Relationship between Intake of Vegetables, Fruit, and Grains and the Prevalence of Tooth Loss in Japanese Women

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Summary Epidemiological evidence regarding dental status and its relationship to diet and nutritional status has been limited. The present cross-sectional study examined the relationship between intake of vegetables, fruit, grains, antioxidants, and fiber and the prevalence of tooth loss. Study subjects were 1,002 pregnant Japanese women. Tooth loss was defined as the previous extraction of 1 or more teeth. Adjustment was made for age, gestation, parity, cigarette smoking, passive smoking at home and at work, family income, education, changes in diet in the previous 1 mo, season when data were collected, and body mass index. Of the 1,002 subjects, 256 women had lost 1 or more teeth. Compared with intake of vegetables other than green and yellow vegetables in the lowest quartile, consumption of the other vegetables in the highest quartile was independently associated with a decreased prevalence of tooth loss, showing a clear inverse dose-response relationship. There was a marginally significant inverse dose-response relationship between the intake of insoluble fiber and tooth loss. No association was observed between intake of green and yellow vegetables, soluble fiber, or antioxidant nutrients and tooth loss. These findings suggested that consumption of vegetables other than green and yellow vegetables and insoluble fiber may be related to a decreased prevalence of tooth loss among young Japanese women.

Key Words cross-sectional studies, dietary fiber, pregnant women, tooth loss, vegetables

Epidemiological evidence regarding dental status and its relationship to diet and nutritional status has been limited. Previous studies evaluating diet and tooth loss have mainly focused on the middle-aged and the elderly (1–7). These studies generally suggested that tooth loss affected food preference and food consumption patterns because of reduced masticating efficiency, leading to nutritional deficiency among those who have fewer natural teeth or are edentulous. Several cross-sectional studies showed that the edentate elderly consumed fewer fruits and vegetables (1, 2), less fiber (1, 3–5), vitamin C (3, 4), carotene (1, 5), vitamin E (3, 5), calcium (3, 4), magnesium (4) and protein (3, 4) and more cholesterol and saturated fat (1) than the dentate. A cross-sectional survey among older Chinese vegetarians found that in the group with poor dental functional status due to tooth loss, intake of fiber was lower than in those with adequate dental functional status, although there was no difference between the 2 groups in consumption of total calories, carbohydrates, protein, fat, vitamin C, or calcium (6). The Health Professionals Follow-up Study demonstrated that subjects who had lost 5 or more teeth changed their dietary intake differently than did those who had no tooth loss during the 8-y period. The men who had lost 5 or more teeth had a significantly smaller reduction in consumption of dietary cholesterol and vitamin B12, a greater reduction in consumption of polyunsaturated fat and a smaller increase in consumption of dietary fiber and whole fruit than did those who did not lose any teeth (7).

On the other hand, it is considered that young adults have retained their natural teeth with sufficient adequate occlusive function for mastication, even if they have experienced tooth loss. Therefore, tooth loss is unlikely to affect selection of foods among young adults. The major cause of tooth loss is extraction due to caries or periodontitis, which is an infection-mediated destruction of tooth-supporting tissues. Both caries and periodontitis are preventable. In order to maintain natural dentition across the adult life span, expanding knowledge of the role of nutrition on oral health among young adults would provide insights into health prac-
tices that can be effective in preventing tooth loss. The purpose of the present study was to investigate the association of intake of vegetables, fruit, grains, fiber and antioxidants and the prevalence of tooth loss among pregnant Japanese women by using baseline data from the Osaka Maternal and Child Health Study (OMCHS).

MATERIALS AND METHODS

Study population. The OMCHS is an ongoing prospective cohort study of risk factors for maternal and child health such as allergic disorders and postpartum depression. The background and general procedure of the OMCHS have been described previously (8, 9). In brief, the OMCHS requested that pregnant women complete a baseline survey, which was followed by several post-natal surveys. Eligible women were those who became pregnant in Neyagawa City, which is one of 44 municipalities in Osaka Prefecture, a metropolis in Japan with a total population of approximately 8.8 million. Of 3,639 eligible subjects, 627 pregnant women (17.2%) in Neyagawa City took part in this study during the period from November 2001 to March 2003. From October 2002 to March 2003, 290 participants were recruited from a university hospital and 3 obstetric hospitals in 3 other municipalities; those women were recommended for participation in the OMCHS by an obstetrician. Finally, a total of 1,002 pregnant women gave their fully informed consent in writing and completed the baseline survey. The OMCHS was approved by the ethics committees of the Osaka City University School of Medicine and the Osaka Prefectural Institute of Public Health.

Questionnaire. In the baseline survey, the participants filled out a set of two self-administered questionnaires. The participants mailed the questionnaires to the data management center. The questionnaires were checked by research technicians, and missing or illogical answers were completed by telephone interview.

A validated self-administered diet history questionnaire (DHQ) was used to assess dietary habits over the previous 1 mo. The structure and validity of the questionnaire were described in detail elsewhere (10, 11). In this instrument, intake of 147 food items was calculated using an ad-hoc computer algorithm developed to analyze the questionnaire. We adjusted for energy intake by using the residual method (12). Our DHQ also included questions about height and weight. Body mass index was defined as the self-reported body weight in kg divided by the square of the self-reported height in m.

Another self-administered questionnaire elicited information on age, gestation, parity, smoking habits, passive smoking exposure at home and at work, family income, education, changes in diet in the previous 1 mo, experience of extraction of permanent teeth excluding third molars, and the number of remaining teeth. Tooth loss was defined as the extraction of 1 or more teeth.

Statistical analysis. Intake of selected foods and nutrients was categorized at quartile points on the basis of the distribution of all study subjects. Age was classified into 3 categories (<29, 29–31, and 32+y); gestation into 3 (<15, 15–20, and 21+wk); parity into 2 (0 and 1+); cigarette smoking into 3 (never, former, and current); passive smoking at home into 3 (never, former, and current); passive smoking at work into 3 (never, former, and current); family income into 3 (<4,000,000, 4,000,000–5,99,999, and 6,000,000+ JPY/yr); education into 3 (<13, 13–14, and 15+y); changes in diet in the previous 1 mo into 3 (none or seldom, slight, and substantial); and season when data were collected into 4 (spring, summer, fall, and winter). Body mass index was used as a continuous variable. The association between intake of selected foods and nutrients and the prevalence of tooth loss was analyzed by using a logistic regression model. Multiple logistic regression analysis was conducted to control for the potential confounding effects of the selected factors. The trend of association was assessed by assigning ordinal scores to the levels of the independent variable. Two-sided p values less than 0.05 were regarded as statistically significant. All analyses were done with SAS statistical software (SAS Institute, Inc., Cary, NC, version 8.2).

RESULTS

Of the 1,002 study subjects, 21.4% had lost 1 to 4 teeth and 4.2% had lost 5 or more teeth (Table 1). The mean age of the subjects was 29.8, with approximately 30% being between 29 and 31 y (Table 2). About 70% of the subjects participated in the study by the 20th week of gestation, and about half had a parity of one or more. Current active smoking was observed in 18% of pregnant women. The prevalence values for current passive smoking exposure at home and at work were 49% and 12%, respectively. Slight or substantial changes in diet in the previous 1 mo were experienced by 702 pregnant women because of nausea gravidarum (585 women), maternal and fetal health (107 women), and other reasons (10 women). Mean daily total energy and energy-adjusted intake of green and
Table 2. Distribution of selected characteristics in 1,002 pregnant women, OMCHS, Japan.

| Factor                          | Number (% or mean (SD)) |
|---------------------------------|-------------------------|
| Age (% y)                       |                         |
| <29                             | 380 (37.9)              |
| 29–31                           | 299 (29.8)              |
| 32+                             | 323 (32.4)              |
| Gestation (% wk)                |                         |
| <15                             | 357 (35.6)              |
| 15–20                           | 329 (32.8)              |
| 21+                             | 316 (31.5)              |
| Parity of one or more (%)       |                         |
| Never                           | 697 (69.6)              |
| Former                          | 121 (12.1)              |
| Current                         | 184 (18.4)              |
| Passive smoking at home         |                         |
| Never                           | 284 (28.3)              |
| Former                          | 224 (22.4)              |
| Current                         | 494 (49.3)              |
| Passive smoking at work         |                         |
| Never                           | 344 (34.3)              |
| Former                          | 538 (53.7)              |
| Current                         | 120 (12.0)              |
| Family income (% JPY/y)         |                         |
| <4,000,000                      | 301 (30.0)              |
| 4,000,000–5,999,999             | 403 (40.2)              |
| 6,000,000+                      | 298 (29.7)              |
| Education (% y)                 |                         |
| <13                             | 323 (32.2)              |
| 13–14                           | 413 (41.2)              |
| 15+                             | 266 (26.6)              |
| Change in diet in the previous 1 mo (%) |               |
| None or seldom                  | 300 (29.9)              |
| Slight                          | 435 (43.4)              |
| Substantial                     | 267 (26.7)              |
| Season when data were collected (%) |                    |
| Spring                          | 318 (31.7)              |
| Summer                          | 162 (16.2)              |
| Fall                            | 223 (22.3)              |
| Winter                          | 299 (29.8)              |
| Body mass index (kg/m²)         | 21.4 (2.8)              |
| Daily nutrient intake           |                         |
| Total energy (kJ)               | 6,815.3 (1,793.8)       |
| Green and yellow vegetables (g) | 69.5 (46.0)             |
| Other vegetables (g)            | 109.2 (68.9)            |
| Fruit (g)                       | 173.2 (182.4)           |
| Grains (g)                      | 340.5 (95.9)            |
| Soluble fiber (g)               | 2.0 (0.7)               |
| Insoluble fiber (g)             | 8.5 (2.3)               |
| Vitamin C (mg)                  | 120.7 (58.7)            |
| Vitamin E (mg)                  | 7.5 (1.8)               |
| β-Carotene (mg)                 | 1,840.4 (1,222.2)       |

OMCHS: Osaka Maternal and Child Health Study; SD: standard deviation; JPY: Japanese Yen.

a Nutrient and food intake were adjusted for total energy intake using the residual method.

yellow vegetables, other vegetables, fruit, and grains were 6,815 kJ, 69.5 g, 109.2 g, 173.2 g, and 340.5 g, respectively.

Odds ratios (ORs) and their 95% confidence intervals (CIs) for relationships between consumption of vegetables, fruit, and grains and the prevalence of tooth loss are presented in Table 3. Compared with intake of vegetables other than yellow and green vegetables such as cabbages, radishes, and onions in the first quartile, consumption of such other vegetables in the third and fourth quartiles, but not the second quartile, were statistically significantly associated with a decreased prevalence of tooth loss, showing a clear inverse dose-response relationship. Adjustment for age, gestation, parity, cigarette smoking, passive smoking at home and at work, family income, education, changes in diet in the previous 1 mo, season when data were collected, and body mass index did not materially change the results although the adjusted OR for the third quartile fell just short of the significance level. There was no measurable relationship between consumption of green and yellow vegetables, fruit, or grains and the prevalence of tooth loss.

There was a tendency for an inverse dose-response relationship of insoluble fiber consumption with the prevalence of tooth loss by the multivariate model although the adjusted OR for comparison of the highest with the lowest quartile was not statistically significant (p for trend=0.05) (Table 4). No evident association was observed between intake of soluble fiber, vitamins C and E, or β-carotene and the prevalence of tooth loss.

After further adjustment for insoluble fiber intake, a statistically significant inverse association between consumption of vegetables other than green and yellow vegetables and the prevalence of tooth loss had disappeared: the adjusted ORs for comparison of the second, third, and fourth quartiles with the lowest quartile were 0.69 (95% CI: 0.45–1.05), 0.68 (95% CI: 0.44–1.07), and 0.72 (95% CI: 0.44–1.17), respectively.

**DISCUSSION**

To our knowledge, no epidemiological information is available regarding the relationship between dietary intake and tooth loss among young adults. Our findings are partially consistent with several epidemiological studies among middle-aged or elderly people showing that the edentate consumed fewer fruits and vegetables, less fiber, carotene, and vitamin C than their dentate counterparts (1–7). These previously cited studies indicated that the edentate had compromised masticating ability and efficiency that led to dietary restrictions. Our study subjects were likely to retain their natural teeth so that they could sufficiently masticate, since only 4.2% had lost 5 or more teeth. We did not have information on the reasons for tooth extraction in our subjects. According to a report on reasons for extraction of teeth in Japanese aged 9–35 y (13), the proportions of extractions resulting from caries, periodontal disease, eruption problems, orthodontic indications, trauma, and other causes were 51.5, 6.2, 21.9, 5.1, 0.1, and 15.2%, respectively. More than 90% of extractions for eruption problems were third molars (13). In the current population, more than one half of tooth loss is likely to be ascribed to dental or oral pathology, such as caries and...
periodontal diseases, and the small number of orthodontic indications might be negligible. Both caries and periodontal diseases are plaque-mediated conditions. Nutrition may impact on the formation and maturation of dental plaque (14). However, it is unclear whether the contribution by nutrition to the development of caries is the same as that of periodontitis.

We have no immediate explanation as to underlying mechanisms for the observed inverse association between intake of vegetables other than green and yellow vegetables and the prevalence of tooth loss. Some of the beneficial effects of a high intake of these vegetables may be due to consumption of insoluble fiber or unrecognized agents in relation to insoluble fiber intake. Required vigorous chewing due to dietary fiber consumption may provide a mechanical stimulus to sialovary flow (15). Saliva acts as a protective agent against dental caries and periodontal diseases through several functions including antimicrobial effects, clearance, buffering power, and saturation with respect to tooth minerals (16, 17). Additionally, fiber itself may remove dental plaque from the tooth surfaces through the mechanical action of chewing. Alternatively, dietary fiber intake may serve as a mediator for the relationship between diet and inflammation. Increased fiber intake was associated with a significantly lower likelihood of elevated C-reactive protein (18). Saito et al. showed a positive relationship between alveolar bone loss, which leads to tooth loss, and C-reactive protein among Japanese men aged 50 to 54 y (19). Another possible explanation is that uncontrolled dietary or nondietary factors may produce a spurious inverse association between intake of vegetables other than green and yellow vegetables and the prevalence of tooth loss. Persons who have a high intake of vegetables other than green and yellow vegetables are likely to practice behaviours protective of oral health such as regular tooth brushing and dental visits.

In the present study, we used self-reported tooth loss as a proxy for dental diseases. We did not have information on the validity of self-reported tooth loss in our subjects. However, several validation studies of self-reported dental health showed that there was no significant difference between the self-reported residual number of teeth and the actual number of teeth determined by clinical examination in spite of age or sex (20, 21).

Table 3. Odds ratios and 95% CIs for tooth loss by quartiles of intake of vegetables, fruit, and grains, OMCHS, Japan.

| Variable | Prevalence | Crude odds ratio (95% CI) | Adjusted odds ratio (95% CI) |
|----------|------------|---------------------------|----------------------------|
| Green and yellow vegetables | 73/250 (29.2%) | 0.70 | 0.52–1.16 | 0.79 | 0.52–1.19 |
| Q2 (50.2) | 61/251 (24.3%) | 0.78 | 0.52–1.16 | 0.79 | 0.52–1.19 |
| Q3 (71.2) | 62/250 (24.8%) | 0.80 | 0.54–1.19 | 0.82 | 0.54–1.24 |
| Q4 (115.6) | 60/251 (23.9%) | 0.76 | 0.51–1.13 | 0.76 | 0.51–1.19 |
| p for linear trend | | 0.21 | 0.29 |
| Other vegetables | 78/250 (31.2%) | 0.72 | 0.49–1.07 | 0.71 | 0.47–1.07 |
| Q1 (51.7) | 58/250 (23.2%) | 0.67 | 0.45–0.99 | 0.67 | 0.44–1.01 |
| Q2 (171.6) | 58/250 (23.1%) | 0.66 | 0.44–0.98 | 0.64 | 0.42–0.98 |
| p for linear trend | | 0.04 | 0.04 |
| Fruit | 68/250 (27.2%) | 0.82 | 0.55–1.23 | 0.80 | 0.53–1.22 |
| Q1 (114.2) | 59/251 (23.5%) | 0.78 | 0.52–1.16 | 0.72 | 0.47–1.10 |
| Q2 (174.3) | 64/250 (25.6%) | 0.83 | 0.62–1.37 | 0.90 | 0.59–1.37 |
| Q4 (89.7) | 65/251 (25.9%) | 0.94 | 0.63–1.39 | 0.94 | 0.61–1.44 |
| p for linear trend | | 0.13 | 0.12 |
| Grains | 71/250 (28.4%) | 0.82 | 0.55–1.23 | 0.80 | 0.53–1.22 |
| Q1 (236.8) | 59/251 (23.5%) | 0.83 | 0.62–1.37 | 0.79 | 0.52–1.19 |
| Q2 (311.3) | 62/250 (24.8%) | 0.86 | 0.66–1.33 | 0.96 | 0.61–1.44 |
| Q4 (441.0) | 64/251 (25.5%) | 0.82 | 0.66–1.29 | 0.87 | 0.59–1.29 |
| p for linear trend | | 0.55 | 0.29 |

CI: confidence interval; OMCHS: Osaka Maternal and Child Health Study.

a Quartile medians in g/d adjusted for energy intake with the residual methods given in parentheses.

b Odds ratios were separately calculated for each dietary variable adjusted for age (<29, 29–31, and 32+), gestation (<15, 15–20, and 21+ wk), parity (0 and 1+), cigarette smoking (never, former, and current), passive smoking at home (never, former and current), passive smoking at work (never, former, and current), family income (<4,000,000, 4,000,000–5,999,999, and 6,000,000+ JPY/y), education (<13, 13–14, and 15+ y), changes in diet in the previous 1 mo (none or seldom, slight, and substantial), season when data were collected (spring, summer, fall, and winter), and a continuous variable for body mass index.
Axelsson and Helgadóttir reported that the kappa statistic for agreement between the self-reported number of remaining teeth and the number found at a clinical examination in the 18-y group, 35-to-44-y group, and the group aged 65 y or older were 0.56, 0.60, and 0.63, respectively (21). Persons are more knowledgeable about tooth loss than about signs and symptoms of disturbances of oral health, such as toothache, sore or swollen gums, and sensitivity of teeth to cold or heat (22). Pitiphat et al. showed that the self-reported number of remaining teeth, fillings, root canal therapies, and prostheses were strongly correlated with clinical records whereas self-reports appear to be less useful for the assessment of dental caries and periodontal disease (23). These data could support the use of self-reported tooth loss in epidemiological research as a key indicator of dental health status.

This present study had several methodological advantages: the homogeneity of study subjects with respect to all being young adults and adjustment for extensive information on potential confounding factors. The dietary information was derived from a DHQ. Since we did not actually observe the dietary habits of the subjects, the possibility of misclassification might be a concern. According to validation studies, the correlation coefficient between vitamin C estimated from the DHQ and that observed by a 3-d dietary record was 0.45 in women (10); the correlation coefficients between intake and the corresponding serum concentrations were 0.40 and 0.60 in men and women, respectively, for β-carotene and 0.23 and 0.22 in men and women, respectively, for vitamin E (11).

### Table 4. Odds ratios for tooth loss by quartiles of intake of fiber and antioxidants, OMCHS, Japan.

| Variablea | Prevalence | Crude odds ratio | Adjusted odds ratio |
|-----------|------------|------------------|--------------------|
|           |            | (95% CI)         | (95% CI)b          |
| Soluble fiber |           |                  |                    |
| Q1 (1.4) | 67/250 (26.8%) | 1.00             | 1.00               |
| Q2 (1.7) | 66/251 (26.3%) | 0.97             | 0.66–1.45          | 0.95 | 0.63–1.44 |
| Q3 (2.1) | 60/250 (24.0%) | 0.86             | 0.58–1.29          | 0.86 | 0.56–1.31 |
| Q4 (2.7) | 63/251 (25.1%) | 0.92             | 0.61–1.37          | 0.89 | 0.58–1.36 |
| p for linear trend | 0.55 | 0.50 |
| Insoluble fiber |           |                  |                    |
| Q1 (6.3) | 65/250 (26.0%) | 1.00             | 1.00               |
| Q2 (7.6) | 78/251 (31.1%) | 1.28             | 0.87–1.90          | 1.27 | 0.85–1.91 |
| Q3 (8.8) | 62/250 (24.8%) | 0.94             | 0.63–1.41          | 0.91 | 0.59–1.39 |
| Q4 (10.8) | 51/251 (20.3%) | 0.73             | 0.48–1.10          | 0.70 | 0.44–1.09 |
| p for linear trend | 0.06 | 0.05 |
| Vitamin C |           |                  |                    |
| Q1 (69.9) | 64/250 (25.6%) | 1.00             | 1.00               |
| Q2 (97.2) | 65/251 (25.9%) | 1.02             | 0.68–1.52          | 1.09 | 0.71–1.65 |
| Q3 (123.5) | 66/250 (26.4%) | 1.04             | 0.70–1.56          | 1.13 | 0.74–1.72 |
| Q4 (179.6) | 61/251 (24.3%) | 0.93             | 0.62–1.40          | 0.98 | 0.63–1.51 |
| p for linear trend | 0.78 | 0.96 |
| Vitamin E |           |                  |                    |
| Q1 (5.7) | 64/250 (25.6%) | 1.00             | 1.00               |
| Q2 (6.8) | 66/251 (26.3%) | 1.04             | 0.70–1.55          | 1.01 | 0.67–1.54 |
| Q3 (7.8) | 52/250 (20.8%) | 0.76             | 0.50–1.16          | 0.72 | 0.46–1.11 |
| Q4 (9.5) | 74/251 (29.5%) | 1.22             | 0.82–1.80          | 1.09 | 0.72–1.65 |
| p for linear trend | 0.62 | 0.95 |
| β-Carotene |           |                  |                    |
| Q1 (758.8) | 72/250 (28.8%) | 1.00             | 1.00               |
| Q2 (1,346.0) | 63/251 (25.1%) | 0.83             | 0.56–1.23          | 0.88 | 0.58–1.32 |
| Q3 (1,916.8) | 59/250 (23.6%) | 0.76             | 0.51–1.14          | 0.83 | 0.55–1.27 |
| Q4 (3,010.3) | 62/251 (24.7%) | 0.81             | 0.55–1.21          | 0.85 | 0.56–1.30 |
| p for linear trend | 0.26 | 0.42 |

CI: confidence interval; OMCHS: Osaka Maternal and Child Health Study.

aQuartile medians in g (except for vitamins C and E and β-carotene; mg)/d adjusted for energy intake with the residual methods given in parentheses.

bOdds ratios were separately calculated for each dietary variable adjusted for age (<29, 29–31, and 32+), gestation (<15, 15–20, and 21+ wk), parity (0 and 1), cigarette smoking (never, former, and current), passive smoking at home (never, former and current), passive smoking at work (never, former, and current), family income (<4,000,000, 4,000,000–5,999,999, and 6,000,000+ JPY/y), education (<13, 13–14, and 15+ y), changes in diet in the previous 1 mo (none or seldom, slight, and substantial), season when data were collected (spring, summer, fall, and winter), and a continuous variable for body mass index.
be nondifferential between cases and noncases and would most likely weaken any true relationship. The DHQ was designed to assess recent dietary intake, i.e. for 1 mo prior to completing the questionnaire. Adjustment for season when data were collected is likely to ease this limitation, however. There are other disadvantages that should be considered. The study subjects were pregnant women who may differ from young adults in the general population in terms of lifestyle characteristics, such as dietary habits. Thus we controlled for changes in diet in the 1 mo prior to the survey. Of a total of 3,639 eligible pregnant women in Neyagawa City, only 627 (17.2%) took part in this study. We were uncertain whether there was a difference between participants and non-participants in Neyagawa City, because data on personal characteristics such as age, socioeconomic status, and experience of extraction of permanent teeth among the non-participants were not available. With regard to the remaining 375 participants, we were not able to calculate the participation rate because the exact number of eligible subjects was not available. Nor could we not compare participants with non-participants in the 4 collaborating hospitals and 6 municipalities. Our subjects were not representative of Japanese women in the general population and the present findings may not be generalized. In fact, educational levels in the present study population were higher than in the general population. According to the 2,000 population census of Japan, the proportions of women aged 30 to 34 y in Osaka Prefecture with years of education of <13, 13–14, 15+, and unknown were 49.2, 32.3, 13.6, and 4.9%, respectively (24). The corresponding figures for the present study were 32.2, 41.2, 26.6, and 0.0%, respectively. However, the prevalence of tooth extraction in this study population (25.5%) is close to that in a sample that consisted of Japanese women aged 25–30 y for a survey of dental diseases in 1999 (27.3%) (25). Our analysis could not include detailed information on oral status such as oral hygiene, dental caries, periodontal diseases, or oral health behavior variables such as tooth brushing frequency and access to professional dental services. Tooth loss explained only severe dental caries and periodontal diseases, i.e. the early stage of dental diseases was not taken into account in this study. The consequence would have given rise to an underestimation of our findings.

This is the first epidemiological study to assess the association between dietary intake and the prevalence of tooth loss among young adults. The data used were cross-sectional, so it was not possible to determine whether any observed relation between diet and tooth loss was causal. Further studies with more detailed and objective indicators of dental health status should be performed to evaluate the role of foods and nutrients in oral health.

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Appendix

Space limitations preclude the inclusion as authors of the following members of the Osaka Maternal and Child Health Study Group: Hidemaru Kanazaki, Mitsuose Kitada, Department of Obstetrics and Gynecology, Kansai Medical University; Yorihiko Horikoshi, Department of Obstetrics and Gynecology, Kansai Medical University Kori: Osamu Ishiko, Yuichi Nakai, Junko Nishio, Seiichi Yamamasu, Department of Obstetorics and Gynecology, Osaka City University Graduate School of Medicine; Jinsuke Yasuda, Department of Obstetrics and Gynecology, Matsushita Memorial Hospital; Seigo Kawai, Department of Obstetrics and Gynecology, Hoshigaoka Koseinenkin Hospital; Kazumi Yanagihara, Yanagihara Clinic; Koji Wakuda, Department of Obstetrics and Gynecology, Fujimoto Hospital; Tokio Kawashima, Kyohitsu Women’s Clinic; Katsuhiko Narimoto, Ishida Hospital Obstetrics, Gynecology; Yoshihiko Iwasa, Iwasa Women’s Clinic; Katsuhiko Orino, Orino Lady’s Clinic; Itsuo Tsunetoh, Tsunetoh Obstetrics and Gynecology; Junichi Yoshida, Yoshida Clinic; Junichi Ito, Ito Obstetrics and Gynecology Clinic; Tukuzi Kaneko, Kaneko Sanfujuinka; Takao Kamiya, Kamiya Ladies Clinic; Hiroyuki Kuribayashi, Kuribayashi Clinic; Takeshi Taniguchi, Taniguchi Hospital; Hideo Takemura, Kosaka Women’s Hospital; Yasuhiko Morimoto, Aizenbashli Hospital.

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