Table 1.

Relationship Between Categories of Proportion of Teeth With BOP and Categories of Proportion of Teeth With PD ≥4 mm

Proportion of Teeth With PD ≥4 mm	Proportion of Teeth With BOP			
	<15% (n = 1,193)	≥15 to <30% (n = 418)	≥30% (n = 387)	*P*
0% (n = 1,036)	801	163	72	<0.001*
>0% to <10% (n = 480)	268	120	92	<0.001†
≥10% (n = 482)	124	135	223	

* Non-linear component calculated using Pearson χ^2 test.
† Linear component calculated using Mantel-Haenszel χ^2 test.

Table 2.

Relationship Between Saliva Occult Blood Test and Periodontal Status

Saliva Occult Blood Test	Periodontal Status		
	Poor*	Healthy†	Total
Positive	861	384	1,245
Negative	336	417	753
Total	1,197	801	1,998

* Proportion of teeth with BOP ≥15% or proportion of teeth with PD ≥4 mm >0%.
† Proportion of teeth with BOP <15% and proportion of teeth with PD ≥4 mm = 0%.

>40 years old.[8] These studies[5-8] did not examine the sensitivity or specificity of SOBT or the relationship between SOBT and the presence of deep periodontal pockets. Another SOBT showed a high sensitivity (75.9%) and specificity (90.5%) for >30% BOP in 50 patients at a university dental clinic after stimulation by sulcular toothbrushing for 1 minute; however, when using unstimulated saliva, the sensitivity decreased to 20.7%.[9] Toothbrushing before a screening test may be difficult in a large-scale health examination, and the definition of periodontal status in that study[9] did not evaluate the presence of deep periodontal pockets. In contrast, our results show that SOBT using an anti-human hemoglobin monoclonal antibody had a significant relationship with BOP and deep periodontal pockets and a certain level of effectiveness in screening periodontal status using unstimulated mouthwash saliva in a large-scale adult population.

Although the SOBT showed a relatively favorable sensitivity in identifying subjects suspected to have gingival inflammation, there appeared to be a substantial number of false-negative results. This indicated that it was difficult to discriminate subjects with periodontal problems by the SOBT alone. In contrast, because the specificity of the test is low, the use of the SOBT might lead to an overestimation of poor periodontal status. The low specificity has several possible causes. Our periodontal examination assessed the mesio-buccal and mid-buccal sites of each tooth. Because deep periodontal pockets are more common at lingual sites than buccal sites,[24] our examination technique might have underestimated the periodontal parameters and, thus, negatively affected the specificity. Because antihypertensive medication and diabetic treatment influenced the SOBT, the presence of hypertension and/or diabetes may promote inflammation of gingival tissue.[25,26] Because the number of DF teeth was also associated with the SOBT, poor oral hygiene due to more caries and restorations, may affect the occult blood reaction. Additionally, it is possible that other factors, such as toothbrushing shortly before examination, recent dental treatment such as tooth extraction or periodontal treatment, and the use of anticoagulant agents, may increase the number of false-positive subjects, although we could not confirm these factors.

According to the Survey of Dental Disease[27] carried out by the Japanese Ministry of Health, Labor, and Welfare in 2005, the proportion of subjects with PD ≥4 mm based on the CPI was ≈50% in dentate adults aged 40 to 79 years, which was similar to the proportion in the present study. The purpose of this study was to examine the effectiveness of the SOBT as a screening method for periodontal status in a community-based health examination. Considering the high proportion of subjects with deep periodontal pockets and the low proportion of subjects undergoing routine dental checkups,[3] it may be desirable to pick out subjects with periodontal problems by using a sensitive test. The reasons found in previous studies[28-30] for low dental use are wide ranging. In Japan, regular visits to a dentist were associated with the type of household and attention to diet in an adult

Table 3.

Effect of Periodontal Parameters and Other Variables on Saliva Occult Blood Test in Logistic Regression Analysis

	Saliva Occult Blood Test		Dependent Variable: Saliva Occult Blood Test (negative = 0; positive = 1)			
Independent Variable	Negative (n = 753)	Positive (n = 1,245)	Crude OR (95% CI)	*P*	Multivariate OR (95% CI)	*P*
Proportion of teeth with BOP						
<15%	550	643	1		1	
≥15% to <30%	129	289	1.92 (1.51 to 2.43)	<0.001	1.45 (1.13 to 1.86)	0.004
≥30%	74	313	3.62 (2.74 to 4.48)	<0.001	2.16 (1.58 to 2.94)	<0.001
Proportion of teeth with PD ≥4 mm						
0%	503	533	1		1	
>0% to <10%	165	315	1.80 (1.44 to 2.26)	<0.001	1.41 (1.11 to 1.78)	0.005
≥10%	85	397	4.41 (3.39 to 5.74)	<0.001	2.71 (2.01 to 3.64)	<0.001
Sex (n)						
Female	478	632	1		1	
Male	275	613	1.69 (1.40 to 2.03)	<0.001	1.51 (1.23 to 1.84)	<0.001
Smoking habit (n)						
Never smoker	464	678	1			
Former smoker	135	303	1.54 (1.22 to 1.94)	<0.001		
Current smoker	154	264	1.17 (0.93 to 1.48)	0.176		
Fasting plasma glucose level						
<110 mg/dl	623	935	1			
≥110 mg/dl	130	310	1.59 (1.26 to 2.00)	<0.001		
Use of antihypertensive medication						
Negative	624	876	1		1	
Positive	129	369	2.04 (1.63 to 2.55)	<0.001	1.46 (1.13 to 1.88)	0.003
Use of lipid-lowering medication						
Negative	670	1,066	1			
Positive	83	179	1.36 (1.03 to 1.79)	0.032		
Use of antidiabetic agent or insulin therapy						
Negative	730	1,146	1		1	
Positive	23	99	2.74 (1.73 to 4.36)	<0.001	1.82 (1.11 to 2.96)	0.017
Age (years; median)	56	59	1.03 (1.02 to 1.04)	<0.001	1.02 (1.01 to 1.03)	0.002
Number of teeth (median)	27	26	0.91 (0.88 to 0.94)	<0.001		
Number of DF teeth (median)	15	16	1.02 (1.00 to 1.04)	0.028	1.02 (1.00 to 1.04)	0.024

OR = odds ratio; CI = confidence interval.

population[29] and with a higher number of remaining teeth, younger age, presence of systemic disease, absence of depressive symptoms, and higher education attainment in a ≥70-year-old population.[30] In the United States,[28] infrequent dental checkups were associated with being male, having a low income, not having a regular place for dental care, and being anxious about receiving dental care. A previous study[31] found that subjects who did not visit a dentist for routine dental checkups had poor self-perceived oral health. An oral-health examination as part of a routine physical checkup in communities and workplaces may be effective in increasing dental use. Conducting a screening test such as SOBT as a substitute for a periodontal examination might be a way to inform people about their periodontal status and could trigger individuals to visit dental clinics.

This study has several limitations. The partial periodontal examination that probed only buccal sites was insufficient as a gold-standard procedure for determining periodontal condition. Thus, our results may have underestimated the presence of BOP and deep PDs,[24] and this might have elevated the incidence of false-positive subjects and affected the low specificity of SOBT. The definition of poor periodontal status in this study was very broad to pick out many people with symptoms of inflamed periodontal tissue by using a simple SOBT. If more specific and sensitive tests were used, a multilevel definition of periodontal status would have been desirable. Although males showed a greater tendency toward a positive SOBT than females, the cause remains unknown. Comparing saliva sampling by mouthrinsing with sampling using resting saliva may provide useful information. Because we determined the relationship between SOBT and periodontal status using cross-sectional findings, we could not determine the ability of SOBT to detect risks that suggest the future progression of periodontal disease. Finally, the effectiveness of SOBT may differ among target populations with a varying prevalence of periodontal disease.

CONCLUSIONS

This study shows that SOBT using an anti-human hemoglobin monoclonal antibody may have advantages in identifying subjects suspected of having periodontal problems, although the specificity and sensitivity of SOBT were not very high. However, when a thorough periodontal examination is not possible in a community-based health examination, SOBT may offer a simple screening method for periodontal status and may contribute to increased awareness about oral health and encourage regular dental visits. SOBT can be easily conducted at a low cost; using this test for screening periodontal conditions in school children may be valuable in dental-health education.

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Field Study

Relationship between Receiving a Workplace Oral Health Examination Including Oral Health Instruction and Oral Health Status in the Japanese Adult Population

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Abstract: Relationship between Receiving a Workplace Oral Health Examination Including Oral Health Instruction and Oral Health Status in the Japanese Adult Population: Tadaaki OSHIKOHJI, *et al.* Section of Preventive and Public Health Dentistry, Division of Oral Health, Growth and Development, Kyushu University Faculty of Dental Science—Objectives: Dental caries and periodontal disease are highly prevalent in the Japanese adult population. Oral examination is an effective method to find various oral health problems in their early stages. However, workplace oral examination is not common in Japan. The purpose of this study was to examine the relationship between receiving workplace oral health examination, including oral health instruction, and oral health status in the Japanese adult population. **Methods:** This study was performed using data from 4,484 Japanese employees aged 35–74 yr. The proportion of teeth with a probing depth (PD) ≥4 mm and the number of decayed teeth were used for periodontal disease and dental caries parameters. The subjects were asked by questionnaire about past experiences with workplace oral health examination. **Results:** The subjects who received a workplace oral health examination every year had better periodontal health status than those receiving an examination for the first time. The odds ratio for having ≥10% of teeth with PD ≥4 mm in the subjects who received workplace oral health examination every year was 0.63 ($p<0.05$) after adjustment for age, sex, smoking habits, tooth-brushing habits, routine visits to dental clinics, number of missing teeth, and oral hygiene status, in a multivariate, multinomial logistic regression analysis. On the other hand, no significant relationship was found between workplace oral health examination and number of decayed teeth. **Conclusions:** These results suggest that workplace oral health examination accompanied by oral health instruction may be effective for maintenance of periodontal health.
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Key words: Dental caries, Oral health examination, Periodontal disease, Workplace

Dental caries and periodontal disease are highly prevalent in the Japanese adult population[1]. However, these diseases develop gradually without obvious symptoms such as pain in their early stage. Also, it is sometimes too late to treat periodontal disease by the time that the patient realizes the condition by him/herself.

Oral examination is an effective method to find various oral health problems in their early stages. The United States National Health Interview Survey[2] had found that 67.5% of respondents aged ≥25 yr had visited a dentist in the preceding year. According to the report of the Ministry of Health, Labour and Welfare of Japan, only 32.7% of Japanese adults aged ≥20 yr received oral examinations in 2004[3], and ≥90% of these subjects received these examinations in dental clinics; very few people received oral examinations in local communities or in the workplace[3]. Therefore, it would appear that oral examinations and routine visits to dental clinics are much less common in the Japanese adult population.

In Japan, business owners are required to conduct an annual general health examination for employees for health maintenance. Concerning oral health, the law

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requires business owners to conduct an oral examination for specific workers who handle acid in the workplace. On the other hand, as oral examinations for workers in general workplaces are conducted based on employer voluntarism, few companies provide workplace oral examination. Recent studies have suggested that periodontal disease might affect systemic health status with respect to conditions such as diabetes, cardiovascular disease, and metabolic syndrome[4–7]. Therefore, maintaining good oral health of employees may contribute to good systemic health.

In this study, the relationship between workplace oral health examination, including oral health instruction, and oral health status was analyzed using data from a company that provides an annual oral health examination.

Subjects and Methods

From April 2008 to March 2009, 15,338 employees (12,023 male and 3,315 female, 28–74 yr of age) received a workplace general health examination at a company in Japan. Since 2003, an oral health examination with oral health instruction has been conducted for employees who wished to receive it as an optional part of the general health examination. In fiscal year 2008, 5,637 subjects (36.8% of 15,338 employees) received a workplace oral health examination. Most of them had been working at the company since 2003, but we did not confirm their length of service at the company.

Each subject received an oral health examination that evaluated tooth condition, periodontal condition, and oral hygiene status in a supine position under sufficient artificial light in a normal dental chair. The numbers of decayed, missing, and filled teeth was used as an index of tooth condition. Teeth that required dental treatment due to caries were defined as decayed. We examined periodontal condition based on the method of the Third National Health and Nutrition Examination Survey[8]. Trained dentists performed a periodontal examination using a periodontal probe (PCP11; Hu-Friedy, Chicago, IL, USA) and examined probing depth (PD), which represents the current status of periodontal disease, and clinical attachment loss, which represents past history of periodontal disease, on the mesiobuccal and midbuccal sites of all retained teeth, with the exception of the third molars. PD ≥4 mm is often used as an indicator of periodontitis because it generally requires specialized periodontal treatment. Oral hygiene status was evaluated by the Simplified Debris Index (DI-S), which calculates the tooth surface area with dental plaque according to the Simplified Oral Hygiene Index[9]. The subjects received oral health instruction from a dental hygienist shortly after the oral examination.

Subjects who received a workplace oral health examination in 2008 were given a questionnaire survey asking about their experiences with examinations in previous years, and routine visits to dental clinics on their own such as for periodontal maintenance therapy. To indicate their previous experience receiving workplace oral health examination, the subjects chose one of three options: first time, sometimes, and every year. For routine visits to dental clinics, the subjects chose one of four options: never, once yearly, twice yearly, and ≥3 times yearly. The proportion of subjects who visited dental clinics ≥3 times/yr was low; therefore, we combined the two categories of twice yearly and ≥3 times yearly into one, ≥2 times/yr. There were 4,556 subjects who completed the questionnaire among the subjects who received a workplace oral health examination (collection rate: 80.8%). The workplace oral health examination included questions about current smoking and tooth-brushing habits. Former smokers were included among nonsmokers.

The present study included 4,484 subjects (3,449 male, 1,035 female) aged 35–74 yr who had sufficient data for analysis. Written informed consent was obtained from each subject, and the ethics committee of the Kyushu University Faculty of Dental Science approved the study design, data collection methods, and procedure for obtaining informed consent.

The subjects were divided into four age groups: 35–44, 45–54, 55–64, and 65–74 yr. Groups were designated according to the proportion of teeth with PD ≥4 mm as follows: 0% (N=3,484, 77.7%), 0.1–9.9% (N=767, 17.1%), and ≥10% (N=233, 5.2%). The categorization of the number of decayed teeth resulted in the following groups: 0 (N=3,610, 80.5%), 1 (N=579, 12.9%), and ≥2 (N=295, 6.6%). The number of missing teeth, excluding third molars, was divided into three categories: 0 (N=3,062, 68.3%), 1–3 (N=1,184, 26.4%), and ≥4 (N=238, 5.3%). Oral hygiene status was divided into two categories according to the DI-S score: good, <0.5 (N=2,696, 60.1%), or poor, ≥0.5 (N=1,788, 39.9%). The relationship between receiving a workplace oral health examination and other variables was evaluated with Pearson's χ^2 test, and linearity was evaluated with the Mantel-Haenszel χ^2 test.

Bivariate and multivariate, multinomial logistic regression analyses were performed to examine the relationship between receiving a workplace oral health examination and other variables, with the proportion of teeth with PD ≥4 mm and the number of decayed teeth as dependent variables, and the odds ratio (OR) and 95% confidence interval (CI) were calculated. Age, sex, smoking habits, tooth-brushing habits, receipt of a workplace oral health examination, routine visits to dental clinics, number of missing teeth, and oral hygiene status were used as independent variables. $p<0.05$ was deemed to indicate statistical significance. The statistical analyses were performed using SPSS version 17.0 (SPSS Japan, Tokyo, Japan).

Table 1. Relationship between receiving a workplace oral health examination and other variables

Variable	Receiving workplace oral health examination: First time (N=394)	Sometimes (N=1,238)	Every year (N=2,852)	*p* value
		N (%)		
Age (yr)				
35–44	181 (45.9)	612 (49.4)	1,782 (62.5)	<0.001 [a]
45–54	94 (23.9)	345 (27.9)	623 (21.8)	<0.001 [b]
55–64	82 (20.8)	218 (17.6)	332 (11.6)	
65–74	37 (9.4)	63 (5.1)	115 (4.0)	
Sex				
Female	146 (37.1)	306 (24.7)	583 (20.4)	<0.001 [a]
Male	248 (62.9)	932 (75.3)	2,269 (79.6)	<0.001 [b]
Smoking habits				
Nonsmoker	265 (67.3)	856 (69.1)	1,978 (69.4)	0.700 [a]
Smoker	129 (32.7)	382 (30.9)	874 (30.6)	0.480 [b]
Tooth-brushing habits				
Once/day	96 (24.4)	303 (24.5)	656 (23.0)	0.053 [a]
Twice/day	222 (56.3)	684 (55.3)	1,513 (53.1)	0.015 [b]
≥3 times/day	76 (19.3)	251 (20.3)	683 (23.9)	
Routine visits to dental clinics				
Never	264 (67.0)	767 (62.0)	1,467 (51.4)	<0.001 [a]
Once/yr	73 (18.5)	335 (27.1)	924 (32.4)	<0.001 [b]
≥2 times/yr	57 (14.5)	136 (11.0)	461 (16.2)	
Number of missing teeth				
0	239 (60.7)	796 (64.3)	2,027 (71.1)	<0.001 [a]
1–3	112 (28.4)	367 (29.6)	705 (24.7)	<0.001 [b]
≥4	43 (10.9)	75 (6.1)	120 (4.2)	
Oral hygiene status				
Good	211 (53.6)	722 (58.3)	1,763 (61.8)	0.002 [a]
Poor	183 (46.4)	516 (41.7)	1,089 (38.2)	0.001 [b]
PD ≥4 mm				
0%	295 (74.9)	942 (76.1)	2,247 (78.8)	0.004 [a]
0.1–9.9%	65 (16.5)	224 (18.1)	478 (16.8)	0.001 [b]
≥10%	34 (8.6)	72 (5.8)	127 (4.5)	
Number of decayed teeth				
0	311 (78.9)	994 (80.3)	2,305 (80.8)	0.101 [a]
1	50 (12.7)	149 (12.0)	380 (13.3)	0.085 [b]
≥2	33 (8.4)	95 (7.7)	167 (5.9)	

[a] Nonlinear component calculated using Pearson's χ^2 test. [b] Linear component calculated using Mantel-Haenszel χ^2 test.

Results

In this study, more than half of the subjects were 35–44 yr old. The subjects' brushing habits were similar to the results of the Survey of Dental Disease in Japan in 2005[1]. On the other hand, the proportions of the subjects with PD ≥4 mm or with decayed teeth were lower than in the national survey.

Table 1 shows the relationship between receiving a workplace oral health examination and other variables. The younger and male subjects received a workplace oral health examination more frequently than their older and female counterparts. The subjects who brushed their teeth and visited dental clinics more frequently tended to receive a workplace oral health examination. Also, the subjects who received a workplace oral health examination more frequently had fewer missing teeth, a better oral hygiene status, and fewer teeth with PD ≥4 mm (Table 1).

The relationship between the proportion of teeth with PD ≥4 mm and other variables was analyzed using multinomial logistic regression analyses (Table 2). In univariate and multivariate analyses, all independent

variables, i.e., age, sex, smoking habits, tooth-brushing habits, receipt of a workplace oral health examination, routine visits to dental clinics, number of missing teeth, and oral hygiene status, were significantly associated with the proportion of teeth with PD ≥4 mm. The older subjects, men, smokers, those with more missing teeth, and those with a poor oral hygiene status had significantly higher ORs for having 0.1–9.9% or ≥10% of teeth with PD ≥4 mm in the multivariate analysis. The subjects who received a workplace oral health examination every year and those who brushed their teeth ≥3 times per day had significantly lower ORs for having ≥10% of teeth with PD ≥4 mm. The subjects who visited dental clinics ≥2 times yearly had higher ORs for having ≥10% of teeth with PD ≥4 mm (Table 2).

Table 3 shows the relationship between the number of decayed teeth and other variables. Age, sex, smoking habits, tooth-brushing habits, routine visits to dental clinics, and oral hygiene status were significantly associated with the number of decayed teeth in the univariate analysis. In the multivariate analysis, smokers and subjects with a poor oral hygiene status had significantly higher ORs for having ≥2 decayed teeth, whereas the subjects who brushed their teeth and visited dental clinics with greater frequency had significantly lower ORs for having decayed teeth (Table 3). There was no significant relationship between receiving a workplace oral health examination and the number of decayed teeth.

Discussion

This study examined the relationship between receiving a workplace oral health examination accompanied by oral health instruction and oral health status in a company in Japan. The results demonstrated that the subjects who received an annual workplace oral health examination had a significantly lower risk for having teeth with deep periodontal pockets than did the subjects who received an oral health examination for the first time. In the present workplace oral health examination, the subjects received oral health instruction from a dental hygienist shortly after a dentist pointed out their oral problems, such as dental caries and periodontal disease. It has been reported that follow-up intervention of tooth brushing in the workplace is effective in improving periodontal health[10]. Some studies have reported that workplace dental programs improve periodontal conditions[11, 12]. The oral health instruction that followed the oral examination could have improved oral hygiene habits and status. In fact, in this study, workplace oral health examination was significantly associated with frequent tooth brushing and good oral hygiene status. On the other hand, the relationship between workplace oral health examination and periodontal status was independent of tooth-brushing habits, oral hygiene status, and other confounding variables in the multivariate analysis. An annual oral health examination accompanied by oral health instruction might have some beneficial effects on periodontal health status *per se*. On the other hand, the subjects who visited dental clinics frequently had a poorer periodontal health status. This indicates that the subjects with advanced periodontal disease visited dental clinics frequently for periodontal treatment and maintenance therapy.

As for dental caries, no significant relationship between receiving a workplace oral health examination and the number of decayed teeth was found. On the other hand, the subjects who visited dental clinics regularly had a markedly lower risk for having decayed teeth. These results suggest that routine dental visits lead to early treatment of decayed teeth, but that receipt of a workplace oral health examination did not always trigger a visit to a dental clinic. Therefore, it is necessary to offer thorough health guidance about dental caries to subjects in whom decayed teeth are detected by a workplace oral health examination.

Smoking is one of the most important risk factors for periodontal disease[13, 14]. In this study, subjects who smoked had a significantly higher risk not only for having deep periodontal pockets, but also for having decayed teeth, compared with nonsmoking subjects. Although no significant difference in receiving workplace oral health examinations was found between smokers and nonsmokers, smokers brushed their teeth less frequently than nonsmokers (data not shown). A previous study reported that current smokers accrue significantly higher annual dental care costs than never-smokers and past smokers[15]. A lack of interest in oral hygiene in smokers may lead to deterioration of oral conditions, which increases dental care costs. Therefore, persistent persuasion by dental specialists is necessary to convince smokers to have an interest in their oral health and receive dental treatment. Also in this study, tooth-brushing habits and oral hygiene status were significantly associated with periodontal disease and dental caries that required treatment. Therefore, to improve the oral health status of employees, it would be useful for them to receive instruction about quitting smoking and oral hygiene through a workplace oral health examination.

Hypothetically speaking, if most people visited dental clinics regularly, oral examinations in communities or workplaces would not be necessary. However, actual dental service utilization in Japanese adults is low[3]. A previous study has shown that infrequent dental checkups are associated with being male, lower income, not having a usual place of care, and being anxious about receiving dental care[16], therefore, it is not realistic to expect that everyone will visit dental clinics on their own initiative. Oral health examinations for the adult population have important dental health implications and may be especially valuable for people who lack interest in oral health. Our

Table 2. Relationship between proportion of teeth with PD ≥4 mm and other variables by multinomial logistic regression analyses

Independent variable	Proportion of teeth with PD ≥4 mm			Dependent variable: proportion of teeth with PD ≥4 mm			
				0.1–9.9% vs. 0%		≥10% vs. 0%	
	0% (N=3,484)	0.1–9.9% (N=767)	≥10% (N=233)	Crude OR (95% CI)	Multivariate OR (95% CI)	Crude OR (95% CI)	Multivariate OR (95% CI)
Age (yr)							
35–44	2,076	405	94	1	1	1	1
45–54	817	187	58	1.17 (0.97–1.42)	1.14 (0.93–1.39)	1.57 (1.12–2.20)**	1.39 (0.98–1.99)
55–64	452	122	58	1.38 (1.10–1.74)**	1.34 (1.04–1.72)*	2.83 (2.01–3.99)**	2.37 (1.59–3.54)**
65–74	139	53	23	1.95 (1.40–2.73)**	1.85 (1.28–2.66)**	3.65 (2.25–5.95)**	2.74 (1.56–4.83)**
Sex							
Female	891	124	20	1	1	1	1
Male	2,593	643	213	1.78 (1.45–2.19)**	1.51 (1.21–1.88)**	3.66 (2.30–5.82)**	2.73 (1.67–4.44)**
Smoking habits							
Nonsmoker	2,480	500	119	1	1	1	1
Smoker	1,004	267	114	1.32 (1.12–1.56)**	1.21 (1.02–1.44)*	2.37 (1.81–3.09)**	2.07 (1.56–2.76)**
Tooth-brushing habits							
Once/day	760	212	83	1	1	1	1
Twice/day	1,877	424	118	0.81 (0.67–0.98)*	0.92 (0.76–1.12)	0.58 (0.43–0.77)**	0.77 (0.56–1.04)
≥3 times/day	847	131	32	0.55 (0.44–0.70)**	0.72 (0.56–0.94)*	0.35 (0.23–0.53)**	0.59 (0.37–0.94)*
Workplace oral health examination							
First time	295	65	34	1	1	1	1
Sometimes	942	224	72	1.08 (0.80–1.47)	1.13 (0.82–1.54)	0.66 (0.43–1.02)	0.75 (0.47–1.18)
Every year	2,247	478	127	0.97 (0.73–1.29)	1.06 (0.79–1.43)	0.49 (0.33–0.73)**	0.63 (0.41–0.97)*
Routine visits to dental clinics							
Never	1,927	443	128	1	1	1	1
Once/yr	1,058	217	57	0.89 (0.75–1.07)	0.94 (0.78–1.13)	0.81 (0.59–1.12)	0.97 (0.69–1.36)
≥2 times/yr	499	107	48	0.93 (0.74–1.18)	0.99 (0.77–1.27)	1.45 (1.03–2.05)*	1.77 (1.19–2.62)**
Number of missing teeth							
0	2,451	494	117	1	1	1	1
1–3	885	211	88	1.18 (0.99–1.41)	1.06 (0.88–1.28)	2.08 (1.56–2.78)**	1.54 (1.13–2.11)**
≥4	148	62	28	2.08 (1.52–2.84)**	1.73 (1.24–2.43)**	3.96 (2.54–6.18)**	2.15 (1.29–3.58)**
Oral hygiene status							
Good	2,237	390	69	1	1	1	1
Poor	1,247	377	164	1.73 (1.48–2.03)**	1.60 (1.36–1.88)**	4.26 (3.19–5.70)**	3.81 (2.82–5.16)**

* and **: $p<0.05$ and $p<0.01$, respectively.

Table 3. Relationship between number of decayed teeth and other variables by multinomial logistic regression analyses

Independent variable	Number of decayed teeth			Dependent variable: number of decayed teeth			
				1 vs. 0		≥2 vs. 0	
	0 (N=3,610)	1 (N=579)	≥2 (N=295)	Crude OR (95% CI)	Multivariate OR (95% CI)	Crude OR (95% CI)	Multivariate OR (95% CI)
Age (yr)							
35–44	2,035	348	192	1	1	1	1
45–54	864	135	63	0.91 (0.74–1.13)	0.97 (0.78–1.21)	0.77 (0.58–1.04)	0.78 (0.57–1.07)
55–64	531	70	31	0.77 (0.59–1.01)	0.93 (0.69–1.26)	0.62 (0.42–0.92)*	0.76 (0.49–1.17)
65–74	180	26	9	0.85 (0.55–1.29)	1.10 (0.69–1.74)	0.53 (0.27–1.05)	0.72 (0.34–1.53)
Sex							
Female	884	112	39	1	1	1	1
Male	2,726	467	256	1.35 (1.09–1.68)**	1.02 (0.80–1.29)	2.13 (1.51–3.01)**	1.41 (0.97–2.04)
Smoking habits							
Nonsmoker	2,561	378	160	1	1	1	1
Smoker	1,049	201	135	1.30 (1.08–1.56)**	1.13 (0.93–1.37)	2.06 (1.62–2.62)**	1.57 (1.22–2.02)**
Tooth-brushing habits							
Once/day	775	169	111	1	1	1	1
Twice/day	1,957	320	142	0.75 (0.61–0.92)**	0.86 (0.69–1.06)	0.51 (0.39–0.66)**	0.68 (0.52–0.90)**
≥3 times/day	878	90	42	0.47 (0.36–0.62)**	0.61 (0.45–0.82)**	0.33 (0.23–0.48)**	0.66 (0.44–0.98)*
Workplace oral health examination							
First time	311	50	33	1	1	1	1
Sometimes	994	149	95	0.93 (0.66–1.32)	0.98 (0.69–1.39)	0.90 (0.59–1.37)	0.96 (0.62–1.47)
Every year	2,305	380	167	1.03 (0.75–1.41)	1.18 (0.85–1.64)	0.68 (0.46–1.01)	0.80 (0.53–1.21)
Routine visits to dental clinics							
Never	1,857	397	244	1	1	1	1
Once/yr	1,153	137	42	0.56 (0.45–0.68)**	0.59 (0.48–0.73)**	0.28 (0.20–0.39)**	0.34 (0.24–0.48)**
≥2 times/yr	600	45	9	0.35 (0.25–0.48)**	0.39 (0.28–0.54)**	0.11 (0.06–0.22)**	0.16 (0.08–0.31)**
Number of missing teeth							
0	2,470	396	196	1	1	1	1
1–3	950	153	81	1.01 (0.82–1.23)	1.05 (0.85–1.30)	1.07 (0.82–1.41)	1.15 (0.86–1.54)
≥4	190	30	18	0.99 (0.66–1.47)	1.20 (0.78–1.85)	1.19 (0.72–1.98)	1.70 (0.97–2.99)
Oral hygiene status							
Good	2,294	297	105	1	1	1	1
Poor	1,316	282	190	1.66 (1.39–1.98)**	1.45 (1.21–1.74)**	3.15 (2.46–4.04)**	2.43 (1.88–3.14)**

* and **: $p<0.05$ and $p<0.01$, respectively.

study showed that a workplace oral health examination including oral health instruction might have a certain suppressive effect on periodontal disease. Therefore, conducting a workplace oral health examination might play a role in encouraging employees to visit dental clinics and increasing their awareness of oral health.

In a study of medical care costs in an occupational population, dental and medical healthcare costs for subjects with severe periodontitis were higher than those for subjects with no pathological pocketing[17]. It has been reported that oral health promotion programs in the workplace contribute to saving dental care costs[18] and are cost-beneficial for employers[19]. Therefore, heightening consciousness about oral health by oral health examination among the adult population may contribute to oral as well as systemic health and consequently may help to reduce dental and medical care costs. As the present study did not contain data about healthcare costs, further studies to clarify the relationship between workplace oral health examination and healthcare costs would be useful.

There were several limitations in this study. Study subjects were asked about their past experiences with workplace oral health examinations and visiting dental clinics by questionnaire; thus, there could have been some bias caused by a misunderstanding on their part. This study examined the oral health status only of the subjects who received a workplace oral health examination, and that of subjects who did not receive such an examination remains uncertain. A previous study has found that subjects who do not visit a dentist for routine checkups have poor self-perceived oral health[20]. There is a possibility that the subjects who did not receive a workplace oral health examination and regular dental checkups in clinics might have had a poorer oral health status. It would be important to determine the oral health status of subjects who have not had any dental checkups. In mass screening, the Community Periodontal Index[21] is often used as a partial periodontal examination method. Although we examined all remaining teeth except for third molars to screen for periodontal disease, our method was also a type of partial periodontal examination and underestimated the proportion of subjects with periodontal disease[22]. However, it would be difficult to conduct an exact periodontal examination due to time and personnel constraints in the workplace and community. In this study, the subjects were from one company and were predominantly male. In future studies, it would be desirable to investigate the relationship between receiving an oral health examination and oral health status in other occupational fields whose company sizes and personnel profiles are different from those in the present study and in communities.

In conclusion, it would appear that a workplace oral health examination including oral health instruction might have an effect on maintenance of periodontal health status. It is important to promote public awareness of oral health examination and oral health instruction in the adult population by accumulating the results of studies that show sufficient evidence of the relationship. The popularization of oral examination and health instruction may have a favorable impact on maintenance of oral health status and improvement in quality of life.

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Ⅱ. 歯

5. 歯周病とメタボリックシンドローム

Association between periodontal diseases and metabolic syndrome

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我々は歯周病とメタボリックシンドロームとの関連性に着目して，両者の関連性を久山町コホート研究の対象者について調べてみた．その結果，メタボリックシンドロームの陽性項目数が増えるに従い歯周病患者の割合が段階的に増加し，メタボリックシンドロームの項目が4つ以上陽性になると，陽性項目が全くない健常者に比べ6.6倍も歯周病患者が増えていた．さらに2010年，歯周病がメタボリックシンドロームを悪化させることを示唆するコホート疫学研究が報告されており，歯周病患者ではメタボリックシンドロームになりやすい，あるいは悪化しやすいと考えられる．

key words

歯周病
メタボリックシンドローム
耐糖能
肥満
生活習慣病

はじめに

歯周病はう蝕(むし歯)と並ぶ歯科の二大疾患の一つであり，歯科医学の中で重要な位置を占める疾患であるが，一般にはその重要性が十分に認識されていないように思われる．たとえば，幼児のう蝕予防を中心として普及してきた1歳6ヵ月児歯科健診や3歳児歯科健診の受診率は，2008年度でそれぞれ92.6%と89.8%と極めて高い値を示すのに対し，成人を対象とした歯周病の検診の受診率はいまだに数%台にとどまっていることをみれば，そのことは火をみるより明らかである．確かに，1961年に開始された3歳児歯科健診や，1977年に開始された1歳6ヵ月児歯科健診に比べ，歯周病の検診の歴史が浅いことがその低受診率の原因となっている事実は否めない．しかし，老人保健法に基づく老人保健事業の一環として2000年に40歳および50歳の者を対象とした歯周病検診が開始されて以来，検診対象年齢層の拡充などの手が打たれて検診者数は増加してはいるものの，10年が過ぎた現在でも受診率はさほど変化していないのが実状である．さらに老人保健法が廃止され，2008年からは歯周病の検診は新しく健康増進事業に組み入れられたが，検診を継続するための財源の担保は十分とはいえず，今後の各市町村における検診の継続性も不透明な状況である．テレビでは歯周病予防を目的とした歯磨き剤や洗口剤のコマーシャルが放映され，歯周病の脅威が日々訴えられているが，前述のように歯周病検診の受診率が一向に向上しない現状では，実際に国民の心にどの程度響いているのかは今ひとつ定かではない．

本稿では，歯周病と近年メタボ検診として注目されているメタボリックシンドロームとの関連性に焦点をあて，読者にこれからの歯科医療において歯周病対策がいかに重要であるかを認識していただく契機としたい．

歯周病と全身疾患

古くから局所の慢性炎症が全身の健康に影響を及ぼすことが少なからず認識されており，1900年には英国のW. Hunterが歯科の慢性炎症が原病巣となり遠隔の組織に炎症性の疾患を惹起

する可能性を“Oral Sepsis（口腔敗血症）”として提唱した[1]．この提唱には賛否両論があったが，米国のF. BillingらはW. Hunterの考えを裏付ける研究を進め，“Focal Infection（病巣感染）”という概念を確立した[2]．歯科医療における病巣感染の考え方は特に歯性病巣感染として取り上げられた．その歴史的変遷については最近，秀逸な総説[3]が報告されているので詳細についてはその総説に譲るが，歯性病巣感染という考え方はある意味で保存的な歯科医療を否定する側面もあり，ややもすると抜歯優先の考え方に偏向しかねない危惧もあったようである．この辺りに，歯性病巣感染の概念が歯科界で十分に成熟してこなかった理由があるのかもしれない．しかし，1980年代になると歯周病が特異的な細菌の感染症であるとする考え方が広まるとともに，歯周病細菌の研究が飛躍的な進歩を遂げ，これらの細菌が全身に及ぼす影響についても科学的な根拠が示されるようになった．

さらに1990年代に入り，数々の疫学研究によって口腔の健康と全身の健康との関連性が明らかにされて，かつての歯性病巣感染を連想させる概念が復活し，その妥当性が見直された．その結果，米国から，歯周病が虚血性心疾患，低体重児出産，呼吸器系疾患，糖尿病などの全身の健康に影響するとする“Periodontal Medicine”の概念が提唱され，その後も口腔保健が全身の健康の維持・増進に大きく寄与することを示す多数の疫学研究が続々と報告されている．このようななか，米国のHealthy People 2000，同2010や，わが国の健康日本21[4]でも口腔保健が単に口腔の健康維持にとどまらず，健康寿命の延伸のために重要であることが謳われている．この Periodontal Medicine の考え方で興味深い点は，かつての病巣感染から波及する二次疾患には主に炎症に関連した疾患が並んでいたのに対し，この新しい概念では直接炎症に関連しない糖尿病や虚血性心疾患などの生活習慣病に歯周病が関連するとしたことである．

メタボリックシンドローム

先進諸国の健康問題はかつての感染症から，心疾患，脳卒中，悪性新生物などの生活習慣関連病に移行しており，なかでも心疾患や脳卒中の多くは動脈硬化症が原因となっている．メタボリックシンドロームは，生活習慣病に関連する肥満，耐糖能異常，脂質異常症，高血圧などの重複によって動脈硬化症を発症するリスクが増大する事実に基づいて提唱された概念である．わが国では，2005年4月に8つの学会の合意に基づき，内臓脂肪蓄積（内臓脂肪面積100cm^{2}以上）の代替マーカーとして，腹囲が男性で85cm，女性で90cm以上であることを必須項目とし，かつ①血清脂質異常（トリグリセリド値150mg/dL以上，またはHDL-コレステロール値40mg/dL未満），②血圧高値（最高血圧130mmHg以上，または最低血圧85mmHg以上），③高血糖（空腹時血糖値110mg/dL以上）の3項目のうち2項目以上を満たす場合をメタボリックシンドロームとした．同じく2005年に，国際糖尿病学会（IDF）から提唱された基準はわが国の基準と同様に腹囲を必須項目としているが，米NCEP-ATP Ⅲ（National Cholesterol Education Program Adult Treatment Panel Ⅲ）の基準（2001年）では，各項目の比重は皆等しく，腹囲（肥満），中性脂肪，HDL-コレステロール，血圧，空腹時血糖の5つの項目の中からいずれか3つ以上の項目が陽性となった場合にメタボシックシンドロームと判定するなど，その基準については必ずしも世界的に統一されていない．また，腹囲についてもさまざまな議論の余地があり，IDFの基準では各国の事情で異なるとされている．先述したわが国の基準についても，久山町コホート研究の結果からは，男性90cm，女性80cm以上とした南アジアで用いられている値を用いたほうが動脈硬化性疾患の発症をよりよく予測できることが報告されており，近い将来にわが国のメタボリックシンドロームの基準値の改訂が行われる可能性がある．

歯周病とメタボリックシンドローム

メタボリックシンドロームの重要な徴候の一つである，血糖値の上昇が主症状となる糖尿病は古くから歯周病と関連することが報告されている．

糖尿病患者の歯周病が重篤であるとの報告は1899年のO.G. Grunertによるものがその始まりとされているが，その後J.B. Williamが1928年に糖尿病患者の歯周病の特徴を“Diabetic

periodontoclasia" として提唱したことが歯周病を糖尿病の合併症に数える今日の概念に大きく影響した[5]．糖尿病患者は一般に易感染性と考えられており，糖尿病患者に歯周病が多発することや，発症した歯周病が重症化することは想像に難くない．実際，糖尿病群は非糖尿病群に比較して歯周炎がより重症であり，糖尿病患者は非糖尿病者に比べ歯周病の発症率が2.6倍高いことが，ピマ・インディアンを調べた米国の疫学研究において報告されている[6]．その後の横断研究でも，2型糖尿病患者は非糖尿病者よりもアタッチメントロス(attachment loss：エナメルセメント境からポケット底までの距離)が大きく，歯周病が悪化しやすいこと[7]，さらに2年間のコホート研究では非糖尿病者に比較して歯槽骨吸収がより多かったことが報告されている[8]．その他にも2型糖尿病が歯周疾患の発症や重症度に影響することを示す多くの研究結果があるが，同じ2型糖尿病患者でも血糖値のコントロールが不良な群では，良好にコントロールされている群に比較して歯槽骨吸収がより進んでいたと報告されている[9]．一方，血糖値のコントロールが良好な場合には非糖尿病者と比べて歯周病の有病率に有意な差はないとの報告もあり[10]，メタボリックシンドロームの徴候の一つである血糖値が歯周病の発症に強く影響することが示唆されている．しかし，これらのデータのほとんどが日本人のものではなく，さらに日本人が欧米人に比較してインスリン分泌能が低く，糖尿病に対する感受性が高いことを考えると，これらのデータを鵜呑みにしてそのまま日本人に適用することは慎むべきであろう．

そこで，久山町コホート研究のデータから日本人における歯周病と耐糖能の関係をみてみたい．表1に久山町の一斉検診(1998年)の際に歯周病検診を行った被験者1,111名中，歯が10本以上あった961名(男性377名，女性584名)について，正常耐糖能(空腹時血糖値＜110mg/dL かつ糖負荷試験後2時間の血糖値＜140mg/dL)，糖尿病(空腹時血糖値＜126mg/dL かつ糖負荷試験後2時間の血糖値＜200mg/dL)，血糖値がいずれにも該当しない耐糖能異常(糖尿病には至らないが血糖値が異常に高値を示すもの)の3群に分けてその歯周組織の状態を比較した結果を示す[11]．

本診査では歯周組織の状態をNHANES Ⅲ (National Health and Nutrition Examination Sarvey Ⅲ)の方法で評価し，歯周ポケット深さやアタッチメントロスをmm単位で比較することが可能であるため，他の多くの疫学研究で用いられているCPI (Community Periodontal Index) に比較して歯周組織の状態をより詳細に分析できる利点がある．多重比較による統計分析では，平均値および最大値のいずれでみても，現状の歯周病の状態を示す歯周ポケット深さおよび過去か

表1　耐糖能別にみた各群間の歯周組織の状態の比較

歯周組織	正常耐糖能群 (n＝669名)	糖尿病群 (n＝101名)	耐糖能異常群 (n＝191名)
	平均[a] (標準偏差)		
平均[b]歯周ポケット深さ(mm)	1.6(0.5)	1.8(0.6)***	1.7(0.5)**
最大歯周ポケット深さ(mm)	3.5(1.4)	4.0(1.7)**	3.9(1.5)*
平均[b]アタッチメントロス(mm)	1.9(0.8)	2.3(0.9)***,†	2.0(0.9)
最大アタッチメントロス(mm)	4.1(1.7)	4.9(2.1)**	4.5(2.1)

a：集団内における個人の値の平均，b：個人内における複数の診査箇所の平均．
群間の統計学的有意差の比較はボンフェローニ法による多重比較によって行った．
*：正常耐糖能に対して $p<0.05$，**：正常耐糖能に対して $p<0.01$，
***：正常耐糖能に対して $p<0.001$ の統計学的有意差を示す．
†：糖尿病と耐糖能異常間で $p<0.05$ の統計学的有意差を示す．

(文献11)より引用)

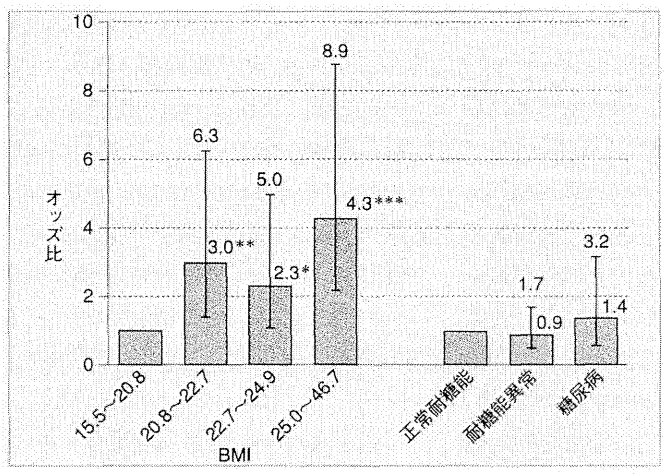

図1　多変量解析によるBMIおよび耐糖能と歯周病との関連性
歯周病を目的変数，年齢，歯垢スコア，性別，運動の頻度，アルコール摂取量，喫煙，職業，BMIおよび耐糖能を説明変数とした多重ロジスティック回帰分析結果のBMI（左側）と耐糖能（右側）のオッズ比を示す．平均歯周ポケット深さが1.9mm以上を歯周病とした．
*：$p<0.05$，**：$p<0.01$，***：$p<0.001$
（文献12)より改変引用）

らの歯周病の進行状態を示すアタッチメントロスの両者が糖尿病群では正常耐糖能群に比較して有意に悪化しており，糖尿病患者に歯周病が多いとする過去の通説を裏付ける結果となった．また，糖尿病には至らないが，血糖値が高値を示す耐糖能異常群では，アタッチメントロスでは正常耐糖能群との間に有意差は認められなかったが，歯周ポケット深さは正常耐糖能群よりも有意に深く，血糖値と歯周組織の二者の関係に限定すれば，日本人においても糖尿病は歯周病に関連していた．

しかし，その一方で歯周病には糖尿病以外の喫煙や肥満などのさまざまな要因が影響を与えることが明らかになっており，これらの交絡因子の影響を加味して糖尿病と歯周病の関連性を調べる必要がある．そこで，同じ対象者について歯周病に関連すると報告のある因子［年齢，性別，BMI（Body Mass Index），運動の頻度，アルコール摂取量，喫煙］を独立変数とした多重ロジスティック回帰分析により，耐糖能と歯周病の関係を調べた．その結果，耐糖能異常や糖尿病が歯周病と有意に関連していることが示唆されたことから，日本人においても糖尿病患者に歯周病の患者が多いと結論付けることはできそうである[11]．

ところが，先述の調査対象者から女性(584名)のみを抽出して，年齢，歯垢スコア，性別，BMI，耐糖能，運動の頻度，アルコール摂取量，喫煙，職業を同時に独立変数とした多重ロジスティック回帰分析を行うと，BMIは歯周病に関連した有意な独立変数であったが(図1左)，耐糖能異常は糖尿病も含めて歯周炎と有意な関連性は認められなかった(図1右)[12]．

さらに，BMIを肥満と関連する体脂肪率やウエストヒップ比に置き換えて，同様の多変量解析を行っても歯周病と耐糖能異常とは有意な関連性を示さなかった．また，アタッチメントロスにより歯周病を判定した場合は，耐糖能異常のみならず肥満関連因子さえも歯周病とは有意な関連を認めなかった．これらの結果に基づけば，これまでの多くの報告のように「糖尿病があれば歯周病になりやすい」と単純に結論付けることはできないことになる．ただし，有意差はないがオッズ比には両者に関連のある傾向があることから，調査対象者を女性に絞り込んだことで被験者数が減少したことがこのような結果を生んだ可能性もある．また，女性ホルモンと骨代謝には密接な関係があることから，そのような性差が歯周炎の感受性に影響しているのかもしれない．これらの点に関しては今後の研究課題といえる．

一方で，メタボリックシンドロームは虚血性心疾患のリスクとして捉えられているが，歯周病は虚血性心疾患にも関連するという疫学研究が多数報告されている．そこで，我々は耐糖能のみに固執するのではなく，歯周病とメタボリックシンドロームとの関連性についても先述の対象者について調べてみた．この研究ではメタボリックシンドロームの定義は米国のNCEP ATP

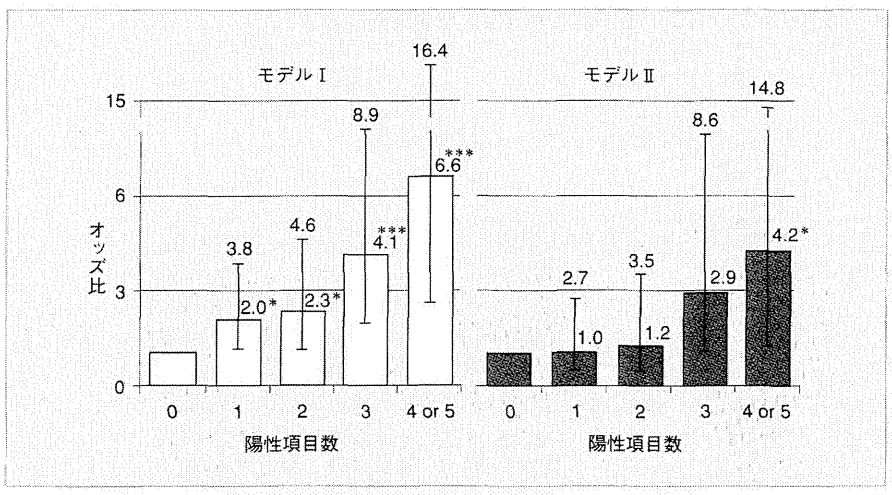

図2　メタボリックシンドロームの陽性項目数と歯周病との関連性

歯周病を目的点数，年齢，喫煙，脂質抑制剤の服用，総コレステロールを説明変数とした多重ロジスティック回帰分析結果を示す．モデルⅠでは平均ポケット深さが2mm以上を歯周病とし，モデルⅡでは平均アタッチメントロスが3mm以上を歯周病とした．
*：p<0.05，***：p<0.001

（文献13）より改変引用）

Ⅲの基準に従った．その結果，メタボリックシンドロームの陽性項目数が増えるほど歯周病患者の割合が段階的に増加した．歯周病を平均歯周ポケット深さで定義したモデルⅠでは，メタボリックシンドロームの項目が4つ以上陽性になると陽性項目が全くない健常者に比べ，実に6.6倍も歯周ポケットの深い歯周病患者が増える結果となった（図2）[13]．

その後，他の多くの研究においても同様の結果が報告されている（表2）[14-17]が，これらのほとんどは時間軸のない横断的な疫学研究結果であり，その因果関係の考察は難しい．

しかし2010年，歯周病がメタボリックシンドロームを悪化させることを示唆するコホート研究が報告され[17]，その因果関係の解明に一歩を進めた．この研究ではベースラインの産業健診の受診者を歯周病の有無の2群に分け，4年後にメタボリックシンドロームの陽性項目数の増加に2群間で差があるか否かを調べている．その結果，歯周病があった群において陽性項目の増加数が有意に高いことが示されており，歯周病があるとメタボリックシンドロームになりやすい，あるいは悪化しやすいことを強く示唆している．しかし，歯周病をアタッチメントロスで定義したモデルⅡではモデルⅠほど歯周病とメタボリックシンドロームとの関連性は強く表れていない．アタッチメントロスは歯周病の過去の病歴も蓄積して評価するが，現時点の歯周ポケットの有無のほうがよりメタボリックシンドロームと関連性が強いという結果は，歯周ポケット内の細菌からの持続的な刺激が大きな意味を持つことを示唆しているのかもしれない．この点についても今後の検討が必要である．

おわりに

超高齢社会を迎えるわが国の健康問題として，生活習慣病は避けて通れない重要な課題である．歯周病と生活習慣病の関連は古くから語り継がれてきたにもかかわらず，その成果が実際の医療現場において十分に生かされてこなかったきらいがある．医科歯科の連携がわが国の健康問題の喫緊の課題であることを，小論を通して幅広い分野の方々に感じていただければこの上のない喜びである．

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表2　歯周病とメタボリックシンドロームの関係を示す主な疫学研究結果

文献番号	調査対象者	年齢	研究手法	主な結果
13	地域住民584名 （女性584名，男性0名）	40～79歳 平均年齢： 55.7歳	横断研究	図1に結果を要約
14	第3回米国健康栄養調査の受診者の中で歯周病検診を受けた者 13,677名 （女性の割合：49.4%）	17歳以上 平均年齢： 40.8歳	横断研究	45歳以上で重度の歯周炎の者では，歯周炎のない者に比較して，メタボリックシンドロームである割合が2.31倍（95%信頼区間：1.13～4.73）高い．歯周病の評価は文献13に同じ．
15	産業健診の受診者2,478名 （男性2,028名，女性450名）	24～60歳 平均年齢： 43.3歳	横断研究	文献13と同様の関係が男女ともに認められる．また，両者の関係は年齢が高いほど強い．歯周病の評価には文献13よりも簡易なCPIを使用．
16	地域住民1,070名 （男性281名，女性789名）	40，50，60，70歳	横断研究	文献1と同様の関係が認められる．歯周病の評価には文献13よりも簡易なCPIを使用．
17	産業健診の受診者1,023名 （男性727名，女性296名）	20～56歳 開始時の平均年齢： 37.3歳	コホート研究	文献15に継続した4年後データによるコホート研究．深さ4 mm以上の歯周ポケットがあると，メタボリックシンドロームの項目が1つ陽性に変化するオッズ比が1.4（95%信頼区間：1.0～2.1），2つあるいはそれ以上の項目が陽性に変化するオッズ比が2.2（95%信頼区間：1.1～4.1）であった．

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主に口腔環境が口腔ならびに全身の健康に与える影響についての研究を行っている．

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Two risk score models for predicting incident Type 2 diabetes in Japan

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Abstract

Aims Risk scoring methods are effective for identifying persons at high risk of Type 2 diabetes mellitus, but such approaches have not yet been established in Japan.

Methods A total of 1935 subjects of a derivation cohort were followed up for 14 years from 1988 and 1147 subjects of a validation cohort independent of the derivation cohort were followed up for 5 years from 2002. Risk scores were estimated based on the coefficients (β) of Cox proportional hazards model in the derivation cohort and were verified in the validation cohort.

Results In the derivation cohort, the non-invasive risk model was established using significant risk factors; namely, age, sex, family history of diabetes, abdominal circumference, body mass index, hypertension, regular exercise and current smoking. We also created another scoring risk model by adding fasting plasma glucose levels to the non-invasive model (plus-fasting plasma glucose model). The area under the curve of the non-invasive model was 0.700 and it increased significantly to 0.772 ($P < 0.001$) in the plus-fasting plasma glucose model. The ability of the non-invasive model to predict Type 2 diabetes was comparable with that of impaired glucose tolerance, and the plus-fasting plasma glucose model was superior to it. The cumulative incidence of Type 2 diabetes was significantly increased with elevating quintiles of the sum scores of both models in the validation cohort (P for trend < 0.001).

Conclusions We developed two practical risk score models for easily identifying individuals at high risk of incident Type 2 diabetes without an oral glucose tolerance test in the Japanese population.

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Keywords community-dwelling Japanese subjects, oral glucose tolerance test, risk models, Type 2 diabetes

Introduction

The number of individuals with Type 2 diabetes mellitus is rapidly growing worldwide [1], probably because population growth, ageing and urbanization are progressing, and the prevalence of obesity and physical inactivity is also increasing [2]. Thus, the burden of Type 2 diabetes and its complications, including macro- and microvascular diseases, is an important concern in global healthcare systems. A practical and effective scheme for the prevention of Type 2 diabetes should be established without delay. Two randomized clinical trials in Europe and the USA have demonstrated that Type 2 diabetes can largely be prevented through diet and lifestyle modifications in individuals at high risk [3,4]. Similar results were also reported in different ethnic populations, such as Japanese [5], Chinese [6] and Asian Indians [7]. In these researches, the estimation of a person's future risk of Type 2 diabetes has depended primarily on identifying impaired glucose tolerance [3–7]. However, the 75-g oral glucose tolerance test integral to a diagnosis of impaired glucose tolerance is relatively costly and inconvenient, and its reliability has been questioned [8]. These facts have stimulated the development of simple scoring methods involving readily available clinical information capable of predicting Type 2 diabetes with equal or better diagnostic properties than impaired glucose tolerance. To date, risk score models have been derived from several Caucasian populations [9–16] and a few Asians populations [17–19] but none have been developed in Japanese.

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