Cigarette smoking is associated with periodontal disease. A causal association has been established according to the guidelines for strength of evidence.\(^1\) With respect to dental caries, a causal association with smoking was suggested for caries on the root surface of teeth. Periodontal disease would increase the possibility of caries development in terms of exposing the root surface to acid-producing bacteria due to recession of the gingival margin.\(^1\) Periodontal disease was the predominant reason for tooth extraction in persons aged over 45 years in a nationwide survey conducted in Japan.\(^2\) Therefore, Japanese smokers may lose more teeth than nonsmokers due to smoking.

Because various life-events may influence tooth extraction, confounding factors should be considered when examining the association between smoking and tooth loss via periodontal disease caused by smoking. Nutrients and foods, in particular, vitamin C\(^3\) and E\(^4\) intakes, body mass index (BMI),\(^5\) and alcohol con-
sumption' may be associated with periodontal disease. Behavioral factors such as oral-health practices and regular dental visits for the prevention of dental diseases may influence the retention of teeth. Socio-economic status (SES) has also been used to examine the association.

In the United States, an association between smoking and tooth loss has been identified. Such an association was also found in subjects residing in Sweden, Australia, Iceland, Jordan, Brazil, and Kuwait. In South-East Asian countries, only a few studies have reported on the association between smoking and tooth loss. These studies were conducted in Japan: Current smoking was significantly associated with tooth loss in workers by controlling for several confounders. The odds ratio (OR) and 95% confidence interval (CI) was 1.53, (1.20, 1.96). Tooth loss in terms of having less than 19 teeth was significantly associated with smoking in elderly subjects of 74 years of age. A positive association between smoking and experience of tooth extraction was identified in pregnant women. These findings suggest an association between smoking and tooth loss in Japanese.

The aim of the present study was to examine the association between smoking and tooth loss at the national level using national databases.

Study Population
National aspects of the dental disease status in Japan have been assessed via reports of the Survey of Dental Diseases (SDD); however, the survey did not include information on the smoking status. The target population was based on the principal extract of a nationally representative sample, and the same population was assessed in the National Nutrition Survey (NNS), which included information on the smoking status. The NNS has been conducted annually since 1945 to monitor health conditions and dietary intake. The study population was derived from 300 of 1,000 areas, which were selected by employing a two-stage cluster sampling method in the Comprehensive Survey of the Living Conditions of the People on Health and Welfare. The SDD, which involved the same sample population as that of the NNS, has been conducted every six years since 1957. Data of the NNS and SDD were stored independently. We obtained the databases from the Ministry of Health, Labour and Welfare with permission for analytical use and linked the records based on the identification number of each household, age, and sex. Records of 12,763 and 6,903 subjects in the NNS and SDD, respectively, aged 1 year and older in 1999 were evaluated; as a result, 6,805 records were linked successfully. Because only 6 subjects had less than 19 teeth in the age group of younger than 39 years, 2,806 records of subjects aged younger than 39 were excluded for analyses. Finally, 3,999 records of subjects aged 40 years or older were analyzed.

Measurements
According to the description of the NNS, dietitians visited each household to collect information regarding the dietary status. Among numerous variables of the NNS, several variables were selected as possible confounders prior to the application of national databases. Variables regarding smoking status, sex, age, BMI, status of alcohol consumption, and intakes of vitamin C and E were analyzed. Smoking status was defined in the questionnaires as: "current smoker", an individual who currently smokes and has smoked more than 100 cigarettes in total after starting smoking; "former smoker", an individual who has previously smoked more than 100 cigarettes in total after starting smoking but does not currently smoke; and "nonsmoker", an individual who has never smoked or smoked no more than 100 cigarettes in total after starting smoking. Subjects were partitioned into four age groups: 40-49, 50-59, 60-69, and 70+ years. The status of alcohol consumption was divided into three groups: current and former drinkers and subjects who have never drank. Habitual drinking was defined in the questionnaires as an intake of more than about 20 g of ethanol per day for 3 days or more per week. The amount of alcohol consumption was derived from responses regarding the type of alcoholic beverages. Based on the Recommended Dietary Allowances and Dietary Reference Intakes for Japanese (6th Revision), vitamin C and E intakes were categorized into two groups according to reference values of the recommended dietary allowance.

According to the description in the report of the SDD, participants visited designated locations where calibrated dentists examined and recorded the status of each tooth which was present in the oral cavity regardless of the degree of eruption. The number of existing teeth was derived from the summation of sound, filled, and decayed (untreated) teeth in the SDD. Lost teeth were defined as permanent teeth (excluding third molars) lost due to extraction or dropout. Dental implants were included for lost teeth. Participants were interviewed for the frequency of tooth brushing. Variables regarding dental visits and the SES were not available in these databases.

Statistical Methods
Due to the national objective of the "8020 Movement", a program promoting the retention of 20 teeth till 80 years of age in Japan, a category of 0-19 or more than 20 teeth has functioned as a marker of tooth loss in Japanese. The association between smoking and tooth loss in terms of having less than 19 existing teeth, i.e., subjects who did not meet the national objective, was analyzed using logistic regression in males and females. In the logistic regression model, unadjusted ORs of current and former smokers relative to nonsmokers were analyzed. Then, adjusted ORs were calculated in the multiple logistic regression model by controlling for confounders (reference category): age (40-49 years), frequency of toothbrushing (more than twice a day), BMI (<25.0 kg/m²), status of alcohol consumption (never), daily intakes of vitamin C (100+ mg) and E (10+ mg for males and 8+ mg for females). The dose-response relationship was evaluated using life-time exposure, with the Brinkman Index, which was calculated by

&5)0%4

mg) and E (10+ mg for males and 8+ mg for females).
The percentage of subjects having less than 19 existing teeth was 37.3%, overall (Table 3). The prevalence of tooth loss increased by age, while the rate was similar in males (35.5%) and females (38.5%), and with smoking status as a total; 37.1%, 38.1%, and 37.3% in nonsmokers, former, and current smokers, respectively. Current smokers showed the highest and nonsmokers the lowest rate of tooth loss in each age-group.

Crude ORs and 95% CIs of having less than 19 existing teeth for former and current smokers were significant in males: 1.58 (1.19-2.11) and 1.47 (1.12-1.93), respectively, and non-significant in females: 0.83 (0.50-1.37) and 1.01 (0.74-1.38), respectively (Table 4). The adjusted OR of former smokers by controlling confounders was non-significant in males and females: 1.29 (0.92-1.80) and 0.86 (0.46-1.60), respectively; however, the OR of current smokers was significant in males and females: 2.22 (1.61-3.06) and 2.14 (1.45-3.15), respectively. The adjusted mean of existing teeth was the lowest in current smokers (18.2 teeth in males and 16.4 teeth in females). In males, nonsmokers possessed the highest number of teeth on average (21.5 teeth) and former smokers fell in the middle (19.7 teeth). In females, these figures were similar in nonsmokers (19.0 teeth) and former smokers (19.2 teeth).

The dose-response relationship between smoking and tooth loss was examined in nonsmokers and current smokers (Table 5). The prevalence of tooth loss and crude OR were the highest in subjects with the highest score of lifetime exposure in males and females. Adjusted ORs increased by lifetime exposure and were significant in all lifetime exposure categories in males and females. Current smokers showed the highest and nonsmokers the lowest rate of tooth loss in each age-group.

Crude ORs and 95% CIs of having less than 19 existing teeth for former and current smokers were significant in males: 1.58 (1.19-2.11) and 1.47 (1.12-1.93), respectively, and non-significant in females: 0.83 (0.50-1.37) and 1.01 (0.74-1.38), respectively (Table 4). The adjusted OR of former smokers by controlling confounders was non-significant in males and females: 1.29 (0.92-1.80) and 0.86 (0.46-1.60), respectively; however, the OR of current smokers was significant in males and females: 2.22 (1.61-3.06) and 2.14 (1.45-3.15), respectively. The adjusted mean of existing teeth was the lowest in current smokers (18.2 teeth in males and 16.4 teeth in females). In males, nonsmokers possessed the highest number of teeth on average (21.5 teeth) and former smokers fell in the middle (19.7 teeth). In females, these figures were similar in nonsmokers (19.0 teeth) and former smokers (19.2 teeth).

Among 3,999 subjects analyzed in the present study, 59.5% were female, and 53.1% were 60 years old or older (Table 1). The distribution of nonsmokers, former, and current smokers was 62.6%, 14.4%, and 23.1%, respectively and differed greatly between males and females: 23.2%, 31.2%, and 45.6% in males and 89.3%, 2.9%, and 7.8% in females, respectively. The rate of current smokers decreased with age, while that of former smokers increased.

Approximately one third of subjects (34.8%) brushed their teeth less than once a day (Table 2). About one fourth was classified with a high BMI score (28.2%) and current drinkers (27.2%). With respect to vitamins C and E, 35.5% and 49.1%, respectively, were classified in lower intake groups. Current smokers were relatively predominant in the following groups: brushing less than once a day (33.2%), current drinking (46.9%), and lower intakes of vitamin C (29.2%) and E (26.7%).

### Table 1. Distribution of the smoking status by age group and sex.

| Age (years) | Non-smoker | Former smoker | Current smoker | Total |
|-------------|------------|---------------|----------------|-------|
| Male        |            |               |                |       |
| 40-49       | 64 (19.9)  | 69 (21.5)     | 188 (58.6)     | 376 (100) |
| 50-59       | 105 (26.6) | 83 (21.1)     | 206 (52.3)     | 394 (100) |
| 60-69       | 121 (23.6) | 180 (35.1)    | 212 (41.3)     | 515 (100) |
| 70+         | 86 (22.1)  | 173 (44.4)    | 131 (33.6)     | 390 (100) |
| Total       | 376 (23.2) | 505 (31.2)    | 737 (45.6)     | 1618 (100) |
| Female      |            |               |                |       |
| 40-49       | 432 (83.6) | 16 (3.1)      | 69 (13.3)      | 517 (100) |
| 50-59       | 572 (88.7) | 22 (3.4)      | 51 (7.9)       | 645 (100) |
| 60-69       | 615 (91.0) | 15 (2.2)      | 46 (6.8)       | 676 (100) |
| 70+         | 507 (93.4) | 17 (3.1)      | 19 (3.5)       | 543 (100) |
| Total       | 2126 (89.3)| 70 (2.9)      | 185 (7.8)      | 2381 (100) |
| Total       | 2502 (62.6)| 575 (14.4)    | 922 (23.1)     | 3999 (100) |

Percentages in parentheses
Table 2. Number of subjects according to smoking status by confounding variables.

| Variables and criteria               | Non-smoker | Former smoker | Current smoker | Total    |
|-------------------------------------|------------|---------------|----------------|----------|
| Frequency of daily tooth brushing   |            |               |                |          |
| More than twice                     | 1822 (69.9)| 325 (12.5)    | 459 (17.6)     | 2606 (100) |
| Less than once                      | 680 (48.8) | 250 (17.9)    | 463 (33.2)     | 1393 (100) |
| Body mass index (Kg/m²)             |            |               |                |          |
| -24.9                               | 1793 (62.5)| 393 (13.7)    | 684 (23.8)     | 2870 (100) |
| 25.0+                               | 709 (62.6) | 182 (16.1)    | 238 (21.1)     | 1129 (100) |
| Status of alcohol consumption       |            |               |                |          |
| Never                               | 2172 (80.0)| 200 (7.4)     | 343 (12.6)     | 2715 (100) |
| Former                              | 45 (23.0)  | 82 (41.8)     | 69 (35.2)      | 196 (100)  |
| Current                             | 285 (26.2) | 293 (26.9)    | 510 (46.9)     | 1088 (100) |
| Intake of vitamin C (mg/day)        |            |               |                |          |
| 100+                                | 1680 (65.1)| 392 (15.2)    | 507 (19.7)     | 2579 (100) |
| <100                                | 822 (57.9) | 183 (12.9)    | 415 (29.2)     | 1420 (100) |
| Intake of vitamin E (mg/day)        |            |               |                |          |
| 10+ (males) or 8+ (females)         | 1377 (67.6)| 261 (12.8)    | 399 (19.6)     | 2037 (100) |
| <10 (males) or <8 (females)         | 1125 (57.3)| 314 (16.0)    | 523 (26.7)     | 1962 (100) |

Percentages in parentheses

Table 3. Number of subjects having less than 19 existing teeth according to smoking status by age group and sex.

| Age (years) | Non-smoker | Former smoker | Current smoker | Total    |
|-------------|------------|---------------|----------------|----------|
| Male        |            |               |                |          |
| 40-49       | 2 (3.1)    | 4 (5.8)       | 13 (6.9)       | 19 (5.9) |
| 50-59       | 14 (13.3)  | 14 (16.9)     | 51 (24.8)      | 79 (20.1) |
| 60-69       | 35 (28.9)  | 61 (33.9)     | 103 (48.6)     | 199 (38.8) |
| 70+         | 56 (65.1)  | 116 (67.1)    | 105 (80.2)     | 277 (71.0) |
| Total       | 107 (28.5) | 195 (38.6)    | 272 (36.9)     | 574 (35.5) |
| Female      |            |               |                |          |
| 40-49       | 26 (6.0)   | 1 (6.3)       | 7 (10.1)       | 34 (6.6) |
| 50-59       | 111 (19.4) | 4 (18.2)      | 21 (41.2)      | 136 (21.1) |
| 60-69       | 280 (45.5) | 7 (46.7)      | 25 (54.3)      | 312 (46.2) |
| 70+         | 404 (79.7) | 12 (70.6)     | 19 (100.0)     | 435 (80.1) |
| Total       | 821 (38.6) | 24 (34.3)     | 72 (38.9)      | 917 (38.5) |
| Total       | 928 (37.1) | 219 (38.1)    | 344 (37.3)     | 1491 (37.3) |

Percentages in parentheses
Table 4. Prevalence, crude and adjusted odds ratios (ORs), and 95% confidence intervals (CIs) of having less than 19 existing teeth and adjusted means of existing teeth by smoking status of 1,618 males and 2,381 females of older than 40 years of age.

| Smoking status | Prevalence (%) | Crude OR (95% CI) | Adjusted OR* (95% CI) | Adjusted means of existing teeth (95% CI) |
|----------------|----------------|-------------------|-----------------------|---------------------------------------|
| **Males**      |                |                   |                       |                                       |
| Nonsmoker      | 28.5 (107/376) | 1.00 (reference)  | 1.00 (reference)      | 21.5 (20.7-22.3)                     |
| Former smoker  | 38.6 (195/505) | 1.58 (1.19-2.11)  | 1.29 (0.92-1.80)      | 19.7 (19.0-20.4)                     |
| Current smoker | 36.9 (272/737) | 1.47 (1.12-1.93)  | 2.22 (1.61-3.06)      | 18.2 (17.6-18.8)                     |
| **Females**    |                |                   |                       |                                       |
| Nonsmoker      | 38.6 (821/2126)| 1.00 (reference)  | 1.00 (reference)      | 19.0 (18.7-19.3)                     |
| Former smoker  | 34.3 (24/70)   | 0.83 (0.50-1.37)  | 0.86 (0.46-1.60)      | 19.2 (17.5-21.0)                     |
| Current smoker | 38.9 (72/185)  | 1.01 (0.74-1.38)  | 2.14 (1.45-3.15)      | 16.4 (15.2-17.5)                     |

* : Based on multiple logistic regression controlling for confounders: age, frequency of daily tooth brushing, body mass index, status of alcohol consumption, and intakes of vitamin C and E. Criteria and distribution of the variables are shown in Tables 1 and 2.

Table 5. Prevalence, crude and adjusted odds ratios (ORs), and 95% confidence intervals (CIs) of having less than 19 existing teeth and adjusted means of existing teeth by lifetime exposure, the Brinkman index score, of 1,113 males and 2,311 females of older than 40 years of age. Former smokers (N=575) were excluded due to the possible effect of quitting smoking on risk reduction.

| Lifetime exposure | Prevalence (%) | Crude OR (95% CI) | Adjusted OR* (95% CI) | Adjusted means of existing teeth (95% CI) |
|-------------------|----------------|-------------------|-----------------------|---------------------------------------|
| **Males**         |                |                   |                       |                                       |
| 0                 | 28.5 (107/376) | 1.00 (reference)  | 1.00 (reference)      | 22.1 (21.3-22.9)                     |
| 1-399             | 28.4 (29/102)  | 1.00 (0.61-1.62)  | 1.99 (1.10-3.59)      | 19.4 (17.9-20.9)                     |
| 400-1199          | 36.6 (191/522) | 1.45 (1.09-1.93)  | 2.20 (1.55-3.11)      | 19.0 (18.4-19.7)                     |
| 1200+             | 46.0 (52/113)  | 2.14 (1.39-3.30)  | 2.94 (1.77-4.91)      | 17.0 (15.6-18.4)                     |

P for trend*: <0.0001

| **Females**       |                |                   |                       |                                       |
| 0                 | 38.6 (821/2126)| 1.00 (reference)  | 1.00 (reference)      | 19.0 (18.6-19.3)                     |
| 1-399             | 32.5 (38/117)  | 0.76 (0.51-1.14)  | 1.74 (1.06-2.87)      | 16.4 (15.0-17.8)                     |
| 400-1199          | 47.5 (29/61)   | 1.44 (0.86-2.40)  | 2.30 (1.26-4.21)      | 16.8 (14.9-18.8)                     |
| 1200+             | 71.4 (5/7)     | 3.97 (0.77-20.5)  | 14.5 (2.35-89.2)      | 11.8 ( 6.2-17.5)                     |

P for trend*: <0.0001

* : Brinkman index score, duration (years) of smoking times daily consumption (cigarettes)

: Based on multiple logistic regression controlling for age, frequency of daily tooth brushing, body mass index, status of alcohol consumption, and intakes of vitamin C and E. Criteria and distribution of the variables are shown in Tables 1 and 2.

: Analysis of covariance was employed to calculate adjusted mean numbers of existing teeth with allowance for the study variables.

: P for a trend across two categories using multiple regression analysis controlling for the study variables.

Four categories of lifetime exposure were entered as continuous variables.
females. This trend was highly significant (P<0.0001). Adjusted means of existing teeth decreased from 22.1 to 17.0 in males and from 19.0 to 11.8 in females as lifetime exposure increased.

A significant association between current smoking and tooth loss was demonstrated in the survey through Japan. Furthermore, the dose-response relationship between smoking and tooth loss was distinct. Few studies have addressed the dose-response relationship in terms of tooth loss. Because this study was cross-sectional, a causal association should not be estimated; however, the adjusted OR of former male smokers fell between those of non-smokers and current smokers and the OR in females was less than that of nonsmokers. The association of former smokers relative to nonsmokers was non-significant. These results suggest the benefit of quitting smoking. In a longitudinal study of 789 men in the United States, a period of quitting of longer than 13 years was required for a reduction of the risk of tooth loss to the level of nonsmokers. Smoking cessation practice is recommended as a part of global public health measures in dental practice. Because the indicator of tooth loss was derived from the national objective in the present study, the effect of smoking on tooth loss should be strengthened as a measure for the prevention of tooth loss.

The primary mechanism of the effect of smoking on tooth loss, which was addressed previously, is via the effect of periodontal disease. In Japan, the major reason for tooth extraction was periodontal disease (41.8%) and the reason was predominant in subjects over 45 years of age. In the present study, subjects were limited to individuals of 40 or older years of age. Current smokers may lose teeth via extraction due to periodontal disease rather than dental caries. Cigarette smoking leads to deterioration of the periodontal condition in Japanese adults by analyses of the same databases used in the present study, though the effect would be underestimated due to the low power in detecting periodontal destruction.

Though the study population was derived from national databases, the results in terms of prevalence and distribution may not represent the national status. The source of the surveyed population in the NNS was based on the household. Only 54% of subjects in the NNS were available for the analysis of tooth loss in the SDD. Subjects who were able to visit for dental examination may be limited and biased. For example, a more health conscious group may have undergone examination. However, smoking rates by sex and age were similar between databases (data not shown). Though the sample may not represent the national average, an association between smoking and tooth loss was demonstrated by the survey which was conducted through Japan.

Discrepancies in the association of former smokers and tooth loss in males, and current smokers and tooth loss in females were apparent between the results from bivariate and multivariate analyses. By bivariate analyses, the association between former male smokers and tooth loss was significant and that between current female smokers and tooth loss was non-significant. The prevalence of tooth loss was similar between nonsmokers and former smokers in males, and nonsmokers and current smokers in females. These findings should be interpreted with caution because the distribution of current and former smokers and subjects with tooth loss differed by several confounders, in particular, age. Current smoking was significantly associated with tooth loss and the association between former smokers and tooth loss was non-significant overall, after confounders were adjusted for the multivariate regression model in males and females. Finally, more current smokers had less than 19 teeth compared to nonsmokers. Although the smoking rate was apparently different by sex, the effect of smoking on tooth loss was significant in males and females. Furthermore, the dose-response relationship was also distinct.

Though the smoking rate decreased with age, tooth loss increased in later life. This phenomenon might be contradictory. However, because the effect of smoking, in general, appears in later life, adjustment of age as a confounding variable compensated for the influence of age. The prevalence of tooth loss was almost equal in males and females, while the smoking rate was higher in males than females. In females, other factors which were not entered into the multivariate model may influence the association. For example, females in general prefer sweets, which is one of the major risks of dental caries. However, the evidence is not sufficient to infer a causal association between smoking and coronal dental caries. The bone mineral content is an important factor for supporting periodontal tissue. Menopause may increase the risk of tooth loss in females via periodontitis due to the effects of osteoporosis; estrogen replacement therapy protects against tooth loss and reduces the risk of total tooth loss. The effect of smoking on coronal dental caries is controversial. The effect on caries in the crown of the tooth, if any, would appear in younger subjects than those examined in the present study, because premature teeth are susceptible to coronal dental caries.

Tooth loss typically occurs by means of dental extraction; thus, it is possible that smokers were more likely to seek dental care than non-smokers due to oral problems. Indeed, a variety of oral symptoms and diseases are associated with smoking. Though data pertaining to access to oral health care were not available in the present study, smoking was significantly associated with tooth loss in young Japanese women upon consideration of the family income and education. SES is often cited as a potential confounder; however, it may not have an independent effect but affect disease risk through its association with smoking. Self-rated health may be associated with social inequality in Japan. However, the negative association of smoking with SES is controversial: Current smokers were likely to be more educated among men and women. In contrast, relationships between the per capita income, unemployment rate, and current smoking were demonstrated. The effect of SES may have been weak at the time when these surveys were conducted in 1999, because the smoking rate of males overall approached half. Some variables used for adjust-
Smoking is a significant risk factor for tooth loss. A nationwide population in Japan indicated an association of smoking with tooth loss. Further studies should be conducted to examine the causal association using possible confounders including socioeconomic status, dietary intake, and lifestyle factors. The strength of the present study corresponded to the outcome derived from a nationwide population. The health consequences of a high smoking rate in terms of tooth loss in Japan warn of a future burden regarding oral health in developing countries where cigarette consumption is increasing.

In conclusion, the findings of this cross-sectional study of a nationwide population in Japan indicated an association of smoking with tooth loss. Further studies should be conducted to examine the causal association using possible confounders including SES and behavioral factors.

1. USDHHS. Dental diseases. In: The Health Consequences of Smoking: A Report of the Surgeon General. Washington DC: USDHHS; 2004. p.732-66.
2. Aida J, Ando Y, Akhter R, Aoyama H, Masui M, Morita M. Reasons for permanent tooth extractions in Japan. J Epidemiol 2006; 16: 214-9.
3. Nishida M, Grossi SG, Dunford RG, Ho AW. Dietary vitamin C and the risk for periodontal disease. J Periodontol 2000; 71: 1215-23.
4. Cohen ME, Meyer DM. Effect of dietary vitamin E supplementation and rotational stress on alveolar bone loss in rice rats. Arch Oral Biol 1993; 38: 601-6.
5. Sheiham A, Steele JG, Marçencs W, Finch S, Walls AW. The relationship between oral health status and Body Mass Index among older people: a national survey of older people in Great Britain. Br Dent J 2002; 192: 703-6.
6. Klein BE, Klein R, Knudtson MD. Life-style correlates of tooth loss in an adult Midwestern population. J Public Health Dent 2004; 64: 145-50.
7. Kressin NR, Boehmer U, Nunn ME, Spiro A 3rd. Increased preventive practices lead to greater tooth retention. J Dent Res 2003; 82: 223-7.
8. Cunha-Cruz J, Nandanovsky P, Faerstein E, Lopes CS. Routine dental visits are associated with tooth retention in Brazilian adults: the Pro-Saude study. J Public Health Dent 2004; 64: 216-22.
9. Gilbert GH, Duncan RP, Shelton BJ. Social determinants of tooth loss. Health Serv Rev 2003; 38: 1843-62.
10. Bollen AM, Taguchi A, Hujoel PP, Hollender LG. Number of teeth and residual alveolar ridge height in subjects with a history of self-reported osteoporotic fractures. Osteoporos Int 2004; 15: 970-4.
11. Eklund SA, Burt BA. Risk factors for total tooth loss in the United States: longitudinal analysis of national data. J Public Health Dent 1994; 54: 5-14.
12. Holm G. Smoking as an additional risk for tooth loss. J Periodontol 1994; 65: 996-1001.
13. McGuire MK, Nunn ME. Prognosis versus actual outcome. III. The effectiveness of clinical parameters in accurately predicting tooth survival. J Periodontol 1996; 67: 666-74.
14. Krall EA, Dawson-Hughes B, Garvey AJ, Garcia RI. Smoking, smoking cessation, and tooth loss. J Dent Res 1997; 76: 1653-9.
15. Albandar JM, Streckfus CF, Adesanya MR, Winn DM. Cigar, pipe, and cigarette smoking as risk factors for periodontal disease and tooth loss. J Periodontol 2000; 71: 1874-81.
16. Copeland LB, Krall EA, Brown LJ, Garcia RI, Streckfus CF. Predictors of tooth loss in two US adult populations. J Public Health Dent 2004; 64: 31-7.
17. Osterberg T, Mellstrom D. Tobacco smoking: a major risk factor for loss of teeth in three 70-year-old cohorts. Community Dent Oral Epidemiol 1986; 14: 367-70.
18. Ahlqwist M, Bengtsson C, Hollender L, Lapidus L, Osterberg T. Smoking habits and tooth loss in Swedish women. Community Dent Oral Epidemiol 1989; 17: 144-7.
19. Axelsson P, Paulander J, Lindhe J. Relationship between smoking and dental status in 35-, 50-, 65-, and 75-year-old individuals. J Clin Periodontol 1998; 25: 297-305.
20. Slade GD, Gansky SA, Spencer AJ. Two-year incidence of tooth loss among South Australians aged 60+ years. Community Dent Oral Epidemiol 1997; 25: 429-37.
21. Ragnarsson E, Eliasson ST, Olafsson SH. Tobacco smoking, a factor in tooth loss in Reykjavik, Iceland. Scand J Dent Res 1992; 100: 322-6.
22. Hamasha AA, Sasa I, Al-Qudah M. Risk indicators associated with tooth loss in Jordanian adults. Community Dent Oral Epidemiol 2000; 28: 67-72.
23. Susin C, Oppermann RV, Haugejorden O, Albandar JM. Tooth loss and associated risk indicators in an adult urban population from south Brazil. Acta Odontol Scand 2005; 63: 85-93.
24. Al-Shammarri KF, Al-Khazzab AK, Al-Ansari JM, Neiva R, Wang HL. Risk indicators for tooth loss due to periodontal disease. J Periodontol 2005; 76: 1910-8.
25. Yoshida Y, Hatanaka Y, Imaki M, Ogawa Y, Miyatani S, Tanada S. Epidemiological study on improving the QOL and oral conditions of the aged – Part 2: Relationship between tooth loss and lifestyle factors for adults men. J Clin Periodontol 1998; 25: 297-305.
26. Yoshida Y, Hatanaka Y, Imaki M, Ogawa Y, Miyatani S, Tanada S. Epidemiological study on improving the QOL and oral conditions of the aged – Part 2: Relationship between tooth loss and lifestyle factors for adults men. J Physiol Anthropol Appl Human Sci. 2001; 20: 369-73.
27. Yoshida Y, Hatanaka Y, Imaki M, Ogawa Y, Miyatani S, Tanada S. Epidemiological study on improving the QOL and oral conditions of the aged – Part 2: Relationship between tooth loss and lifestyle factors for adults men. J Physiol Anthropol Appl Human Sci. 2001; 20: 369-73.
28. Yoshida Y, Hatanaka Y, Imaki M, Ogawa Y, Miyatani S, Tanada S. Epidemiological study on improving the QOL and oral conditions of the aged – Part 2: Relationship between tooth loss and lifestyle factors for adults men. J Physiol Anthropol Appl Human Sci. 2001; 20: 369-73.
29. Ministry of Health, Labor and Welfare, Japan. The National Nutrition Survey in Japan, 2001. Tokyo: Daiichi-Shuppan Co, 2003. (in Japanese)
30. Krall EA, Dietrich T, Nunn ME, Garcia RI. Risk of tooth loss after cigarette smoking cessation. Prev Chronic Dis 2006; 3: A115.
31. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. Bull World Health Organ 2005; 83: 661-9. Epub 2005 Sept. 30.
32. Ojima M, Hanioka T, Tanaka K, Inoshita E, Aoyama H. Relationship between smoking status and periodontal conditions: findings from national databases in Japan. J Periodont Res 2006; 41: 573-9.
33. Katanoda K, Nitta H, Hayashi K, Matsumura Y. Is the national nutrition survey in Japan representative of the entire Japanese population? Nutrition 2005; 21: 964-6.
34. Krall EA, Dawson-Hughes B, Hannan MT, Wilson PW, Kiel DP. Postmenopausal estrogen replacement and tooth retention. Am J Med 1997; 102: 536-42.
35. Honjo K, Kawakami N, Takeshima T, Tachimori H et al. Social class inequalities in self-rated health and their gender and age group differences in Japan. J Epidemiol 2006; 16: 223-32.
36. Uno F, Ishikawa S, Nakamura Y, Gotoh T, Nago N, Kayaba K et al. Smoking and risk of all-cause mortality: the Jichi Medical School (JMS) Cohort Study. J Epidemiol 2005; 15: 173-9.
37. Fukuda Y, Nakamura K, Takano T. Accumulation of health risk behaviours is associated with lower socioeconomic status and women's urban residence: a multilevel analysis in Japan. BMC Public Health 2005; 5: 53.