Dietary Vitamins and DMFT index in Rafsanjan adults, a Cross- sectional Study on Rafsanjan Adults Cohort Data

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Abstract

Introduction: Vitamins are generally known to be important in oral health. Some associations have been found between vitamins and dental caries, but these findings have been controversial so far. This study aimed to investigate the associations of dietary intakes of vitamins and DMFT index.

Methods and materials: In this cross-sectional study, the study population was 3028 subjects aged 35-70 years from Rafsanjan Cohort Study's Oral Health Branch (OHBRCS) which is a branch of Rafsanjan Cohort Study (RCS). RCS is a part of the prospective epidemiological research studies in IRAN (PERSIAN). Subjects' demographic information, variables related to oral health, history of underlying diseases, history of smoking, alcohol, and opium use based on questionnaires and checklists produced by the Persian cohort team was obtained and also dietary intakes of vitamin A, vitamin E and vitamin B family were collected by a validated food frequency questionnaire. Linier regression analysis was used to investigate the association between intake of dietary vitamins and DMFT (Decayed, Missing, and filled Teeth) using crude and adjusted models.

Results: The findings showed low levels of education and socio-economic status, older age, smoking and opium consumption, and decreasing the frequency of brushing are significantly associated with an increase in the DMFT index. DMFT index were more unfavorable in people with dietary intake ≤ median of all measured vitamins. In fully adjusted model, DMFT index showed a significant negative relationship with dietary intakes of Vitamin A, β_carotene, lutein_zea xanthin, Vitamin E, Vitamin K, thiamin, Vitamin B6, and folate (Unstd.B =-0.54, 0.63,0.86,0.49,0.88,0.63,0.66,0.54,respectively).

Conclusion: Increasing the intake of Vitamin A, β_carotene, lutein_zea xanthin, Vitamin E, Vitamin K, thiamin, Vitamin B6, and folate may be associated with the low DMFT index, so it is recommended to use more this category of vitamins.

Introduction

Nutrition is related to the absorption of food and its effect on the body's metabolic processes. According to the World Health Organization, "Nutrition is the science of food and its relationship with health" (1, 2). The rapid turnover of cells and the dense microbial biofilm of the oral cavity cause the first signs of micronutrient deficiencies to be seen in the oral tissues. A healthy oral epithelium is an effective barrier against toxins that needs to undergo a 3-to-7-day cell turnover to function properly. Insufficient intake of nutrients can cause tissue breakdown, leading to oral lesions and infection (3).Vitamins as micronutrients are essential organic compounds that act as catalysts for metabolic reactions in the body. Their other functions can be mentioned as electron donors, antioxidants, and transcription factors (4). A minimum intake of all thirteen vitamins discovered so far is required to prevent nutritional deficiencies (5).Various studies have suggested that vitamins are important in the treatment and prevention of oral diseases such as dental caries(6). However, the evidence supporting this association has been weak (6).

Tooth decay is one of the most common chronic diseases worldwide. Humans are susceptible to this disease throughout their lives. The disease is fermented through the complex over time between acid-producing bacteria and carbohydrates, and many factors are formed, including saliva. The disease can occur in both parts of the teeth (crown and roots). It can also be invasive in childhood, which also affects deciduous teeth. Risk factors for caries include physical, biological, environmental, behavioral, and lifestyle-related factors such as high bacteria count, insufficient saliva flow, insufficient fluoride, poor oral hygiene, and poor nutrition of infants and poverty. The primary prevention approach should be based on common risk factors. Secondary prevention and treatment should focus on managing the caries process for specific patients with an approach that minimizes tissue invasion and preservation (7, 8).

Vitamins do not play a role in energy production, but they are so important in carrying out vital phenomena that the absence or deficiency of any of them causes severe disorders in one organ or the whole body (9).

Numerous studies have evaluated the relationship between tooth decay and serum levels of vitamins (10–12). Hedge et al. assessed the relationship between serum vitamin C levels and the DMFT index. They found that serum vitamin C levels in people with high dental caries are significantly lower than in the control group (10). Hugar et al. in 2017 also investigated relationship between vitamin B12 and tooth decay and gum disease in 10–14 year old children. There is a significant relationship between systemic vitamin B12 deficiency and tooth decay and gum problem (13). Also, contradictory results were obtained from other studies that examined the effect of vitamins on caries (14, 15).

The role and effect of vitamins on the general health of the body have been discussed previously, but few studies have been performed on the effect of these vitamins on the teeth. The aim of this study was to investigate the relationship between dietary intakes of vitamins and DMFT among adult population of the Rafsanjan Cohort Center.

Materials And Methods

This cross-sectional study was conducted using data from the Rafsanjan Cohort Study's Oral Health Branch. OHBRCS is a branch of the Rafsanjan Cohort Study (RCS) aimed to explore the most significant aspects of the participants' dental and oral health. RCS is a part of the Prospective Epidemiological Research Studies in IRAN (PERSIAN) (16) was initiated in Rafsanjan, an area in southeast Iran, in 2015. 10,000 people between the ages of 35 and 70 of both genders enrolled RCS. Each participant signed the letter of informed written consent (17). Individuals were interviewed using a standardized and comprehensive questionnaire validated in the PERSIAN database (16). The surveys include demographic information, socioeconomic standing, medication and medical history, lifestyle, anthropometric measures, and the Food Frequency Questionnaire. Self-reported alcohol consumption, smoking, and opium use were collected. Lifetime smoking was defined as more than 100 cigarettes smoked. Alcohol usage comprises all persons who have drunk 200 ml of beer or 45 ml of liquor at least once each week for a minimum of six months. A participant was defined as an opium user if,, he or she reported using opium at least once per week for six months(18). Individuals' Socioeconomic Status (SES) was calculated using the Wealth Score Index (WSI). According to WSI, the investigated population was classified into four groups based on the 25, 50, and 75 percentiles: low class, low-middle class, middle-high class, and high class.

About 8682 participants from the RCS took part in the OHBRCS. Among them people with a history of taking food supplements and those with removable full dentures were excluded from the research. In the end, 3028 individuals were entered in present study. The questionnaire contained oral health-related parameters, and oral health practitioners conducted a full-mouth examination. Tooth brushing was divided into two categories (no, yes). Based on the findings of a clinical examination and computation of the number of decayed (D), filled (F), and lost (M) teeth owing to caries, the participants' DMFT score was computed.

This study was authorized by the Ethics Committee of Rafsanjan University of Medical Sciences (Ethical codes: ID: IR.RUMS.REC.1400.035) and conducted according to the rules for reporting observational studies in epidemiology (STROBE).

Food Frequency Questionnaire

Trained nutritionists interviewed research participants and had them fill out a 118-item semi-quantitative food frequency questionnaire (FFQ) regarding their diets during the previous year. Each participant was given two questions for each food item: (1) how often they ate that food in the preceding year (how many times per month, week, or day), and (2) how much of that food they typically ate at each sitting (portion size based on the standard serving sizes commonly consumed by Iranians). All reported intakes were converted to g/day by using household portion sizes of consumed foods Food intakes were analyzed using data from the USDA's food database.

Statistical analyses

The frequency (%) for categorical variables and mean (SD: standard deviation) for quantitative variables were employed, and baseline characteristics were compared among our research groups using t-test for continuous data.

Furthermore, we utilized a Linier regression analysis to assess the linear relationship between DMFT and vitamin dietary consumption in the research individuals. First, to investigate the associations using linear regression, the assumption of normality of the distribution of DMFT was tested using normal probability plots (skewness and kurtosis index). In the regression analysis, we employed two models. Confounder factors were discovered through the use of relevant epidemiological publications and subject domain knowledge.

Potential confounding factors were incorporated into models in the order of their predicted degree of correlation with DMFT and vitamins dietary consumption. Then, factors with p-values less than 0.25 were chosen as confounders. Furthermore, the adjusted model controlled for confounding factors such as age (continuous variable), gender (male/ female), education years (continuous variable), wealth status index (continuous variable), cigarette smoking (yes, no), opium use (yes, no), alcohol consumption (yes, no)., and dental brushing (yes, no). All analyses were carried out using State V.14, and all p-values are two-sided.

Results

Table 1 shows demographic chrematistics and personal habits of the study population between D, M, F and DMFT indexes. Of 3028 participants involved in this study, 1910 people (62.85%) were male, 1129 people (37.15%) were female. In addition, 2225 (73.19%) of the respondents use tooth brushing. The frequency of alcohol, cigarette and opium consumption were 12.1%, 27.78% and 24.36% respectively. The results showed that the mean (SD) value of D index was associated with gender, education, WSI, cigarette, alcohol drinking, opium consumption and tooth brushing ($p < 0.001$). The mean (SD) values of M, F and DMFT indexes were associated with age group, education, WSI, cigarette and opium consumption and tooth brushing ($p < 0.001$). The DMFT index was more unfavorable in people aged ≥ 56 year old, people with lower education and income, people smoked cigarette, people used opium ($p < 0.001$). Also, DMFT index was more favorable in people who brush their teeth ($p < 0.001$).

Table 1
Mean number of decayed, missing, and filled (D, M, and F) teeth and DMFT index of study participants by the demographic variables (n = 3028).

Characteristics	Overall N (%)	D Mean ± SD	P-Value	M Mean ± SD	P-Value	F Mean ± SD	P-Value	DMFT Mean ± SD	P-Value
Age- yr.			0.06		**< 0.001**		**< 0.001**		**< 0.001**
35–45	1237(40.72)	4.32 ± 4.03		7.45 ± 5.7		3.20 ± 3.78		14.97 ± 6.74	
46–55	1024(33.71)	4.48 ± 4.01		10.98 ± 7.21		2.44 ± 3.22		17.90 ± 7.16	
> 55	777(25.58)	4.02 ± 3.78		14.63 ± 7.94		1.84 ± 2.91		20.49 ± 7.21	
Gender			**< 0.001**		0.07		0.63		0.802
Female	1129(37.15)	3.87 ± 3.33		10.79 ± 6.91		2.74 ± 3.47		17.41 ± 6.61	
Male	1910(62.85)	4.55 ± 4.27		10.29 ± 7.7		2.51 ± 3.4		17.34 ± 7.75	
Education			**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
< 5	928(30.58)	4.53 ± 3.88		13.92 ± 7.79		1.26 ± 2.27		19.71 ± 7.34	
6–12	1574(51.86)	4.54 ± 4.20		9.68 ± 6.91		2.73 ± 3.44		16.95 ± 7.23	
> 13	533(17.56)	3.17 ± 3.09		6.82 ± 5.6		4.52 ± 4.04		14.50 ± 6.43	
Wealth score index			**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
Low	669(22.05)	5.04 ± 4.41		13.00 ± 8.06		1.11 ± 2.15		19.16 ± 7.75	
Low-middle	828(27.29)	4.65 ± 4.1		11.38 ± 7.5		1.89 ± 2.83		17.92 ± 7.65	
Middle-high	886(29.20)	4.2 ± 3.68		10.2 ± 7.08		2.83 ± 3.39		17.22 ± 6.98	
High	651(21.46)	3.2 ± 3.37		7.09 ± 5.59		4.71 ± 4.11		14.99 ± 6.32	

Characteristics	Overall N (%)	D Mean ± SD	P-Value	M Mean ± SD	P-Value	F Mean ± SD	P-Value	DMFT Mean ± SD	P-Value
Alcohol consumption			**0.003**		0.325		0.085		0.825
Yes	365(12.1)	4.85 ± 4.4		10.11 ± 7.81		2.30 ± 3.25		17.27 ± 7.87	
No	2652(87.9)	4.21 ± 3.87		10.52 ± 7.35		2.63 ± 3.45		17.36 ± 7.26	
Cigarette smoking			**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
Yes	838(27.78)	5.34 ± 4.64		**12.73 ± 8.32**		**1.82 ± 3.06**		**19.89 ± 7.75**	
No	2179(72.22	3.88 ± 3.56		**9.6 ± 6.83**		**2.89 ± 3.52**		**16.37 ± 6.93**	
Opium consumption			**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
Yes	735(24.36)	5.41 ± 4.68		13.25 ± 8.61		1.52 ± 2.76		20.19 ± 8.1	
No	2282(75.64)	3.92 ± 3.6		9.57 ± 6.73		2.94 ± 3.55		16.43 ± 6.83	
Tooth brushing			**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
Yes	2225(73.19)	3.81 ± 3.4		8.74 ± 6.08		3.17 ± 3.57		15.72 ± 6.43	
No	815(26.81)	5.62 ± 4.95		15.21 ± 8.58		1.02 ± 2.37		21.85 ± 7.81	

The mean number of D, M, F and DMFT indexes of study participants by dietary intake of vitamins has shown in Table 2. The results showed that the mean (SD) value of D index was associated with dietary intake of Vitamin A, α_carotene, β_carotene, β – cryptoxanthin, lutein_zea xanthin, Vitamin C, Vitamin E and Vitamin K ($p < 0.001$). D index was more unfavorable in people with dietary intake ≤ median of mentioned vitamins ($p < 0.001$). The mean (SD) values of M, F and DMFT indexes were associated with Vitamin A, Retinol, α_carotene, β_carotene, β – cryptoxanthin, lycopene, lutein_zea xanthin, Vitamin C, Vitamin D, Vitamin E, Vitamin K, thiamin, riboflavin, niacin, pantothenic_acid, Vitamin B12, folate and choline ($p < 0.001$). M and DMFT indexes were more unfavorable in people with dietary intake ≤ median of mentioned vitamins ($p < 0.001$).

Table 2
Mean number of decayed, missing, and filled (D, M, and F) teeth and DMFT index of study participants by dietary intake of vitamins (n = 3028).

Characteristics	**D Mean ± SD**	**P-Value**	**M Mean ± SD**	**P-Value**	**F Mean ± SD**	**P-Value**	**DMFT Mean ± SD**	**P-Value**
Vitamin A.(iu)		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.62 ± 4.11		11.4 ± 7.54		2.09 ± 3.13		18.11 ± 7.41	
>Median	4.02 ± 3.81		9.65 ± 7.2		3.03 ± 3.6		16.70 ± 7.22	
Retinol		0.75		**< 0.001**		**< 0.001**		**0.004**
≤ Median	4.32 ± 3.97		11.1 ± 7.3		2.36 ± 3.17		17.78 ± 7.19	
>Median	4.28 ± 3.96		9.23 ± 7.47		2.79 ± 3.62		17.00 ± 7.46	
α_carot ene -no (%)		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.61 ± 4.12		11.03 ± 7.54		2.20 ± 3.26		17.84 ± 7.45	
>Median	4.01 ± 3.79		9.95 ± 7.25		2.96 ± 3.53		16.92 ± 7.21	
β_carotene		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.67 ± 4.10		11.33 ± 7.61		2.10 ± 3.19		18.11 ± 7.44	
>Median	3.97 ± 3.82		9.71 ± 7.14		3.02 ± 3.56		16.71 ± 7.19	
β – cryptoxanthin		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.67 ± 4.13		11.78 ± 7.73		1.81 ± 2.82		18.26 ± 7.54	
>Median	3.96 ± 3.77		9.28 ± 6.89		3.31 ± 3.75		16.55 ± 7.06	
Lycopene		0.036		**< 0.001**		**< 0.001**		**< 0.001**

Characteristics								
	D **Mean ± SD**	**P-Value**	**M** **Mean ± SD**	**P-Value**	**F** **Mean ± SD**	**P-Value**	**DMFT** **Mean ± SD**	**P-Value**
≤ Median	4.46 ± 4.08		11.03 ± 7.64		2.35 ± 3.33		17.84 ± 7.46	
>Median	4.15 ± 3.85		9.95 ± 7.15		2.82 ± 3.49		16.92 ± 7.21	
Lutein_zeaxanthin		**0.002**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.54 ± 4.13		11.52 ± 7.69		2.29 ± 3.31		18.35 ± 7.43	
>Median	4.09 ± 3.81		9.58 ± 7.04		2.85 ± 3.49		16.52 ± 7.16	
Vitamin C		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.66 ± 4.09		11.53 ± 7.74		1.95 ± 2.9		18.14 ± 7.53	
>Median	3.97 ± 3.82		9.52 ± 6.97		3.17 ± 3.74		16.67 ± 7.10	
Vitamin D. (iu)		0.81		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.32 ± 3.88		11.43 ± 7.44		2.26 ± 3.18		18.01 ± 7.29	
>Median	4.29 ± 4.04		9.64 ± 7.28		2.88 ± 3.59		16.80 ± 7.36	
Vitamin E		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.58 ± 4.11		11.81 ± 7.62		2.03 ± 3.07		18.41 ± 7.46	
>Median	4.07 ± 3.83		9.37 ± 7.04		3.06 ± 3.63		16.49 ± 7.12	
Vitamin K		**< 0.001**		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.56 ± 4.13		11.44 ± 7.7		2.27 ± 3.32		18.27 ± 7.47	
>Median	4.08 ± 3.8		9.64 ± 7.04		2.86 ± 3.48		16.58 ± 7.14	

Characteristics								
	D Mean ± SD	P-Value	M Mean ± SD	P-Value	F Mean ± SD	P-Value	DMFT Mean ± SD	P-Value
Thiamin		0.385		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.37 ± 4.04		11.38 ± 7.58		2.32 ± 3.3		18.07 ± 7.37	
>Median	4.24 ± 3.9		9.67 ± 7.17		2.83 ± 3.51		16.74 ± 7.27	
Riboflavin		0.24		**< 0.001**		**< 0.001**		**0.003**
≤ Median	4.39 ± 3.96		11.19 ± 7.41		2.21 ± 3.18		17.79 ± 7.27	
>Median	4.22 ± 3.97		9.83 ± 7.36		2.93 ± 3.59		16.98 ± 7.39	
Niacin		0.099		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.42 ± 4.06		11.12 ± 7.53		2.33 ± 3.27		17.87 ± 7.40	
>Median	4.19 ± 3.88		9.89 ± 7.25		2.83 ± 3.53		16.91 ± 7.26	
Pantotheni c_acid		0.1		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.43 ± 4.02		11.41 ± 7.53		2.22 ± 3.23		18.06 ± 7.36	
>Median	4.19 ± 3.92		9.64 ± 7.2		2.92 ± 3.55		16.75 ± 7.27	
Vitamin B6		0.411		0.498		0.406		0.13
≤ Median	4.36 ± 3.93		10.57 ± 7.5		2.64 ± 3.48		17.56 ± 7.26	
>Median	4.24 ± 4.01		10.38 ± 7.31		2.54 ± 3.35		17.16 ± 7.42	
Vitamin B12		0.152		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.41 ± 3.97		11.12 ± 7.46		2.32 ± 3.27		17.85 ± 7.36	

Characteristics								
	D Mean ± SD	P-Value	M Mean ± SD	P-Value	F Mean ± SD	P-Value	DMFT Mean ± SD	P-Value
>Median	4.2 ± 3.96		9.87 ± 7.32		2.84 ± 3.54		16.91 ± 7.31	
Folate		0.157	< 0.001	**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.41 ± 3.98		11.14 ± 7.43		2.36 ± 3.34		17.91 ± 7.28	
>Median	4.2 ± 3.95		9.87 ± 7.34		2.80 ± 3.48		16.87 ± 7.37	
Choline		0.262		**< 0.001**		**< 0.001**		**< 0.001**
≤ Median	4.39 ± 3.98		11.32 ± 7.46		2.24 ± 3.22		17.95 ± 7.32	
>Median	4.23 ± 3.95		9.73 ± 7.29		2.90 ± 3.56		16.85 ± 7.33	

Table 3 shows the association between dietary intake of vitamins with the DMFT index by linear regression analysis. Results without the confounder effect showed that dietary intake > median of Vitamin A, Retinol, α_carotene, β_carotene, β – cryptoxanthin, lycopene, lutein_zea xanthin, Vitamin C, Vitamin D, Vitamin E, Vitamin K, thiamin, riboflavin, niacin, pantothenic_acid, Vitamin B6, Vitamin B12, folate and choline in compared to dietary intake ≤ median of these vitamins were negatively associated with DMFT index. After adjusting the model, Vitamin A, β_carotene, lutein_zea xanthin, Vitamin E, Vitamin K, thiamin, Vitamin B6, and folate were negatively associated with DMFT index ($p < 0.05$). After adjusting the model, among these vitamins, Vitamin K and lutein_zea xanthin (Unstd.B =-0.88, $p < 0.001$ and Unstd.B =-0.86, $p < 0.001$ respectively) had the highest levels of negative associations with the DMFT index.

Table 3
Linier regression analysis of the dependent variable DMFT against dietary intake of vitamins in the study participants.

Variables	Crude		Adjusted	
	Unstd.B	P –value	Unstd.B	P -value
VitaminA (iu)	-1.41	**> 0.001**	− .0.54	**0.024**
Retinol	-0.78	**0.004**	0.025	0.917
α_carot ene -no (%)	-0.93	**0.001**	-0.46	0.051
β_caro tene	-1.40	**> 0.001**	-0.63	**0.009**
β - cryptoxanthin	-1.71	**> 0.001**	-0.41	0.1
lycopene	-0.92	**0.001**	-0.21	0.383
lutein_zea xanthin	-1.83	**> 0.001**	-0.86	> 0.001
Vitamin C	-1.48	**> 0.001**	-0.42	0.085
Vitamin D (iu)	-1.21	**> 0.001**	-0.1	0.688
Vitamin E	-1.93	**> 0.001**	-0.49	**0.047**
Vitamin K	-1.69	**> 0.001**	-0.88	**> 0.001**
thiamin	-1.33	**> 0.001**	-0.63	**0.01**
Riboflavin	-0.81	**0.003**	-0.05	0.852
niacin	-0.96	**> 0.001**	-0.34	0.167
pantotheni c_acid	-1.3	**> 0.001**	-0.37	0.129
Vitamin B6	-0.41	0.130	-0.66	**0.005**
Vitamin B12	-0.94	**> 0.001**	-0.27	0.273
folate	-1.04	**> 0.001**	-0.54	**0.026**
choline	-1.10	**> 0.001**	0.014	0.956

Variables	Crude		Adjusted	
	Unstd.B	P –value	Unstd.B	P -value
Unstandardized regression coefficient (Unstd.B). Crude model has been stratified on dietary intake of vitamins. Adjusted model has been adjusted for confounding variables age (continuous variable), gender, education years (continuous variable), wealth status index, cigarette smoking, alcohol drinking and opium consumption and tooth brushing.				

Discussion

The major finding of the present study was that the DMFT index showed a significant relationship with dietary intakes of Vitamin A, β_carotene, lutein_zea xanthin, Vitamin E, Vitamin K, thiamin, Vitamin B6, and folate. The results revealed that a decrease in brushing frequency is substantially related to an increase in the DMFT index. Also, there was a significant relationship between increased DMFT and elder age, lower education, lower income, smoking, and opium use.

Our findings about education, income, gender, and age were consistent with the research performed by do Nascimento et.al in 2022 (19). The knowledge and the cost of dentistry can be the reason for this relationship.

Similarly, Moradi et al (20) study suggested that there was a significant association between the tooth brushing habit and DMFT index. Moreover, a significant relationship between DMFT and smoking was the same results of the Olczak-Kowalczyk and et.al study (21).

The findings of present study support the hypothesis that mentioned vitamins may be associated with improvements in DMFT index and act as suppressors against the decreased of DMFT. Mariele et.al evaluated the relationship between tooth loss, nutritional status and consumption of macro and micronutrients in elderly people from southern Brazil. It stated that vit B1 and B9 have the positive effect on the rate of DMFT which is similar to our study (19).

Cagetti et.al did a systematic review and Meta-Analysis on the role of Vitamins in oral health. It explained that vitamins in particular vit D (as a promising oral health-preventive agent) may reduce the incidence of caries (6) while in our study, there was not any significant relationship between vit D and DMFT.

Krall et.al showed a significant relationship between vit D and DMFT in the elderly while in current research we could not find any relationship(22). The age and the number of participations can lead to the differences of these studies.

There was not any considerable relationship between Vit C and DMFT in present study when compared to study conducted earlier in Hong Kong (23). The difference may be attributed to geographical, socioeconomic factors and age of participants.

Association between Vitamin B12 and caries in Hugar et.al research (13) was similar to the finding of our study and they showed a significant relationship between Vit B12 and DMFT index.

We found that there was a significant relationship between Vit A and Vit E but not between Vitamin c and DMFT. In study of **Sadatullah et.al** Salivary vitamin A level was not statistically significantly associated to caries risk, ,while, Vitamin C and Vitamin E displayed a statistically significant correlation (24). The difference of these research goes back to the methodology of studies. In this study we evaluated vitamins in dietary intake while **Sadatullah et.al measured these items in saliva.**

Contrary to the results of present study, in MacKeown study there was a significant relationship between intake of Vitamin B12 and riboflavin and lower caries rates in 5 years old children (15). Moreover, unlike present study in MacKeown research, (15) they did not find any significant correlation between Vitamin A and Vitamin E and caries .

The key advantages of our study were the size of the sample, the population-based research, and an abundance of data on possible confounders, particularly potential confounding variables. Additionally, strength of the current study is the use of face-to-face interviews for FFQ data collection, which results in more accurate FFQ data. There were a few restrictions on our research, however. Firstly, although our study was cross-sectional, no causal relationship could be deduced. It is advised that this relationship be taken into consideration in the prospective study's follow-up phase. Second, recollection bias can affect FFQ results. Participants may underestimate or overestimate their dietary intake during the previous year.

Conclusion

Increasing the intake of Vitamin A, Vitamin E and Vitamin B family (except choline, riboflavin,B12, niacin and crypthoxantin can be associated with the low DMFT index in the community and recommended to use more this category of vitamins.

The datasets used during the current study are available on the Persian Adult Cohort Study Center, Rafsanjan University of Medical Sciences, Iran. The data are not available publicly. However, upon a reasonable request, the data can be obtained from the authors.

Declarations

Ethical Approval and Consent to Participate

The ethics committee of Rafsanjan University of Medical Sciences approved this study (Ethical codes: ID: IR.RUMS.REC.1400.035). Written informed consent was obtained from the participants. The participants' data were kept confidential and were only accessible to the study investigators. All methods were performed in accordance with the relevant guidelines and regulations.

Data Availability

The datasets used during the current study are available on the Persian Adult Cohort Study Center, Rafsanjan University of Medical Sciences, Iran. The data are not available publicly. However, the datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Consent for Publication

Not applicable

Disclosure

The context of this article involves the authors' views, and the funder had no role in the design of the study, data collection, analysis, and interpretation, decision to publish, and writing the manuscript.

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Competing Interests

The authors declare that there are no conflicts of interest.

Authors' Contributions

Farimah Sardari designed the study and supervised the project. Amirhosein Eslami and Zahra Jamali collected the data and prepared Tables. Parvin Khalili performed the statistical analysis. .Raziyehsadat Rezvaninejad and Rayehehossadat Rezvaninejad wrote and revised the initial manuscript. All the authors read and approved the final manuscript.

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