

## The relationship between periodontal disease and oral health behavior in adult Japanese people

Yoshimi NAKAYAMA<sup>1,2</sup>, Mitsuru MORI<sup>2</sup>

<sup>1</sup>Hokkaido Tomakomai Public Health Center

<sup>2</sup>Department of Public Health, Sapporo Medical University School of Medicine

### ABSTRACT

Evidence for a link between periodontal disease and several systemic diseases is increasing rapidly. However the relationship of periodontal disease to oral health behavior and oral health knowledge have been studied as extensively. The aim of the present study was to investigate the association of periodontal disease with oral health behavior and oral health knowledge among adult Japanese people.

Subjects were 988 persons over 20 years in the eastern part of Hokkaido, Japan. The survey items were age, sex, history of systemic diseases, smoking status, oral health behavior such as frequency of tooth brushing, having a family dentist and so on. Odds ratios (ORs) and their 95% confidence intervals (CIs) of variables related to having Community Periodontal Index (CPI)  $\geq 3$  were evaluated using the unconditional logistic regression model by sex. Former smoking (OR=1.94, 95% CI: 1.02-3.69) and having no family dentist (OR=2.52, 95% CI: 1.49-4.27) were significantly associated with risk of having CPI  $\geq 3$  in the male subjects. Not using a toothpaste was marginally significantly associated with risk of having CPI  $\geq 3$  in the female subjects (OR=1.43, 95% CI: 0.99-2.04).

This study suggests that there is a significant relationship of oral health behavior and smoking to periodontal disease.

(Received July 23, 2012 and Accepted August 31, 2012)

**Key words:** periodontal disease, smoking, oral health behavior, CPI

### INTRODUCTION

In Japan, the dental examination for preventive periodontal disease was initiated in 1995. However, the Survey of Dental Diseases in Japan in 2005 reported that the proportion of people aged over 60 years with periodontal disease has increased year by year (1). Most cases of periodontal disease have no subjective symptoms and become gradually worse. Finally, the disease leads to tooth loss. Most studies have reported the impact of dentition status on nutritional conditions and dietary habits (2-8). Several reports have suggested that impaired mastication ability by tooth loss might be a risk factor for cardiovascular disease, gastrointestinal disease, and other health problems (2, 7). Additionally several studies have reported that periodontal disease is associated with obesity (9-11), diabetes (12, 13), atherosclerosis (14) and ischemic stroke (15, 16). Therefore, sustaining healthy periodontal tissue is very important.

Evidence for a link between periodontal disease and several systemic diseases is growing

rapidly. However the relationship of periodontal disease to oral health behavior and oral health knowledge has been poorly studied.

The aim of the present study was to investigate the association of periodontal disease with oral health behavior and oral health knowledge among adult Japanese people.

### Participants and Methods

#### Subjects

The participants in this survey were 1034 subjects (457 males, 577 females) over 20 years of age who had a dental examination conducted by municipality from June of 2010 to March of 2011 in Obihiro city and Honbetsu town of the Tokachi area, located in the eastern part of Hokkaido, the northern island of Japan. The subjects in Obihiro city were 39,609 people aged 20 years or over who were covered by national health insurance. The subjects in Honbetsu town were 513 people aged 40 years or over who participated in a health checkup for preventive metabolic syndrome which was started in 2008 by the government. The

**Table 1** Characteristics of the subjects by Community Periodontal Index (CPI) by sex

Age (year)	males			females		
	n	CPI		n	CPI	
		$\geq 3$	$\leq 2$		$\geq 3$	$\leq 2$
20-29	26	12	14	24	17	7
30-39	37	22	15	45	24	21
40-49	37	24	13	40	21	19
50-59	46	26	20	70	42	28
60-69	124	82	42	185	110	75
70-79	133	71	62	150	88	62
80+	37	13	24	34	18	16

people who had a dental examination in Obihiro city and in Honbetsu town were 791 subjects (365 males, 426 females), and 243 subjects (92 males, 151 females), respectively. We excluded 46 subjects because their Community Periodontal Index (CPI) was unmeasurable. Furthermore, we excluded 37 male subjects over 80 years because distribution of their CPI was different from that of another ages as shown in Table 1. Eventually, we analyzed 951 subjects (403 males, 548 females).

This study was approved by the Ethical Committee of Sapporo Medical University.

### Method of Survey

For the survey, public health nurses in Honbetsu town or dental hygienists of a dental clinic in Obihiro city interviewed the subjects with a structured questionnaire at the time of the dental check-up. The surveyed items were age, sex, history of systemic diseases, smoking status (current, former and non smoker), oral satisfactory degree, frequency of tooth brushing, using toothpaste, using dental floss, having regular dental check-ups, having a family dentist and knowledge of the 8020 campaign (The 80 year old people should have more than 20 teeth).

The dental examination was conducted by a trained dentist of a local dental clinic under sufficient artificial light with dental mirrors, CPI probe developed by the World Health Organization (WHO) and explorers. The contents of the dental examination were the diagnoses of dental caries (sound teeth, filled teeth, decayed teeth and missing teeth) and CPI.

Severity of periodontal disease was evaluated with Community Periodontal Index (CPI) developed by WHO (17).

The conditions of periodontal tissue were evaluated in six sections of dentition and 10 teeth(maxillary right central incisor, mandibular left central incisor, first and second molar both maxillary and mandibular) using CPI scores of 0, 1, 2, 3 and 4 to indicate healthy, bleeding after probing, dental calculus detected by probing, 4- to 5- mm deep pockets, and > 6- mm deep pockets, respectively. The highest CPI score in the six section was used as the subject's score. Individuals with scores of 3 or 4 were classified as having a periodontal disease, while those with scores of 0,1 or 2 were diagnosed as being without periodontal disease.

### Analyses

We compared subjects who had  $CPI \geq 3$  with those who had  $CPI \leq 2$  using an unconditional logistic regression model by sex. The odds ratios (ORs) and their 95% confidence intervals (95% CIs) were estimated with regard to risk factor for periodontal disease. Before the multivariate logistic regression analysis was conducted, we confirmed that multicollinearity among the variables did not exist by the Spearman rank correlation test by sex. Tests of statistical significance were based on a two-sided P value, and the  $\alpha$ -error was set at the 5% level. The SAS system (ver.9.2) was employed for the analysis.

### Results

The average ages among 440 males and 548 females were 59.8 (standard deviation,  $SD=15.7$ ) and 61.6 ( $SD=14.9$ ) years old, respectively. The average numbers of present teeth in the male subjects and in the female subjects were 21.0 ( $SD=6.6$ ), 19.8 ( $SD=7.1$ ), respectively. The DMFT (average number of decayed teeth, missing

teeth or filled teeth) in the male subjects and in the female subjects were 18.8 (SD=6.5), 20.8 (SD=5.8), respectively.

Table 2 shows crude ORs with 95% CIs for  $CPI \geq 3$  by sex. Having no family dentist (OR=2.56, 95%CI: 1.54-4.26), current smoking (OR=2.13, 95%CI: 1.34-3.40) and former smoking (OR=1.87, 95%CI: 1.03-3.39) were significantly associated with the risk of having  $CPI \geq 3$  in the male subjects. No usage of toothpaste (OR=1.44, 95%CI: 1.02-2.04) and current smoking (OR=1.74, 95%CI: 1.01-3.02) were associated with the risk of having  $CPI \geq 3$  in the female subjects. However oral complaint, usage of dental floss, regular dental check-ups, frequency of tooth brushing, systematic disease and knowledge about the 8020 campaign were not associated with the risk of having  $CPI \geq 3$ .

As shown in Table 3, the multivariate analysis included the significant variables found by an univariate analysis such as having a family dentist and smoking status in the male subjects. Having no family dentist (OR=2.52, 95%CI: 1.49-4.27) and former smoking (OR=1.94, 95%CI: 1.02-3.69) were significantly associated with the risk of having  $CPI \geq$

3.

As shown in Tables 3, the multivariate analysis included the significant variables found by an univariate analysis of using a toothpaste and smoking status in the female subjects. Smoking status was not associated with the risk of having  $CPI \geq 3$  in the female subjects. However, not using a toothpaste was marginally significantly associated with the risk of having  $CPI \geq 3$  in the female subjects (OR=1.43, 95%CI: 0.99-2.04).

### Discussion

We found former smoking were associated with periodontal disease in the male subjects. Most studies (18-24) have reported that smoking is associated with periodontal disease. Pham et al. (18) reported that past smokers and current smokers were more likely to have periodontal disease than nonsmokers among 243 Vietnamese people aged 30-60 years old by multivariate analysis. This result was consistent with our results. Oshikohji et al. (20) reported that smoking was significantly associated with the proportion of teeth

**Table 2** Odds ratios (ORs), and 95% confidence intervals (CIs) of having  $CPI \geq 3$  with univariate logistic regression analysis by sex

Variables	males			females		
	$\geq 3$	$\leq 2$	OR (95%CI)	$\geq 3$	$\leq 2$	OR (95%CI)
Age: 20-49 years	58	42	1.00 (reference)	62	47	1.00 (reference)
50-69 years	108	62	1.26 (0.76-2.09)	152	103	1.12 (0.71-1.76)
70+ years	71	62	0.83 (0.49-1.40)	106	78	1.03 (0.64-1.66)
Complaint of oral condition: No	69	54	1.00 (reference)	95	84	1.00 (reference)
Yes	155	107	1.13 (0.74-1.75)	204	129	1.40 (0.97-2.02)
Frequency of tooth brushing: $\geq 3$ times a day	38	26	1.00 (reference)	99	68	1.00 (reference)
2 times a day	103	67	1.05 (0.59-1.89)	154	99	1.07 (0.72-1.59)
$\leq$ Once a day	87	68	0.88 (0.49-1.58)	54	47	0.79 (0.48-1.30)
Using a toothpaste: Regularly	77	66	1.00 (reference)	119	105	1.00 (reference)
Not regularly	160	100	1.37 (0.91-2.07)	201	123	1.44 (1.02-2.04)
Using a dental floss: Regularly	18	12	1.00 (reference)	36	32	1.00 (reference)
Not regularly	219	154	0.95 (0.44-2.03)	284	196	1.29 (0.77-2.14)
Regular dental check-ups: Yes	111	70	1.00 (reference)	143	100	1.00 (reference)
No	112	89	0.79 (0.53-1.19)	148	112	0.92 (0.65-1.32)
Having a family dentist: Yes	137	125	1.00 (reference)	215	166	1.00 (reference)
No	73	26	2.56 (1.54-4.26)	63	39	1.25 (0.80-1.95)
Smoking status: Nonsmoker	101	99	1.00 (reference)	230	179	1.00 (reference)
Ex-smoker	40	21	1.87 (1.03-3.39)	17	12	1.10 (0.51-2.37)
Current smoker	87	40	2.13 (1.34-3.40)	47	21	1.74 (1.01-3.02)
Systemic disease: Absence	154	108	1.00 (reference)	209	145	1.00 (reference)
Presence	83	58	1.00 (0.66-1.52)	111	83	0.93 (0.65-1.32)
Knowledge of 8020 campaign: Yes	84	58	1.00 (reference)	102	108	1.00 (reference)
No	133	94	0.98 (0.64-1.50)	150	144	1.10 (0.77-1.57)

Systematic disease: Diabetes mellitus, cardiovascular disease, stroke, cancer, and so on

8020 campaign: The 80 years old people should have more than 20 teeth

**Table 3** Adjusted odd ratios (ORs), and 95% confidence intervals (CIs) of having CPI  $\geq 3$  with multivariate logistic regression analysis in males and females

Variables	OR (95%CI)	<i>p</i> -value
Males		
Having a family dentist: Yes	1.00 (reference)	
No	2.52 (1.49-4.27)	< 0.001
Smoking status: Nonsmoker	1.00 (reference)	
Ex-smoker	1.94 (1.02-3.69)	0.043
Current smoker	1.57 (0.95-2.57)	0.077
Females		
Using a toothpaste: Regularly	1.00 (reference)	
Not regularly	1.43 (0.99-2.04)	0.053
Smoking status: Nonsmoker	1.00 (reference)	
Ex-smoker	1.07 (0.50-2.31)	0.856
Current smoker	1.66 (0.95-2.89)	0.073

with probing depth  $\geq 4$ mm (periodontal disease) among 4,484 Japanese employees aged 35-74 years old by multivariate analysis. Okamoto et al. (22) reported that in 1,332 Japanese males, smokers consuming more than 20 cigarettes per day showed significantly high ORs (2.16, 2.03 and 15.1 among the 30-39, 40-49 and 50-59 years old, respectively) compared with nonsmokers by a 4-yr longitudinal study. However, no significant association was found for ex-smokers in any age group. However this analysis was only adjusted for alcohol consumption. Yanagisawa et al. (23) reported that current smokers are more likely to have periodontitis compared to nonsmokers adjusted for age and oral health behavior. Adjusted ORs of subjects with periodontitis were significantly higher in current smokers who smoked 16 or more cigarettes per day than in those who had never smoked among 1,088 Japanese men aged 40-75 years. However, no significant association was found for former smokers. Ojima et al. (24) reported that current smoking was associated with higher prevalence of periodontitis and a more severe form of periodontitis among 3,493 Japanese adults aged over 40 years. However former smoking was not associated with prevalence of periodontitis.

In our study, having no family dentist was significantly associated with periodontal disease in males. Having an own family dentist lead to increases in opportunities to get early treatment. Pham et al. (18) reported that subjects who do not

frequently visit a dentist are more likely to have periodontal disease compared with those who often visit a dentist by multivariate analysis. Therefore having a family dentist is important for the prevention of periodontal disease.

In our research, not using toothpaste was associated with periodontal disease in females. Arweiler et al. (25) suggested that toothpaste containing an anti-inflammatory plant extract is able to significantly reduce the extent of gingivitis, plaque development and vital flora. Prevention of gingivitis leads to prevention of periodontal disease. Blinkhorn et al. (26) suggested that patients with the twice daily use of a triclosan copolymer toothpaste will gain clinically significant improvements in plaque control and gingivitis, benefiting from the slower progression of periodontal disease. We did not research content of the toothpaste. However, the current result may suggest that most toothpastes on the market in Japan contain antibacterial agents.

Pham et al. (18) reported that subjects who brushed their teeth only once a day were more likely to have periodontal disease compared with those who brushed their teeth more than or equal to twice a day by multivariate analysis. Ojima et al. (24) reported that subjects who brushed teeth less than twice a day were more likely to have periodontal disease compared with those who brushed teeth more than or equal to twice a day by multivariate analysis. Oshikohji et al. (20) reported that tooth brushing once a day was significantly

associated with the proportion of teeth with probing depth deeper than or equal to 4mm (periodontal disease) compared with tooth brushing more than or equal to twice a day by multivariate analysis. However, in our research, frequency of tooth brushing was not associated with periodontal disease either in males or females. Our result might be due to the control group who had dental problem such as dental calculus (61.2%) and gingival bleeding (24.4%).

There were some limitations in our study. First, our results clearly fail to identify the cause of periodontal disease as it is a cross-sectional study. Further study such as a cohort study is necessary to establish the relationship between periodontal disease and oral health behavior. Secondly, self-selection bias might exist in our study because relatively healthy subjects participated in a dental examination offered by the municipality.

In conclusion, this study suggests that there is a significant relationship between periodontal disease and oral health behavior such as having a family dentist, using toothpaste and smoking status.

### References

1. Ministry of Health, Labour and Welfare of Japan [homepage on the Internet]. Tokyo: The survey of dental disease in 2005; tp0129-1 [update 2007 January 19; cited 2011 June 13]. <http://www.mhlw.go.jp/topics/2007/01/> (in Japanese).
2. Yoshihara A, Watanabe R, Nishimuta M, Hanada N, Miyazaki H. The relationship between dietary intake and the number of teeth in elderly Japanese subjects. *Gerodontology* 2005; 22: 211-218.
3. Wakai K, Naito M, Naito T, Kojima M, Nakagaki H, Umemura O, Yokota M, Hanada N, Kawamura T. Tooth loss and intakes of nutrients and foods: a nationwide survey of Japanese dentists. *Community Dent Oral Epidemiol* 2010; 38: 43-49.
4. Nowjack-Raymer RE, Sheiham A. Number of natural teeth, diet, and nutritional status in US adults. *J Dent Res* 2007; 86 (12): 1171-1175.
5. Savoca MR, Arcury TA, Leng X, Chen H, Bell RA, Anderson AM, Kohrman T, Frazier RJ, Gilbert GH, Quandt SA. Severe tooth loss in older adults as a key indicator of compromised dietary quality. *Public Health Nutr* 2009; 13 (4): 466-474.
6. Sheiham A, Steele JG, Marcenes W, Lowe C, Finch S, Bates CJ, Prentice A, Walls AWG. The relationship among dental status, nutrient intake, and nutritional status in older people. *J Dent Res* 2001; 80 (2): 408-413.
7. Hung H-C, Colditz G, Joshupura KJ. The association between tooth loss and the self-reported intake of selected CVD-related nutrients and foods among US women. *Community Dent Oral Epidemiol* 2005; 33: 167-173.
8. Joshupura KJ, Willett WC, Douglass CW. The impact of edentulousness on food and nutrient intake. *J Am Dent Assoc* 1996; 127: 459-467.
9. Al-Zahrani MS, Bissada NF, Borawski EA. Obesity and periodontal disease in young, middle-aged, and older adults. *J Periodontol* 2003; 74: 610-615.
10. Saxlin T, Ylostalo P, Suominen-Taipale L, Mannisto S, Knuuttila M. Association between periodontal infection and obesity: results of the health 2000 survey. *J Clin Periodontol* 2011; 38: 236-242.
11. Khader YS, Bawadi HA, Haroun TF, Alomari M, Tayyem RF. The association between periodontal disease and obesity among adults in Jordan. *J Clin Periodontol* 2009; 36: 18-24.
12. Taiyeb-Ali TB, Cheta Raman RP, Vaithilingam RD. Relationship between periodontal disease and diabetes mellitus: an Asian perspective. *Periodontol* 2000 2011; 56: 258-268.
13. Demmer RT, Jacobs DR Jr, Desvarieux M. Periodontal disease and incident type 2 diabetes. *Diabetes Care* 2008; 31: 1373-1379.
14. Haynes WG, Stanford C. Periodontal disease and atherosclerosis from dental to arterial plaque. *Arterioscler Thromb Vasc Biol* 2003; 23: 1309-1311.
15. Joshupura KJ, Hung H-C, Rimm EB, Willett WC, Asherio A. Periodontal disease, tooth loss, and incidence of ischemic stroke. *Stroke* 2003; 34: 47-52.
16. Grau AJ, Becher H, Ziegler CM, Lichy C, Buggle F, Kaiser C, Lutz R, Bültmann S, Preusch M, Dörfer CE. Periodontal disease as a risk factor for ischemic stroke. *Stroke* 2004; 35: 496-501.
17. World Health Organization. Periodontal country profiles. [http://www.who.int/oral\\_health/databases/niigata/en/index.html](http://www.who.int/oral_health/databases/niigata/en/index.html)
18. Pham TAV, Ueno M, Shinada K, Yanagisawa T, Wright FAC, Kawaguchi Y. Periodontal disease and related factors among Vietnamese dental patients. *Oral Health Prev Dent* 2011; 9: 185-194.
19. Ogawa H, Yoshihara A, Hirotoomi T, Ando Y, Miyazaki H. Risk factors for periodontal disease progression among elderly people. *J Clin Periodontol* 2002; 29:

- 592-597.
20. Oshikohoji T, Shimazaki Y, Shinagawa T, Fukui N, Akifusa S, Hirata Y, Yamashita Y. Relationship between receiving a workplace oral health examination including oral health instruction and oral health status in the Japanese adult population. *J Occup Health* 2011; 53 (3): 222-229.
  21. Zee K-Y. Smoking and periodontal disease. *Aust Dent J* 2009; 54: S44-S50.
  22. Okamoto Y, Tsuboi S, Suzuki S, Nakagaki H, Ogura Y, Maeda K, Tokudome S. Effects of smoking and drinking habits on the incidence of periodontal disease and tooth loss among Japanese males: a 4-yr longitudinal study. *J Periodontal Res* 2006; 41 560-566.
  23. Yanagisawa T, Ueno M, Shinada K, Ohara S, Wright FAC, Kawaguchi Y. Relationship of smoking and smoking cessation with oral health status in Japanese men. *J Periodontal Res* 2010; 45: 277-283.
  24. 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: 573-579.
  25. Arweiler NB, Pergola G, Kuenz J, Hellwig E, Sculean A, Auschill TM. Clinical and antibacterial effect of an anti-inflammatory toothpaste formulation with *Scutellaria baicalensis* extract on experimental gingivitis. *Clin Oral Invest* 2011; 15: 909-913.
  26. Blinkhorn A, Bartold PM, Cullinan MP, Madden TE, Marshall RI, Raphael SL, Seymour GJ. Is there a role for triclosan/copolymer toothpaste in the management of periodontal disease? *Br Dent J* 2009; 207: 117-125.
- 
- Adress for correspondance:  
Yoshimi NAKAYAMA  
Hokkaido Tomakomai Public Health Center  
2-2-21 Wakakusa-cho, Tomakomai, 053-0021, Japan  
TEL: 0144-34-4168  
E-mail: nakayama.yoshimi@pref.hokkaido.lg.jp

## 日本の成人の歯周疾患と口腔保健行動との関連性

中山佳美<sup>1, 2)</sup>, 森 満<sup>2)</sup>

<sup>1)</sup> 北海道苫小牧保健所

<sup>2)</sup> 札幌医科大学医学部公衆衛生学講座

歯周疾患といくつかの全身疾患との関連性の根拠は、急激に増えている。しかしながら、歯周疾患と口腔保健行動及び口腔保健知識との関連性は、研究が少ない。この研究の目的は、歯周疾患と口腔保健行動及び口腔保健知識との関連性を調査することである。

対象は、北海道道東地域に居住する20歳以上の988人であった。調査項目は、年齢、性別、全身疾患の既往、喫煙状況、歯磨き回数、かかりつけ歯科医の有無等であった。CPI  $\geq 3$  と関連したオッズ比と95%信頼区間は、性別に口

ジスティック回帰分析を使用して求めた。過去喫煙者 (OR = 1.91, 95%CI: 1.03-3.51)、かかりつけ歯科医を持っている (OR = 2.51, 95%CI: 1.50-4.21) は、男性でCPI  $\geq 3$  と有意に関連性があった。歯磨き粉の不使用は、女性で、CPI  $\geq 3$  と関連性が境界値に近かった (OR = 1.43, 95%CI: 0.99-2.04)。

この研究は、口腔保健行動や喫煙が、有意に歯周疾患と関連性があることを示唆している。