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ASSOCIATION OF DENTAL STATUS WITH VEGETABLE INTAKE IN AN ELDERLY POPULATION

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Abstract: *Objective:* To investigate the association of dental status with fruit and vegetable intake in a Japanese elderly population. *Design:* A cross-sectional survey on a household basis. *Setting:* A prefecture in Japan: Niigata. *Participants:* A total of 123 edentulous and 541 dentulous Japanese elderly people aged 65 years and older. *Measurements:* During a single day of the survey period, each individual household member recorded the type and amount of food eaten and each record was confirmed by dietitians. Data regarding the number of teeth present were collected by questionnaire. *Results:* The adjusted mean of vegetable intake was significantly lower in the edentulous (351.6 +/- 17.1 g, P = 0.042) and those with 1-9 teeth (344.6 +/- 16.3 g, P = 0.013) than in those with 20 teeth or more (394.9 +/- 11.3 g). A significantly higher adjusted level of consumption of sweets was found in the edentulous (32.6 +/- 3.7 g, P = 0.033) than in those with 20 teeth or more (22.8 +/- 2.4 g). While total fruit intake did not differ by dental status, edentulous elderly consumed significantly more oranges (33.1 +/- 4.9 g, P = 0.021), less cabbage (17.3 +/- 4.8 g, P = 0.001) and tended to eat fewer apples. *Conclusions:* Retention of even a few teeth could help in terms of the intake of some kinds of fruit for the elderly.

Key words: Vegetable, fruit, dental status, older people.

Introduction

Impaired oral health could affect overall quality of life, including enjoyment of food and overall nutrition (1). Evidence generally available for elderly populations suggests that the risk of compromised nutrition is greater in those without any of their own teeth (2-4), even when prosthetic replacement has been provided (2).

Alterations in dietary intake have been suspected to increase the risk of some systemic diseases. For example, some studies reported that the intake of some food that is protective against coronary heart disease (CHD), such as fruit and vegetables, was lower in edentulous patients; thus, it is possible that oral health indirectly affected the risk of CHD via nutrition intake (3, 5). Moreover, tooth loss was shown to be associated with a lower intake of nutritious hard-to-chew foods such as apples and carrots (5).

However, several previous studies categorized their samples just into the edentulous and dentate (3, 4), included only dentulous subjects (6) or just compared the edentulous to those with many teeth (2, 7). Thus, it is not fully understood how much fruit and vegetables elderly people with few remaining teeth consume and whether they are less likely to avoid hard-to-chew foods compared with the edentulous elderly. The purpose of this community-based study was to investigate the association of dental status with fruit and vegetable intake in a Japanese elderly population aged 65 years or older.

Methods

Study population

This study was performed by the administrative office of Niigata Prefecture from November 1st to 30th, 2008. Niigata Prefecture, located in the middle of the main island of Japan, on the Sea of Japan, has a population of 2.4 million in an area of approximately 1,200 square kilometers. The ethnicity of the people is almost exclusively Japanese. The subjects were selected from the residents of Niigata Prefecture according to the cluster sampling procedure. First, 25 areas were selected by the stratified random sampling method. Then, all people aged one year and older in 1,425 households were selected for this regional survey. A total of 2,222 subjects

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in 783 households (54.9%) participated in this survey. Among the 2,222 participants, this study focused on 677 subjects aged 65 years and over to investigate the association between dental status and food groups consumed in the elderly. Among them, 13 subjects were excluded because they did not have data on smoking status. As a result, 123 edentulous and 541 dentulous elderly people were included in this study.

Data collection

The nutrition survey was conducted on a household basis. Prefectural staff visited selected households to request participating in this survey and verbal consent for participation was obtained. During a single day in November, each individual household member recorded the type and amount of food eaten and each record was checked and confirmed by dietitians at the local public health centers covering the survey districts. The record included food commonly consumed in Japan, mainly from a food list used in the National Nutrition Survey in 2008.

Data regarding the number of teeth were collected by questionnaire and subjects were divided into 4 groups: those who had (1) no teeth (edentulous), (2) from 1 to 9 teeth, (3) from 10 to 19 teeth and (4) from 20 to 32 teeth. Information on current smoking status was also requested in the questionnaire.

Statistics

Multiple linear regression procedures were used to calculate adjusted means of energy and energy-adjusted intakes of fruit, vegetables and sweets with control for confounding variables including age, gender and smoking status. These were also used to compare adjusted means by the dental status with the tooth grouping of 20 teeth or more serving as a reference category. As the Japan Ministry of Health, Labour and Welfare recommends a daily vegetable intake of at least 350 g, a logistic regression procedure was used to assess whether edentulos elderly and those with few remaining teeth were less likely to meet the recommendation of vegetable intake than those with 20 teeth or more. Data analysis was performed using STATA software (Stata 10 for Windows, Stata Corporation). Statistical significance was set at $p < 0.05$.

Results

Of the 664 subjects, 18.5% were edentulous and 41.9% had 20 teeth or more (Table 1). The mean age of the subjects was highest in the edentulous (79.1 +/- 7.9 years) and lowest in those with 20 teeth or more (72.2 +/- 5.7 years). Around 60% of the population was male in all of the tooth groupings except for the ≥20 teeth category. While current smoking was most prevalent in the edentulous (16.3%), the percentage of those who had never smoked was also highest in the edentulous (69.9%).

Table 1
Characteristics of study population by number of teeth among elderly aged 65 years or older

Subject characteristics (%)	Number of teeth: Edentulous (n = 123)	1-9 (n = 125)	10-19 (n = 138)	≥20 (n = 278)
Age group, years (%)				
65-69	12,2	17,6	17,4	39,9
70-74	13,8	24,8	31,9	27,7
75-79	27,6	23,2	29,7	21,2
80+	46,3	34,4	21,0	11,2
Male (%)	58,5	60,0	60,1	51,8
Smoking history (%)				
Current	16,3	11,2	13,0	12,2
Former	13,8	22,4	19,6	22,7
Never	69,9	66,4	67,4	65,1

Table 2 shows unadjusted and adjusted means for daily intake of total energy, vegetables, fruit and sweets among the four tooth categories. Although adjusted energy intake was lowest in edentulous subjects (7310.5 +/- 186.5 kJ) and highest in the dentulous with 20 teeth or more (7708.6 +/- 123.5 kJ), there was no significant difference. An adjusted mean of vegetable intake was significantly lower in the edentulous (351.6 +/- 17.1 g, P = 0.042) and those with 1-9 teeth (344.6 +/- 16.3 g; P = 0.013) than in their counterparts with 20 teeth or more (394.9 +/- 11.3 g). Fruit intake did not differ among the groups. Although adjusted consumption of sweets slightly increased with the number of teeth among dentulous subjects, it was significantly higher in the edentulous (32.6 +/- 3.7 g, P = 0.033) than in those with 20 teeth or more (22.8 +/- 2.4 g).

Daily intakes of selected types of fruit and vegetables by number of teeth are shown in Table 3. In the univariate model, significantly lower consumption of apples was found in the edentulous and those with fewer teeth than in those with 20 teeth or more. However, when adjusted for other confounding factors, this association failed to reach statistical significance. Edentulous elderly consumed significantly more oranges (33.1 +/- 4.9 g, P = 0.021) and less cabbage (17.3 +/- 4.8 g, P = 0.001) than those with 20 teeth or more. There was also significantly less consumption of cabbage in those with 1-9 teeth.

The percentage of subjects who met the recommendation of vegetable intake of 350 g/day gradually increased with increasing number of teeth, with that in the edentulous being lowest (41.5%) and that in the dentulous with 20 teeth or more being highest (55.0%). Logistic regression analysis showed that the edentulous (odds ratio, 0.58; 95 percent confidence interval, 0.38 to 0.89; P = 0.013) and those with 1-9 teeth (odds ratio, 0.60; 95 percent confidence interval, 0.39 to 0.92; P = 0.019) were less likely to meet the recommendation for the amount of vegetable intake than those with 20 teeth or more.

Table 2

Associations between number of teeth present and daily intake of total energy, vegetables, fruit and sweets among elderly aged 65 years or older

Food groups by number of teeth	Unadjusted Mean	SE	P value‡	Adjusted† Mean	SE	P value‡
Total energy (kJ/day)						
Edentulous	7000,1	193,0	< 0.001	7310,5	186,5	0,086
1-9	7186,8	191,4	0,001	7326,4	178,1	0,082
10-19	7314,3	182,2	0,005	7390,3	168,8	0,130
≥20§	7946,5	128,4	-	7708,6	123,5	-
Vegetables (g/day)						
Edentulous	327,5	18,3	< 0.001	351,6	17,1	0,042
1-9	332,0	18,2	< 0.001	344,6	16,3	0,013
10-19	367,1	17,3	0,025	373,9	15,4	0,276
≥20§	414,6	12,2	-	394,9	11,3	-
Fruit (g/day)						
Edentulous	155,9	14,7	0,702	165,7	14,6	0,534
1-9	161,8	14,6	0,961	167,3	14,0	0,457
10-19	154,1	13,9	0,616	156,9	13,2	0,881
≥20§	162,7	9,8	-	154,4	9,7	-
Sweets (g/day)						
Edentulous	33,1	3,8	0,025	32,6	3,7	0,033
1-9	17,9	3,7	0,256	18,5	3,5	0,322
10-19	21,4	3,6	0,716	21,7	3,3	0,802
≥20§	23,0	2,5	-	22,8	2,4	-

† Adjusted mean energy intake was calculated from multiple linear regression analyses controlled for age, gender and smoking status. Other adjusted intakes were calculated similarly, including total energy intake as an additional confounder; ‡ Comparison to reference category; § Reference category

Table 3

Daily intakes of selected types of fruit and vegetables by number of teeth present among elderly aged 65 years or older

Fruit and vegetables by dental status (g/day)	Unadjusted Mean	SE	P value‡	Adjusted† Mean	SE	P value‡
Apples						
Edentulous	18,2	4,9	0,006	20,5	5,0	0,059
1-9	20,7	4,9	0,02	22,0	4,8	0,082
10-19	24,4	4,6	0,078	25,3	4,5	0,215
≥20§	34,4	3,3	-	32,3	3,3	-
Oranges						
Edentulous	33,0	4,8	0,018	33,1	4,9	0,021
1-9	21,8	4,7	0,678	22,4	4,7	0,556
10-19	28,3	4,5	0,108	28,4	4,5	0,089
≥20§	19,4	3,2	-	19,0	3,3	-
Bananas						
Edentulous	20,6	3,6	0,379	20,5	3,7	0,434
1-9	14,9	3,5	0,646	14,9	3,6	0,661
10-19	20,5	3,4	0,371	20,6	3,4	0,371
≥20§	16,8	2,4	-	16,8	2,5	-
Cabbage						
Edentulous	14,0	4,7	< 0.001	17,3	4,8	0,001
1-9	23,6	4,6	0,005	25,2	4,6	0,04
10-19	29,0	4,4	0,052	29,7	4,4	0,184
≥20§	39,5	3,1	-	36,9	3,2	-
Carrots						
Edentulous	25,6	2,8	0,481	27,7	3,0	0,749
1-9	23,9	2,8	0,227	24,7	2,8	0,596
10-19	26,5	2,7	0,637	26,9	2,7	0,918
≥20§	28,0	1,9	-	26,6	2,0	-
Tomatoes						
Edentulous	11,0	3,9	0,044	11,6	4,1	0,102
1-9	18,5	3,9	0,667	19,1	3,9	0,862
10-19	22,6	3,7	0,654	23,0	3,7	0,504
≥20§	20,6	2,6	-	19,9	2,7	-

† Adjusted means were calculated from multiple linear regression analyses controlled for age, gender, smoking status and total energy intake; ‡Comparison to reference category; §Reference category.

Discussion

This community-based study indicated that the edentulous and those with few remaining teeth showed significantly less consumption of vegetables and were less likely to meet the recommendation for the amount of vegetable intake than those with 20 teeth or more. In addition, although the edentulous consumed significantly more oranges, less cabbage and tended to eat fewer apples, subjects with few teeth only avoided cabbage. This finding suggests that retention of even a few teeth could be of some value for consuming some kinds of fruit.

While the amount of total fruit intake did not differ between the edentulous and those with 20 teeth or more, the edentulous consumed more oranges and tended to eat fewer apples. This finding indicates that the edentulous elderly in this study maintain total fruit intake by consuming some kinds of fruit. A epidemiological study focusing on male health professionals demonstrated that men who lost more teeth were more likely to stop eating hard-to-chew foods such as apples and raw carrots while they maintained similar or increased consumption of soft foods such as bananas and cooked carrots (8). Another survey on US women also showed that, while women who lost more teeth were more likely to reduce intake of fresh apples or pears and raw carrots, they were likely to maintain their consumption of cooked carrots (9). These findings may imply that people who have lost more teeth recognize the importance of fruit and vegetable intake and try to maintain this intake in some way. In addition, the lack of reduction of carrot consumption in the edentulous may be partly due to the Japanese dietary pattern. Most of the Japanese have much more opportunities to eat cooked carrots than raw carrots.

We did not have exact data on how many edentulous subjects wore dentures. However, further analysis of 264 subjects who had also undergone a dental examination showed that there was only one who did not wear dentures among 40 edentulous subjects. Thus, it seems that most of the edentulous subjects in this population wore dentures. The edentulous and those with few teeth showed significantly less consumption of vegetables than those with 20 teeth or more. Many other studies have repeatedly reported that chewing function was actually improved by various types of prostheses, but dietary intake was not (10, 11). However, when providing dietary counseling at the time of insertion of new full dentures, consumption of fruit and vegetables was shown to increase (12). These findings suggest that prosthetic treatment should be combined with dietary consulting, and it could contribute to increased fruit and vegetable intake in the edentulous elderly.

Although the edentulous ate markedly more sweets than those with 1-9 teeth, there did not seem to be a marked difference in relation to masticatory function

between the two groups. It must be remembered that oral health status is not the only factor affecting food choice and dietary habits. Taste and texture preferences could also be influential. It therefore seems likely that higher intake of sweets among edentulous elderly in this population might not be the consequence but rather the cause of their tooth loss (3, 13).

Findings from the National Diet and Nutrition Survey of older people in Great Britain showed that 20% of the edentulous subjects could not eat tomato easily or at all, while the corresponding value of the dentate subjects was only 3% (14). This finding could partly support our results that the lowest consumption of tomatoes was found in the edentulous subjects. Although tomatoes are not so hard to chew, seeds accumulating under the denture base could make the edentulous difficult to eat tomatoes.

To assess the validity of self-reported number of teeth, we carried out further analysis of a subgroup consisting of 264 subjects who had also undergone a dental examination. The results showed that 84.8% of subjects were correctly classified into the four tooth groupings according to the self-reported number of teeth. Specifically, self-reported edentulousness was highly reliable (95.0%). Thus, tooth groupings based on self-reports could be accurate enough to explore the relationship of dental status with fruit and vegetable intake. In fact, self-reported number of teeth has been found to be highly accurate in various populations (15, 16).

This study has some limitations. First, it could not determine whether any observed relationship between edentulism and nutritional status was causal or not, since this community-based survey was cross-sectional. Second, this study did not take socio-economic status (SES) and educational attainment into consideration. Since these factors have been shown to be associated with both diet (17) and oral health status (18), adjustments should be needed when exploring the relationship between diet and tooth loss. However, as the Japanese health insurance system covers most of the general treatment cost, SES would presumably have had a small effect on tooth loss in this elderly population. Contrarily, we cannot clarify how much degree SES would affect nutritional status in this elderly population. Third, we did not have exact data on how many edentulous/dentate subjects wore dentures or bridges to replace their missing teeth. Detailed prosthetic status is critical to the assessment of dental status and thus should be considered in future studies.

In conclusion, this community-based study indicated that edentulous elderly and those with few remaining teeth showed significantly less consumption of vegetables and that retention of even a few teeth could be of some value for consuming some kinds of fruit.

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