569 (25.94)	1495 (24.72)	1379 (22.80)	
Decayed teeth, mean ± SD	3.60 ± 4.16	3.60 ± 3.91	3.57 ± 4.11	3.65 ± 4.35	3.60 ± 4.31	0.014
Missed teeth, mean ± SD	8.19 ± 6.40	9.76 ± 7.13	8.10 ± 6.00	7.56 ± 5.99	6.90 ± 5.87	< 0.001
Filled teeth, mean ± SD	1.54 ± 2.65	0.92 ± 2.10	1.46 ± 2.53	1.82 ± 2.90	2.14 ± 2.95	< 0.001
DMFT, mean ± SD	13.33 ± 7.28	14.29 ± 7.54	13.12 ± 7.10	13.03 ± 7.27	12.64 ± 7.04	< 0.001
Number of teeth, mean ± SD	23.19 ± 6.26	21.82 ± 7.01	23.31 ± 5.85	23.77 ± 5.88	24.23 ± 5.80	< 0.001

* P- value was obtained one-way ANOVA and Chi square tests.

Table 3 presents the status of decayed, missing, filled teeth based on the basic characteristics of the participants. The mean number of filled teeth was significantly higher in women (P = 0.015). The mean number of decayed and missing teeth, as well as DMFT was significantly lower in participants with higher SES than those with lower SES (P value for all < 0.001). The condition of the teeth (decayed, missing, filled and DMFT variables) was significantly better in participants who flossed than in participants who did not (P value for all < 0.001). The mean of DMFT was 11.33 ± 5.95 in participants who brushed once or twice daily, and 17.05 ± 8.17 in participants who never brushed (P < 0.001).

Table 3
Baseline characteristics according to the condition of teeth

Variables	Condition of the teeth, n (%)			
	Decayed	Missed	Filled	DMF
Age (year)				
35–50 years	3.46 ± 4.10	6.46 ± 5.03	1.86 ± 2.86	11.79 ± 6.50
51–65 years	3.99 ± 4.34	13.01 ± 7.32	0.63 ± 1.65	17.63 ± 7.64
P value	0.002	< 0.001	< 0.001	< 0.001
Gender				
Male	3.86 ± 4.50	8.43 ± 6.71	1.44 ± 2.56	13.73 ± 7.67
Female	3.34 ± 3.76	7.93 ± 6.10	1.64 ± 2.73	12.91 ± 6.84
P value	0.003	0.007	0.015	< 0.001
Marital status				
Married	2.51 ± 3.60	4.91 ± 4.17	2.16 ± 3.01	9.58 ± 5.83
Single	3.65 ± 4.19	8.27 ± 6.42	1.52 ± 2.63	13.46 ± 7.29
Widowed/Divorced	3.72 ± 3.93	10.04 ± 6.92	1.15 ± 2.35	14.91 ± 7.30
P value	0.001	< 0.001	< 0.001	< 0.001
Socio-economic status				
1(lowest)	4.283 ± 4.51	10.29 ± 7.11	0.62± 1.83	15.19 ± 7.81
2	3.85 ± 4.34	8.21 ± 6.10	1.18 ± 2.19	13.24 ± 7.18
3(Highest)	2.70 ± 3.35	6.20 ± 5.32	2.76 ± 3.21	11.66 ± 6.37
P value	< 0.001	< 0.001	< 0.001	< 0.001
Physical activity (Met-h/week)				
Light	3.14 ± 3.74	7.73 ± 6.38	1.90 ± 2.87	12.77 ± 7.18
Moderate	3.45 ± 3.93	8.02 ± 6.26	1.66 ± 2.73	13.13 ± 7.02
High	4.49 ± 4.90	9.10 ± 6.63	0.84 ± 1.97	14.42 ± 7.79
P value	< 0.001	< 0.001	< 0.001	< 0.001
Smoking				
Current	5.17 ± 5.28	11.01 ± 7.82	0.73 ± 1.69	16.91 ± 8.41

*P- value was obtained one-way ANOVA and Chi square tests

Variables	Condition of the teeth, n (%)			
	Decayed	**Missed**	**Filled**	**DMF**
Former	4.12 ± 4.38	10.43 ± 6.94	0.93 ± 1.95	15.49 ± 7.48
Never	3.32 ± 3.88	7.56 ± 5.95	1.71 ± 2.79	12.61 ± 6.88
P value	< 0.001	< 0.001	< 0.001	< 0.001
Flossing				
Yes	2.44 ± 3.37	4.95 ± 3.98	3.45 ± 3.40	10.84 ± 5.39
No	3.78 ± 4.24	8.69 ± 6.56	1.24 ± 2.38	13.71 ± 7.46
P value	< 0.001	< 0.001	< 0.001	< 0.001
Brushing				
Once or twice daily	2.86 ± 3.41	6.26 ± 4.85	2.19 ± 3.01	11.33 ± 5.95
Three times ≤ a day	2.43 ± 2.80	5.90 ± 4.81	2.38 ± 3.10	10.71 ± 5.30
Doesn't brush	4.42 ± 4.83	12.11 ± 7.64	0.51 ± 1.58	17.05 ± 8.17
P value	< 0.001	< 0.001	< 0.001	< 0.001
*P- value was obtained one-way ANOVA and Chi square tests				

A significant inverse correlation was found between HEI- 2015 and DMFT (r = -0.10, P < 0.001). In addition, a significant inverse correlation was found between HEI- 2015 and missed teeth (r = -0.172, P < 0.001) and filled teeth (r = -0.170, P < 0.001).

Association between the HEI- 2015 and condition of the teeth assessed by linear regression model is shown in Table 4. Compared to HEI-2015 first quartile, the risk of missing teeth in HEI-2015 third and fourth quartiles was significantly lower, -2.21 (95% CI: -2.06, -1.81) and – 2.86 (95% CI: -3.27, -2.45) time, respectively. This association remained significant after adjusting for confounding variables including sex, age, SES, smoking. After adjusting for confounding variables, the increasing DMFT in the first quartile of HEI-2015 was significantly 0.11 times lower than in the fourth quartile (β= -0.11; 95% CI: -0.54, -0.30).

Table 4
Association between the HEI- 2015 and condition of the teeth

Condition of the teeth	Quartiles of HEI 2015	Model I		Model II		Model III	
		β (95% CI)	**P value**	**β (95% CI)**	**P value**	**β (95% CI)**	**P value**
Decayed teeth	Quartile 1	Ref.	-	Ref.	-	Ref.	-
	Quartile 2	-0.03 (-0.28, 0.23)	0.826	0.02 (-0.23, 0.27)	0.896	0.32 (0.07, 0.57)	0.011
	Quartile 3	0.05 (-0.20, 0.31)	0.687	0.10 (-0.16, 0.35)	0.454	0.60 (0.34, 0.85)	< 0.001
	Quartile 4	0.01 (-0.27,0.27)	0.993	0.11 (-0.19, 0.34)	0.588	0.83 (0.56, 1.14)	< 0.001
Missed teeth	Quartile 1	Ref.	-	Ref.	-	Ref.	-
	Quartile 2	-1.67 (-2.06, -1.28)	< 0.001	-1.12 (-1.46,-0.79)	< 0.001	-0.63 (-0.95,-0.30)	< 0.001
	Quartile 3	-2.21 (-2.06, -1.81)	< 0.001	-1.64 (-1.97, -1.30)	< 0.001	-0.85 (-1.18,-0.51)	< 0.001
	Quartile 4	-2.86 (-3.27, -2.45)	< 0.001	-2.18 (-2.53, -1.83)	< 0.001	-1.10 (-1.42, -0.72)	< 0.001
Filled teeth	Quartile 1	Ref.	-	Ref.	-	Ref.	-
	Quartile 2	0.53 (0.37, 0.69)	< 0.001	0.43 (0.27, 0.59)	< 0.001	0.14 (-0.05, 0.29)	0.059
	Quartile 3	0.89 (0.73, 1.05)	< 0.001	0.79 (0.63, 0.95)	< 0.001	0.31 (0.16, 0.47)	< 0.001
	Quartile 4	1.21 (1.04, 1.38)	< 0.001	1.10 (0.92, 1.25)	< 0.001	0.39 (0.24, 0.53)	< 0.001
DMFT	Quartile 1	Ref.	-	Ref.	-	Ref.	-
	Quartile 2	-1.16 (-1.61, -0.72)	< 0.001	-0.68 (-1.10, -0.27)	0.001	0.05 (-0.34, 0.44)	0.405
	Quartile 3	-1.26 (-1.71, -0.81)	< 0.001	-0.74 (-1.16, -0.33)	< 0.001	0.08 (-0.03, 0.77)	0.749
	Quartile 4	-1.64 (-2.11, -1.17)	< 0.001	-1.01 (-1.44, -0.58)	< 0.001	-0.11 (-0.54, -0.30)	0.047

Model I: Unadjusted; Model II: Adjusted for sex and age; Model III: Adjusted for sex, age, SES and smoking

Association between the HEI-2015 components and DMFT by linear regression model is presented in Table 5. After adjusting for confounding variables, increasing dairy intake was significantly associated

with decreasing DMFT score. In addition, increasing refined grains and sodium intake was significantly associated with increasing DMFT score.

Table 5
Association between the HEI- 2015 components and DMFT

Components of HEI	Crude model		Adjusted model	
	β (CI 95%)*	P value	β (CI 95%)*	P value
Total Fruits	-0.06 (0.18, 0.06)	0.352	0.33 (0.22, 0.45)	< 0.001
Whole Fruits	-0.21 (-0.35, 0.08)	0.002	0.25 (0.13, 0.37)	< 0.001
Total Vegetables	-0.12 (-0.26, 0.03)	0.117	0.01 (-0.12, 0.18)	0.889
Greens and Beans	0.16 (0.04, 0.29)	0.010	0.19 (0.08, 0.31)	0.001
Whole Grains	0.001 (-0.10, 0.10)	0.980	0.02 (-0.11, 0.15)	0.789
Dairy	-0.12 (-0.18, -0.06)	< 0.001	-0.08 (-0.13, -0.03)	0.002
Total Protein Foods	0.06 (-0.08, 0.20)	0.401	0.23 (0.10, 0.36)	0.001
Seafood and Plant Proteins	-0.18 (-0.42, 0.06)	0.142	-0.09 (-0.30, 0.12)	0.385
Fatty Acids	-0.11 (-0.16, -0.05)	< 0.001	-0.01 (-0.06, 0.03)	0.621
Refined Grains	0.29 (0.10, 0.47)	0.002	0.20 (0.02, 0.35)	0.016
Sodium	-0.11 (-0.17,00.05)	< 0.001	0.06 (0.01, 0.11)	0.036
Added Sugars	-0.14 (-0.20, -0.10)	< 0.001	-0.34 (-0.43, -0.26)	< 0.001
Saturated Fats	0.01 (-0.05, 0.07)	0.753	-0.01 (-0.06, 0.04)	0.775
*Adjusted for sex, age, SES and smoking				

Discussion

The major finding of the present study was that a healthy eating was significantly associated with a decrease in DMFT score. According to the findings of this study, the increase in DMFT score in the HEI-2015 fourth quartile was significantly 0.11 times lower than in the first quartile. In addition, after adjusting for confounding variables, increasing dairy intake was significantly associated with decreasing DMFT score and increasing refined grains and sodium intake was significantly associated with increasing DMFT score.

A study in American adults has shown, greater compliance with the DGA is associated with lower odds of untreated caries. The average coronal DMFT decreased as HEI-2015 scores increased, but trends were not consistent in different ethnic or racial groups. American adults who followed the HEI-2015 component

recommendations were less odds to have untreated coronal caries than those who did not follow the recommendations [17].

Bawadi et al. have reported that poor diet was significantly associated with an increased risk of periodontal disease in Jordanian adults [10]. A cross-sectional study conducted by Al-Zahrani et al. on 12,110 individuals showed that individuals who maintained a healthy diet had lower odds to have periodontitis compared with people who did not [18]. Despite being provided with information about healthy nutrition at area's health centers, most of the people do not follow the guidelines of a healthy diet. Thus, the consumption of fruits and vegetables is less than the recommended amount and the consumption of salt, sugar and fats is higher than the allowed limit. It is noteworthy that the increase in food prices in recent years in Iran, can be one of the reasons for the restriction of consumption of some nutritional groups such as fresh fruits and vegetables, nuts and proteins.

According to the findings of the present study, after adjusting for confounding variables, increasing refined grains and sodium intake was significantly associated with increasing DMFT score. Moreover, increasing dairy intake was significantly associated with decreasing DMFT score. Studies in Denmark and India have shown that dental plaque is lower in people who receive dairy products as recommended [19, 20]. A prospective study in American adults also investigated the effect of dietary pattern on dental caries and found that a diet based on consuming more sugar and less dairy increased the risk of dental caries [21].

In the present study, it was found that mean DMFT score was higher in people in the older age group, women, participants with lower SES, and current smokers. The study of Najafi et al. (2020) has shown the effect of socioeconomic inequality in dental caries in 17 provinces of Iran [22]. A systematic review and meta-analysis study (2019) reported an increased risk of dental caries with increased tobacco smoking [23]. In addition, SES and current smoking were also related to HEI-2015. In the upper SES, the percentage of people in the fourth quartile of HEI-2015 was significantly higher than in the first quartile. With weak SES, the percentage of people in the first quartile was higher than in the fourth quartile. However, the role of SES in people's food choices and purchasing power is undeniable, and other studies have proven this association [24, 25]. Therefore, these factors were adjusted as confounding variables in examining the association between HEI-2015 and DMFT.

Similar to previous studies, one of the findings of our study, was age-specificity the association between HEI-2015 and tooth decay. This difference in age groups may be due to mechanical changes in tooth decay due to aging, including changes in calcium absorption and cariogenic microbiota [21, 26].

The results of this study showed that there is a need for more training in the region to increase compliance to a healthy diet. Regular dental examinations and trainings related to oral health also need to be strengthened in the health centers of this region.

One of the limitations of this study was its cross-sectional nature and therefore, causal associations cannot be established based on these findings. We were not able to measure or modulate the effect of

genetic factors. A large sample size is one of the strengths of this study. We were able to control most potentially confounding variables.

Conclusion

The finding of the present study showed that a healthy diet was significantly associated with a decrease in DMFT score. According to the findings of this study, the risk of increasing DMFT in the HEI-2015 fourth quartile was significantly 0.11 times lower than in the first quartile. In addition, after adjusting for confounding variables, increasing dairy intake was significantly associated with decreasing DMFT score and increasing refined grains and sodium intake was significantly associated with increasing DMFT score.

Abbreviations

HEI
Healthy Eating Index
DMFT
decayed, missing, and filled teeth
RaNCD
Ravansar Non-Communicable Diseases
FFQ
Food Frequency Questionnaire
T2DM
type 2 diabetes mellitus
CVDs
cardiovascular diseases
DGA
Dietary Guidelines for Americans
PERSIAN
Prospective Epidemiological Research Studies in Iran
SES
socio-economic status

Declarations

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Authors’ contributions

AM and FN designed the study. MD and FN conducted data analyses. MD and YP interpreted the results. FN and NZ supervised the whole project. AM and MM drafted the manuscript, and all authors revised it critically for important intellectual content and have read and approved the final manuscript.

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Ethics approval and consent to participate

The Ethics Committee of Kermanshah University of Medical Sciences approved the design of this study (code: KUMS.REC.1399.067). All methods were carried out in accordance with relevant guidelines and regulations. All the participants provided oral and signed written informed consent.

Consent for publication

All participants provided consent to publish their data, and all authors approved the final manuscript for publication.

Competing interests

The authors declare they have no competing interests

Availability of data and materials

The data sets generated during this study are available from the correspondence author on reasonable request via email.

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