Original article

Advances in Bioscience & Clinical Medicine
ISSN: 2203-1413 Vol.02 No.02

The Relationship between dental status, body mass index and nutrient intake

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Abstract

Introduction: Nutrition is one of the basic requirements for growth and development. In all the age groups, good oral health is necessary for masticatory efficacy, sense of taste, deglutition, articulation and aesthetics. The aim of this study was to assess the relationship between tooth loss and food intake in a group of middle aged population.
Materials and Methods: A total number of 200 participants with age range of 40-60 years were chosen and divided into four groups. The study population was classified into one of four groups by number of permanent teeth present. Required data for the study were gathered by interviews, oral and dental examinations, anthropometric measurements and 24-hour dietary recall. Data were analyzed statistically by descriptive methods, Variance test, Kruskal-Wallis test and Pearson's chi-square test.
Results: Statistical analysis proved that, by controlling important confounding factors, individuals with more teeth had higher mean body mass index, weight, height, energy and nutrient intake compared to those with fewer teeth.
Conclusion: Food intake and nutritional status are associated with oral health status and number of teeth.

Key words: Body mass index; Food intake; Tooth loss

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Receive date: 2014-05-05 | Accept date: 2014-05-20 | Publish date: 2014-06-05 DOI: 10.7575/aiac.abcmed.14.02.02.06

Introduction

Nutrition is one of the major prerequisites for maintaining health, growth and development. Proper nutrition has an important role in life quality of all age groups, especially the elderly (1-3). Several factors influence food intake, with the health of the masticatory system being one of the most important factors in this respect (4). Of all the factors involved, healthy dentition is very important as one of the prerequisites for mastication (5, 6); tooth loss results in a decrease in chewing ability, leading to abstinence from eating the materials that are difficult to chew (3, 7).

Since tooth loss due to carious lesions or periodontal diseases is prevalent all over the world (8), great attention has been focused on the effect of tooth loss on induction of nutritional deficiencies (9) Clinical and laboratory studies have shown a relationship between the status of dentition and food intake, bite force, BMI and even alcohol use (10-12). Available evidence shows that damaged teeth influence individuals through nutritional and masticatory problems and tooth loss results in changes in preference of food, resulting in nutritional deficiencies in the elderly (4). Therefore, a modified diet appears to be necessary in edentulous individuals, even in those who wear high-quality dentures (5). Such individuals prefer soft foods and receive low concentrations of vitamin C, proteins and calcium due to the inability to eat fruits, vegetables and meat (1).

Such significant alterations in food intake after tooth loss might increase the individual's susceptibility to systemic conditions (7). In this context, a diet rich in fat and cholesterol increases the risk of cardiovascular disease and a decrease in the intake of fibers, fruits and vegetables increases the risk of gastrointestinal tract cancers (13).

Although the increase in health risks due to tooth loss might be minimal, the problem becomes important when a large proportion of the population has such a problem (14, 15). Despite the potential risk of such a problem, there is little information in this regard from studies on large populations about the effect of tooth loss on diet (4). Considering the importance of diet and its effect on the body's general health, the aim of the present study was to further evaluate the relationship between tooth loss and food intake.

Materials and Methods

The subjects in the present study consisted of 40–60-year-old patients referring to Tabriz Faculty of Dentistry, Tabriz, Iran in 4 study groups. The subjects in groups 1–4 had 28 teeth or more, 21–27 teeth, 11–20 teeth and 1–10 teeth, respectively (11). In addition to the age range mentioned above, the subjects in the present study had the physical and mental capacities to register the required information (in special forms) and were able to feed themselves. They also were generally healthy. The subjects did not receive any dietary supplements and wore no prosthetic appliances. Subjects with physical deficiencies (such as organ defects etc.), in which anthropometric measurements were not possible, and patients with chronic systemic conditions such as diabetes, renal insufficiency, gastrointestinal disorders, obesity, malignancy etc. were excluded from this study. In addition, patients with any maxillofacial pathologic lesions, TMJ problems or any specific diets were excluded.

A total of 200 subjects, 50 in each study group, were included in the study. An attempt was made to match the subjects to some extent in the four study groups in relation to confounding factors by adjusting and tailoring inclusion and exclusion criteria.

Data included demographic, social and economic information and the general and oral health status, along with behaviors related to health, dental status and diet.

A special questionnaire was prepared which was filled out by a small number of subjects before the study, and the responses were evaluated. The reproducibility of the questionnaire was evaluated using validity testing of the questionnaire content and by revising the content by the professors of Faculty of Dentistry and Faculty of Nutrition. Cronbach's alpha was used to evaluate the reliability of the questionnaire.

The social-demographic and economic characteristics included age, gender, occupation, education, marital status, location of studying and family income.

Oral and dental examinations were carried out using a probe and a dental mirror under sufficient illumination by one examiner under supervision of a prosthodontic assistant professor. In order to evaluate the nutritional status of the samples, a questionnaire was used on the subjects' nutrition and their body mass index (BMI) and the 24-hour nutrition diary were evaluated. Data collected from this diary were evaluated by Nutrition 4 software program in order to calculate the amount of energy and the nutritive foods received.

To collect data, the subjects were interviewed after they themselves or their legal representatives signed an informed written consent form and the questionnaire and the dietary 24-hour diary were completed. Subsequently, oral examinations were carried out and the data collected were registered. Then based on #38 standard guidelines body indexes were evaluated as follows:

Weight: A digital weighing machine (Seca 707, Germany) was used to weigh the subjects after removing shoes and heavy clothes. The weighing machine was accurate to 50 g and was placed on a smooth surface.

Height: The subjects' height was measured using a conventional expansible measuring tape accurate to 0.5 cm, attached on a wall, and with the use of a horizontal head board.

BMI: After measuring height and weight, each subject's BMI was calculated using the fallowing formula:

$$\text{BMI (kg/m}^2\text{)} = \frac{\text{Body weight (kg)}}{\text{Height square (m}^2\text{)}}$$

All the measurements were made three times in order to eliminate individual and functional errors and their means were recorded as the final measurement by a trained examiner. Data were reported descriptively using frequencies for qualitative variables and means and standard deviations for quantitative variables.

Data were analyzed with SPSS 15 and N4 software programs. ANOVA was used for variables distributed normally, Pearson's chi-squared test was used for descriptive variables and Kruskal-Wallis test was used for variables not distributed normally.

Results

In the present study, 200 subjects were evaluated and statistically analyzed in 4 groups (n=50) based on the status of the dentition as follows:

Group A: The subjects had 28 teeth or more.

Group B: The subjects had 21–27 teeth.

Group C: The subjects had 11–20 teeth.

Group D: The subjects had 1–10 teeth.

From the demographic data viewpoint, the subjects in all four groups were matched in relation to gender, with 25 males and 25 females. The subjects were 40–60 years of age and there were no significant differences in age between the subjects in the 4 study groups. The monthly incomes and educational statuses were significantly different between the 4 study groups, with the maximum number of subjects having a balance between their income and expenditure in group A and with the minimum number of such subjects in group D. The educational status decreased from group A to group D. There were significant differences between the study groups in medical history, affliction with different diseases and the amount of physical activities and sports activities; in relation to individual subjects, group D had the greatest number of subjects with disease conditions, who were under the care of a physician, with the minimum number of subjects in group D reporting a history of sports or physical activities.

Based on the results of the questionnaire, the maximum number of subjects satisfied with their nutritional status were in group A, with the minimum number of such subjects in group D; the difference was statistically significant (P=0.000).

There were significant differences between the groups regarding the incidence of problems during eating and chewing foods and in the ability of subjects to eat all kinds of foods (P=0.000). In this context, monthly consumption of salads and carrots with meals is an indication of the masticatory efficacy of an individual, which was significantly higher in groups A and B. Tables 1-4 present the dental status, height, weight, BMI, calorie intake, protein, fat, carbohydrate, different kinds of fibers, foods eaten etc.

Table 1: BMI of the study groups

	BMI(kg/m^2)	*Number*	*Mean(± SD)*	*Minimum*	*Maximum*
A	Normal (18.5-24.99)	49	21.92(2.11)	18.70	24.60
	Over weight (25≤)	1	25.80(0.00)	25.80	25.80
B	Normal (18.5-24.99)	46	23.14(1.09)	19.80	24.90
	Over weight (25≤)	4	25.82(0.53)	25.20	26.40
C	Under weight (≤18.5)	8	17.70(0.40)	17.00	18.20
	Normal (18.5-24.99)	38	21.02(1.37)	18.60	23.50
	Over weight (25≤)	4	26.30(0.29)	26.00	26.70
D	Under weight (≤18.5)	15	17.90(0.45)	16.90	18.40
	Normal (18.5-24.99)	35	20.40(1.30)	18.50	23.00

Table 2: Number of teeth, height, and weight and energy intake of the study groups

	A *Mean(± SD)*	*B* *Mean(± SD)*	*C* *Mean(± SD)*	*D* *Mean(± SD)*
Number of teeth	28/54 (1/01)	24/48 (1/96)	15/72(3/02)	6/30(2/83)
Height(cm)	169/38(3/15)	167/92(3/76)	165/52(4/17)	167/00(3/09)
Weight(kg)	63/21(5/65)	66/08(4/91)	57/36(6/28)	54/28(4/96)
Energy(kcal)	2059/46 (1230/51)	1790/56 (851/44)	1502/10 (390/56)	1010/80 (286/55)

Based on data collated, there were significant differences between the study groups in height, weight and BMI (P<0.05). Comparison of the 4 study groups in relation to nutritional status and based on analysis of 24-hour diaries of the foods taken revealed that there were significant differences in calorie intake between the 4 study groups (P<0.05), with a decrease from group A to group D. In relation to the intake of nutritious foods, the mean intake of the majority of such foods was significantly different between the study groups, with the maximum in group A and the minimum in group D. These food materials consisted of proteins, carbohydrates, different lipids, cholesterol, omega-3, sodium, potassium, iron, calcium, magnesium, phosphorus, zinc, copper, manganese, selenium, chromium, beta-carotene, folate, different kinds of fibers, glucose, fructose, galactose, lactose, maltose, different amino acids (lysine, isoleucine, leucine, tryptophan, threonine, methionine, phenylalanine, valine, histidine, aspartic acid, glycine, serine, proline, cysteine, glutamic acid, alanine, arginine and tyrosine.

There were no significant differences between the study groups in the intake of fluoride, alcohol, molybdenum, vitamin D, sucrose and caffeine.

Table 4 presents the amount of vitamin intake separately in the 4 study groups, which was significantly different between the study groups except for vitamin D. In general, statistical analyses showed that subjects with more teeth (those in groups A and B) had higher means of BMI, height, calorie intake and nutritive foods, which gradually decreased in other groups, reaching a minimum in group D with the majority of variables.

Table 3: Vitamin intake of the study groups

	A *Mean(± SD)* *Standard error of the mean*	*B* *Mean(± SD)* *Standard error of the mean*	*C* *Mean(± SD)* *Standard error of the mean*	*D* *Mean(± SD)* *Standard error of the mean*
Vit E	4/79 (5/33)	2/43 (1/72)	3/46 (3/67)	1/06 (1/25)
(mg)	0/75	0/24	0/52	0/18
Vit B_1	1/72 (0/43)	1/60 (0/48)	1/44 (0/54)	0/93 (0/55)
(mg)	0/06	0/07	0/08	0/08
Vit B_2	1/29 (1/66)	1/07 (0/76)	0/99 (0/44)	0/56 (0/27)
(mg)	0/23	0/11	0/06	0/04
Vit B_3	18/80 (5/76)	22/33 (23/56)	16/65 (6/92)	9/71 (4/35)
(mg)	0/81	3/33	0/98	0/62
Vit B_6	1/13 (1/09)	0/95 (1/47)	0/79 (0/42)	0/32 (0/22)
(mg)	0/15	0/21	0/06	0/03
Vit B_{12}	3/09 (4/51)	2/96 (7/84)	1/86(1/18)	1/50 (1/72)
(mg)	0/06	1/11	0/17	0/24
Biotin	12/77 (7/05)	11/92 (4/96)	11/05 (4/81)	8/39 (5/28)
(µg)	1/00	0/71	0/65	0/78
Folate	209/26 (399/97)	145/05 (67/52)	139/51 (77/93)	63/76 (37/05)
(µg)	46/66	9/55	11/02	5/24
Vit C	50/72 (43/18)	57/62 (45/34)	49/78 (41/46)	16/59 (27/26)
(mg)	6/11	6/41	5/86	3/86
Vit k	111/20 (135/88)	84/90(74/85)	82/04(59/31)	48/92(70/09)
(mg)	19/23	10/59	8/39	9/91

Discussion

Nutrition is one of the basic requirements for growth and development (1). In all the age groups, good oral health is necessary for masticatory efficacy, sense of taste, deglutition, articulation and esthetics. Food intake and nutrition are significant factors that have a role in the quality of life in all the age groups, especially in the elderly (2). Dental health might have a significant effect on the quality of life, health status and life span (3) Oral health and dental status can affect diet and health by bringing about changes in the pattern of foods intake (16).

Table 4: Daily intake of nutrients of the study groups

	A *Mean(± SD)* *Standard error of the mean*	*B* *Mean(± SD)* *Standard error of the mean*	*C* *Mean(± SD)* *Standard error of the mean*	*D* *Mean(± SD)* *Standard error of the mean*
Protein (gr)	77/82(82/08) 11/61	68/53(80/49) 11/38	50/05(18/42) 2/60	28/04(10/18) 1/44
Fat (gr)	(88/29)2175/ 12/49	63/75(55/30) 7/83	48/87(16/90) 2/39	33/25(10/51) 1/49
Carbohydrate (gr)	276/64(86/69) 12/26	237/73(69/58) 9/84	217/71(58/13) 8/22	150/99(50/57) 7/15
Edible Fiber (gr)	9/82(3/23) 0/46	9/25(3/96) 0/49	7/83(3/39) 0/48	4/86(2/50) 0/35
Soluble Fiber (gr)	0/41(0/32) 0/05	0/30(0/24) 0/03	0/31(0/22) 0/03	0/18(0/21) 0/03
Unsoluble Fiber (gr)	2/10(1/33) 0/19	1/84(1/40) 0/20	1/62(1/30) 0/18	0/78(0/86) 0/12
Sodium (mg)	1424/3(4494/1) 635/57	712/74(647/78) 91/61	836/50(846/31) 69119/	303/25(188/37) 26/64
Potassium (mg)	1956/8 (1183/7) 167/41	/8)12911831/8 (182/69	1661/1 (627/55) 88/75	(322/49)82881/ 45/61
Calcium (mg)	789/47 (2198/0) 314/00	452/84 (152/21) 21/53	442/99 (199/49) 28/21	398/14 (173/66) 24/56
Beta carotene (mg)	291/87 (493/00) 69/72	331/95 (482/88) 68/29	/39 (285/81)200 40/42	194/60 (348/24) 49/25

Since one of the major functions of the teeth is mastication, loss of teeth can decrease masticatory efficacy and lead to refraining from foods that are difficult to chew (3, 7) Several research studies have shown that with the loss of natural teeth, the masticatory efficacy decreases (17) which affects selection of foods and the individual's nutrition (17, 18) Edentulous patients have difficulty chewing hard foods and prefer soft foods, resulting in a decrease in the intake of fruits, vegetables and meat in their diet. Therefore, they receive less vitamin C, proteins and calcium (1).

Diets with a low content of vegetables and fruits, and consequently with low carotene and fibers, are associated with an increased risk of cancers and cardiovascular diseases (19). Despite the importance and potential risks of such a situation, there is limited data from large

populations on the effect of dental status on diet (4). In the present study, the results showed that subjects who had more teeth, in general received higher amounts of energy and nutritive foods compared to other groups. Moreover, the presence of a relationship between the number of teeth and food intake in individuals aged 40–60 was detected. Sheiham et al. (16) evaluated the relationship between oral health and BMI in subjects over 50 years of age; 55% of the subjects were dentate and 45% were edentulous. The results showed that the odds of being underweight in edentulous subjects were significantly higher compared to subjects with 11 teeth or more. In general, based on the results, in individuals over 65 having a limited number of natural teeth or not having them increased the risk of low body weight and obesity. In fact, the relationship between the number of teeth and BMI was not linear, consistent with the results of the present study.

Rauen et al. (20) evaluated the relationship between oral status and dietary status in the elderly in Brazil. The results showed a significant relationship between these two factors, indicating that unfavorable dental status might have a role in tendency toward an improper dietary status. The results of the present study also showed that subjects with incomplete dentition had unfavorable BMI. In a cross-sectional study by Semon et al. (21), the relationship between functional dentition and inadequate calorie intake and low weight was evaluated in the elderly over 60 years of age. The results showed that the elderly with compromised dentition received insufficient calorie and were underweight, consistent with the results of the present study. In a study by Sahyoun et al. (3) in 2003, the relationship between the paired posterior occluding teeth and the dietary status was evaluated in the elderly participating in NHANES III. The results showed that subjects with defective dentition, who had 1-4 pairs of posterior occluding teeth had lower HEI scores, consumed less fruit and had lower serum levels of carotene, folic acid and ascorbic acid. They also had more unfavorable HEI scores in relation to dietary variations, cholesterol and sodium content, consistent with the results of the present study.

A cross-sectional study by Johnsson et al. (22) in 1994 showed that edentulous men, with or without prosthetic appliances, consumed less fruits and vegetables compared to their dentate counterparts. In addition, the results showed that edentulous subjects had higher BMI due to the use of more sweet snacks, which is in contrast to the results of the present study in relation to the subjects' BMI.

A study by De Andrade et al. (1) in 2008 showed a statistically significant relationship between the number of teeth and food intake; however, there was no significant relationship between the number of teeth and BMI. In contrast, there was a relationship between the number of teeth and BMI in the present study. The discrepancies in the relationship between BMI and the number of teeth and dental status reflect the relative complexity of the relationship between these two factors. In this context, the relationship between the low number of teeth and low BMI can be attributed to dental problems which prevent normal nutrition, resulting in inadequate intake of calorie and low body weight. On the other hand, high BMI in subjects with low number of teeth might be explained by the quality of nutrition: due to low masticatory efficacy in such individuals, use of high-calorie foods such as sweet snacks in common as they are easy to chew.

A study by Wakai et al. (7) showed a decreased consumption of carotene, vitamin A, vitamin C, milk, dairy products and green and yellow vegetables after an increase in the number of lost teeth, consistent with the results of the present study. Sheiham et al. (23)

showed that consumption of non-starch polysaccharides, proteins, calcium, niacin and vitamin C was significantly lower in edentulous patients, consistent with the results of the present study. Nowjack-Raymer et al. (11) reported that consumption of carrots, mixed salads and dietary fibers decreased in the American adult population with a decrease in the number of teeth to less than 28 teeth. In addition, the subjects of their study had lower serum levels of vitamin C and carotene. A study by Marcenes et al. (4) showed a low intake of non-starch polysaccharides, proteins, iron, calcium, niacin and vitamin C in subjects with fewer teeth. A study by Tanaka et al. (24) did not reveal any relationship between intake of vegetables, fruits, antioxidants, soluble fibers, vitamin C, vitamin B and beta-carotene on the one hand and the incidence of edentulism in Japanese women on the other hand, in contrast to the results of the present study.

Given the fact that healthy natural teeth have a better masticatory function, it seems logical that subjects with healthy teeth are able to eat more fruits, vegetables, fibers and proteins and subjects with fewer teeth can eat less fruits and vegetables.

Finally, this important fact should be kept in mind that the relationship between orodental health and nutrition and food intake is very complex. Since many factors can influence orodental health, intake of food and the nutritional status, it is difficult to say whether or not orodental health or these confounding factors are responsible for the relationship reported between oral health and nutrition. (25)

Conclusion

The dental status and the number of the teeth influence BMI and the amount of received energy and nutritive foods.

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