

# Association between education level and dentition status in Japanese adults: Japan public health center-based oral health study

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**Abstract – Objectives:** The aim of this study was to examine whether there is an educational gradient in dentition status among Japanese adults who are under the universal public health insurance system. **Methods:** Subjects were 1201 community residents aged 55–75 years as of May 2005 who completed a self-administered questionnaire and had a standard clinical oral examination. Analysis focused on the association of three education levels (junior high school, senior high school, and any college or higher education) with dentition status. **Results:** The proportion of subjects with 20 or more teeth ( $P < 0.001$ ), number of teeth present ( $P = 0.037$ ), number of filled teeth ( $P = 0.016$ ), and two types of functional tooth units (FTUs): FTUs with natural teeth (n-FTUs) ( $P < 0.001$ ) and FTUs with natural teeth and artificial teeth on implant-supported and fixed prostheses (nif-FTUs) ( $P < 0.001$ ) were significantly associated with education level after adjusting for confounders. The significant trend of these values in dental indexes indicated a poorer dentition status with a lower education level. **Conclusions:** The results suggest that the level of education has an independent impact on dentition status in a group of Japanese adults, even after taking into account oral health-related factors. Therefore, providing appropriate oral health information from an early age within a compulsory school education program appears necessary to enhance health literacy and lessen the inequalities in dental health by educational level.

**Key words:** education level; functional tooth units; oral health status; universal public health insurance

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There are several indicators employed in the evaluation of socioeconomic status (SES). Generally, SES is measured by income, occupational status, or education level as the proxy, and these have been used singularly or in combination (1, 2). Education level is often used in research to distinguish people with a high status in society from those with a low status. Among SES measures, education level is fairly stable for most adults throughout their life, while income and

occupational status are greatly influenced by economic fluctuations (3).

The relationship between SES and general health has been widely investigated, and the close link between SES and health is well established. An unfavorable health status is often found among people with a lower SES (4, 5). The association of a lower education level with a higher risk of general health problems has been often investigated among people in Europe and the United States (4, 6), but few

studies have been conducted in the Japanese population (7–9). An earlier Japanese study reported that the relationship between education level and health behaviors was weaker in Japan than in other developed countries (7). There is, however, evidence that lower education levels are associated with worse general health conditions in Japan (8, 9).

Socioeconomic disparities in oral health have also been repeatedly demonstrated in many countries (10). People in lower SES groups are reported to have markedly poorer oral health than those in higher SES counterparts (11). There is also substantial evidence of a strong association between education level and oral health from many countries (12–14). One previous study reported that subjects with a low education level had a larger number of missing teeth compared with those with a high education level (15). Further, elderly Danes with a low education level had a tendency to have more decayed tooth (DT) surfaces compared with those with a high education level. On the other hand, individuals with a high education level had significantly more filled teeth (FT) than those with a low education level (16). A low education level in older people also has an independent negative impact on oral health-related quality of life (17).

To date, no study has assessed whether education level contributes to the inequalities of oral health in Japanese people. Thus, it is not possible to verify whether the relationship between education level and oral health status, identified in Europe and the United States, also exists in Japan. Japan is known to have a less marked socioeconomic differential compared with other developed countries. In addition, Japan has had a universal health insurance system, including dentistry, since 1961 (18). Thus, every Japanese person can receive most dental treatments, including restorations, prostheses, and oral surgery for the same price at any dental clinic by paying 30% of the cost.

Therefore, the aim of this study was to examine whether there is an educational gradient in dentition status among Japanese adults who are under the universal public health insurance system.

## Methods

### *Subjects*

The Japan Public Health Center-Based (JPHC) Study Cohort I was initiated in 1990 for the purpose of prospectively following the morbidity and mortality of various diseases, such as cancer and

cardiovascular diseases, in a large population-based Japanese sample of administrative districts supervised by five public health centers (19).

In 2005, a dental survey was conducted for the first time in a cohort from the Yokote health center jurisdiction, Akita Prefecture. Thus, subjects in this study were a subsample in the Yokote health center jurisdiction, who had participated both in the JPHC Study Cohort I in 1990 and the dental survey in 2005.

Invitation letters were mailed to 15 782 residents (aged 55–75 years as of May 2005) who had joined the JPHC Study Cohort I, informing them about the purposes and procedures of the study and seeking their participation in the research. A total of 1518 subjects completed a self-administered dental questionnaire and presented for a clinical oral examination between July 2005 and January 2006. Information on demographics (date of birth and gender) and education was obtained from a self-completed questionnaire administered in 1990 as a part of the JPHC Study Cohort I. The final number of subjects used for the analysis was 1201 after excluding those with missing data for either the outcome or any explanatory variable. Ethical approval of this study was granted by the Ethics Committee of the National Cancer Center in Tokyo and Tokyo Medical and Dental University Ethical Committee, Japan.

### *Education levels*

The response options of the question inquiring about the highest education level achieved by subjects were junior high school, senior high school, junior college or vocational school, and university or higher. The education level was then collapsed into three groups: low (junior high school), middle (senior high school), and high (any college or higher education) education levels.

### *Health behaviors*

A self-completed dental questionnaire, administered at the time of the presentation for the oral examinations in 2005, consisted of health-behavior-related questions such as intake of sweet snacks or drinks (rarely, sometimes and everyday), dental check-up in the previous year (yes or no) and smoking status (nonsmoker, past smoker, and current smoker).

### *Dentition status*

Clinical oral examinations of dentition status (excluding third molars) were conducted in 2005

according to the World Health Organization guidelines (20). The standardized clinical oral examinations were performed by one of 43 participating dentists trained in the survey methods. A handbook describing the clinical criteria was distributed to all participating dentists prior to the examination. The examination included the number of teeth present, DT, and FT, following which the prevalence of edentulousness and proportion of subjects with 20 or more teeth were calculated.

The total number of Functional Tooth Units (total-FTUs) was defined as the number of pairs of opposing natural teeth (i.e., sound, restored, and carious teeth) and artificial teeth on implant-supported, fixed (bridge pontics), and/or removable prostheses in posterior teeth occlusion. Carious teeth with extensive coronal destruction and missing teeth were regarded as nonfunctional. Two opposing premolars were defined as one FTU, and two opposing molars were defined as two FTUs. Therefore, a person with a complete dentition had 12 FTUs. The FTUs were further divided by tooth composition into n-FTUs (FTUs of natural teeth) and nif-FTUs (FTUs of natural teeth and artificial teeth on implant-supported and fixed prostheses).

Oral hygiene of teeth or dentures was visually evaluated by examining all teeth present or on the dentures and was scored as: (i) good = plaque covering less than one-third of tooth surfaces; (ii) fair = plaque covering more than one-third but less than two-thirds of tooth surfaces; and (iii) poor = plaque covering more than two-thirds of tooth surfaces. The worst score was recorded as representative for the subject.

### Statistical analysis

The two-sample *t*-test was used for testing the difference of mean age between two groups, and chi-square test for the relationship of categorical values such as gender or education level. The linear trend of education level with demographics, health behaviors, and oral hygiene was analyzed by a linear regression model for continuous data and by the Mantel-Haenzel's chi-square test for categorical data. The linear trend of education level with each clinical dental outcome was assessed using a logistic regression for binary data and generalized linear regression of the negative binomial model with logit built-in link function for count data. The analysis was performed both unadjusted and adjusted for age, gender, intake of sweet snacks and drinks, dental check-up, smoking, and oral hygiene of teeth or dentures. All

analyses were conducted using SPSS (SPSS Japan Inc., Tokyo, Japan) 18J software.

## Results

The nonresponse analyses to compare participants and nonparticipants on socio-demographics assessed at baseline in 1990 indicated that the number of nonparticipants of the study (excluding those with missing data) was 10 236 (mean age:  $66.2 \pm 7.96$ , 5005 men, 5231 women) (Table 1). Nonparticipants had a similar mean age to participants ( $65.5 \pm 5.77$  years), although the difference was significant ( $P = 0.003$ ). Male to female ratio of nonparticipants (48.9–51.1%) was similar to that of participants (46.4–53.6%) ( $P = 0.102$ ). However, nonparticipants had a higher proportion of low education level (low: 49.8%, middle: 37.5%, and high: 12.7%) compared with participants in this study (low: 33.5%, middle: 50.6%, and high: 15.9%).

Mean ages ( $\pm$ SD) of men in the low, middle, and high education levels were  $66.8 \pm 5.8$ ,  $65.2 \pm 5.5$ , and  $64.8 \pm 6.0$ , respectively, and those of women were  $67.5 \pm 5.5$ ,  $64.2 \pm 5.6$ , and  $63.8 \pm 5.5$ , respectively. Age was inversely related with education level in both men ( $P$  for trend  $< 0.01$ ) and women ( $P$  for trend  $< 0.001$ ), with older ages in the lower education levels.

The proportions of men in the low, middle, and high education levels were 30.7% ( $N = 171$ ), 51.3% ( $N = 286$ ), and 18.0% ( $N = 100$ ), respectively, and those of women were 35.9% ( $N = 231$ ), 50.0% ( $N = 322$ ), and 14.1% ( $N = 91$ ), respectively. There was a significant distributional difference in gender by education level ( $P$  for trend = 0.023).

Intake of sweet drinks in men was significantly associated with education level (Table 2). More

Table 1. Socio-demographics of participants and non-participants

	Participants ( $n = 1201$ )	Nonparticipants ( $n = 10\ 236$ )	<i>P</i> value
Age			
Mean (SD)	65.5 (5.77)	66.2 (7.96)	0.003
Gender, <i>n</i> (%)			
Male	557 (46.4)	5005 (48.9)	0.102
Female	644 (53.6)	5231 (51.1)	
Education level, <i>n</i> (%)			
Low	402 (33.5)	5098 (49.8)	<0.001
Middle	608 (50.6)	3838 (37.5)	
High	191 (15.9)	1300 (12.7)	

Table 2. Health behaviors and oral hygiene among the study subjects by gender ( $n = 1201$ )

	Male education level			<i>P</i> for trend	Female education level			<i>P</i> for trend
	Low	Middle	High		Low	Middle	High	
Sweet snacks, <i>n</i> (%)								
Rarely	26 (11.2)	54 (18.9)	21 (21.0)	0.204	19 (8.2)	18 (5.6)	3 (3.3)	0.961
Sometimes	108 (63.2)	184 (64.3)	60 (60.0)		119 (51.5)	161 (50.0)	59 (64.8)	
Everyday	37 (21.6)	48 (16.8)	19 (19.0)		93 (40.3)	143 (44.4)	29 (31.9)	
Sweet drinks, <i>n</i> (%)								
Rarely	36 (21.1)	97 (33.9)	43 (43.0)	0.001	109 (47.2)	145 (45.0)	52 (57.1)	0.490
Sometimes	83 (48.5)	130 (45.5)	45 (45.0)		78 (33.8)	118 (36.6)	21 (23.1)	
Everyday	52 (30.4)	59 (20.6)	12 (12.0)		44 (19.0)	59 (18.3)	18 (19.8)	
Dental check-up, <i>n</i> (%)								
Yes	74 (43.3)	135 (47.2)	51 (51.0)	0.216	102 (44.2)	143 (44.4)	44 (48.4)	0.597
No	97 (56.7)	151 (52.8)	49 (49.0)		129 (55.8)	179 (55.6)	47 (51.6)	
Smoking, <i>n</i> (%)								
Nonsmoker	69 (40.4)	108 (37.8)	24 (24.0)	0.213	227 (98.3)	313 (97.2)	87 (95.6)	0.350
Past smoker	57 (33.3)	112 (39.2)	52 (52.0)		3 (1.3)	2 (0.6)	4 (4.4)	
Current smoker	45 (26.3)	66 (23.1)	24 (24.0)		1 (0.4)	7 (2.2)	0 (0.0)	
Oral hygiene, <i>n</i> (%)								
Good	17 (9.9)	35 (12.2)	16 (16.0)	0.379	26 (11.3)	60 (18.6)	14 (15.4)	0.064
Fair	112 (65.5)	177 (61.9)	61 (61.0)		157 (68.0)	44 (13.7)	16 (17.6)	
Poor	42 (24.6)	74 (25.9)	23 (23.0)		48 (20.8)	74 (25.9)	23 (23.0)	

subjects who drank sweet drinks everyday were observed in the lower education levels ( $P$  for trend = 0.001). Intake of sweet snacks, dental check-up in the previous year, smoking status and oral hygiene of teeth or dentures were not significantly related with education level.

In the bivariate analysis, without adjustment by demographic and oral health-related variables, there were significant linear trends in dentition status by education level (Table 3). Prevalence of edentulousness declined with the rise of education level ( $P$  for trend < 0.001), whereas the proportion of subjects with 20 or more teeth increased as the education level went up ( $P$  for trend < 0.001).

No significant trends were observed in the number of DT and total-FTUs by education

level (Table 4). Numbers of teeth present and FT showed an ascending trend by education level ( $P$  for trend < 0.001). Further, significantly more n-FTUs and nif-FTUs were found in subjects with a higher education level ( $P$  for trend < 0.001).

After adjustment for demographic and oral health-related variables, the significant association between edentulousness and education level disappeared. The proportion of subjects with 20 or more teeth ( $P$  for trend < 0.001), numbers of teeth present ( $P$  for trend = 0.037), FT ( $P$  for trend = 0.016), n-FTUs ( $P$  for trend < 0.001), and nif-FTUs ( $P$  for trend < 0.001) remained significantly related with education level. The values of these variables had a significantly increasing trend with the rise in education level.

Table 3. Prevalence of edentulousness and proportion of subjects with 20 or more teeth by education level

	Education level			<i>P</i> for trend
	Low	Middle	High	
Edentulousness				
% (No. of cases/subjects)	8.5 (34/402)	5.1 (31/608)	2.1 (4/191)	
OR (95% CI)	1.00	0.58 (0.35–0.96)	0.23 (0.08–0.66)	<0.001
Adjusted OR <sup>a</sup> (95% CI)	1.00	1.03 (0.58–1.83)	0.42 (0.14–1.27)	0.085
20 or more teeth				
% (No. of cases/subjects)	45.8 (184/402)	62.5 (380/608)	74.9 (143/191)	
OR (95% CI)	1.00	1.98 (1.53–2.55)	3.53 (2.41–5.17)	<0.001
Adjusted OR <sup>a</sup> (95% CI)	1.00	1.53 (1.16–2.01)	2.72 (1.81–4.07)	<0.001

<sup>a</sup>Adjusted for age, gender, intake of sweet snacks, intake of sweet drinks, dental check-up, smoking, oral hygiene of teeth or dentures.

Table 4. Mean numbers of teeth present, decayed teeth (DT), filled teeth (FT), and functional tooth units (FTUs) by education level

	Education level			<i>P</i> for trend
	Low	Middle	High	
Number of teeth present				
Mean (SD)	16.33 (8.76)	19.21 (8.52)	21.71 (7.00)	<0.001
Adjusted Mean (SD) <sup>a</sup>	16.97 (17.80)	18.46 (19.09)	20.72 (21.35)	0.037
Number of DT				
Mean (SD)	1.01 (1.96)	1.20 (2.38)	1.28 (2.54)	0.184
Adjusted Mean (SD) <sup>a</sup>	0.82 (1.26)	0.93 (1.38)	0.95 (1.38)	0.248
Number of FT				
Mean (SD)	8.94 (6.16)	10.21 (6.22)	11.84 (6.03)	<0.001
Adjusted Mean (SD) <sup>a</sup>	9.03 (9.72)	9.76 (10.33)	11.46 (12.07)	0.016
Number of n-FTUs				
Mean (SD)	3.65 (4.01)	5.11 (4.42)	6.28 (4.32)	<0.001
Adjusted Mean (SD) <sup>a</sup>	3.76 (4.33)	4.68 (5.20)	5.78 (6.29)	<0.001
Number of nif-FTUs				
Mean (SD)	4.42 (4.58)	5.87 (4.75)	7.37 (4.64)	<0.001
Adjusted Mean (SD) <sup>a</sup>	4.58 (5.15)	5.40 (5.94)	6.79 (7.31)	<0.001
Number of total-FTUs				
Mean (SD)	10.09 (2.67)	10.14 (2.68)	10.49 (2.18)	0.084
Adjusted Mean (SD) <sup>a</sup>	10.05 (10.75)	10.14 (10.70)	10.53 (11.13)	0.623

<sup>a</sup>Adjusted for age, gender, intake of sweet snacks, intake of sweet drinks, dental check-up, smoking, oral hygiene of teeth or dentures.

## Discussion

This cross-sectional study explored the association between education level and dentition status in a sample of Japanese adults. Even in Japan, where a universal public health insurance system is instituted, there existed a gradient in oral health by education level, and the gradient still persisted while controlling for other relevant demographic and health behavioral variables commonly used in many studies (11, 21, 22).

Health behaviors and oral hygiene used in this study have been demonstrated to be associated with dentition status (23–26). Dietary habit such as consumption of sweet snacks or sweet drinks is still one of risk factors of dental caries despite of the widely use of fluoride (23). Dental visit pattern is contributory to periodontal disease (24). Smoking has a positive association with missing teeth and periodontal disease (25, 26). Oral hygiene condition, especially plaque accumulation, is closely related with the development of dental diseases (27).

These possible confounding variables used to control for variability were not related with education level except for intake of sweet drinks in men. These findings were align with the report by Paulander et al. (15) who found no association of education level with dietary habit, dental care habits, and oral hygiene. Similarly, in respect to

smoking status, Anzai et al. (7) also reported no differences by education level in Japanese men aged 50–59 years and 70 years or older as well as women aged 60–69 years and 70 years or older. Male subjects with a higher education level were less likely to take sweet drinks in this study.

The former studies reported that the percentage of edentulous subjects in low education level groups were significantly higher than that in higher education level groups (10, 15, 28). The unadjusted bivariate analysis in this study showed a similar trend, although this trend was attenuated and was not marginally significant ( $P = 0.085$ ) after adjusting for confounders. Therefore, confounding factors influence the relationship between edentulousness and the education level to some degree.

Keeping at least 20 or more natural teeth until the age of 80 is the goal of the national oral health campaign in Japan (29). People with 20 or more teeth are reported to be able to eat most types of Japanese foods (30). Similar goals of having 20 and more functional natural teeth exist in the World Health Organization (31) and Federation Dentaire Internationale (32). There was a significant increasing trend in the proportion of subjects with 20 or more teeth as education level increased. Previous research has also indicated that there were fewer persons with 20 or more teeth in less educated groups (10). A further study showed a linear relationship between the prevalence of having fewer

than 24 teeth and SES, with prevalence decreasing at higher levels of perceived social status (11).

The present study showed that persons with a higher education level had significantly more FT compared with those with a low education level. Similar results were found in the National Health and Nutrition Examination Survey 1999–2004 (28). This trend might be explained by people's attitude and behavior toward oral health care utilization (10).

On the other hand, there was no significant association between education level and number of DT, confirming previous reports. For example, in a Danish study of the elderly, those with a lower education level tended to have more decayed surfaces compared with their counterparts, but the difference was not significant (16). A possible reason for not detecting a significant difference in this study is that the mean number of DT was very small, that is, close to 1, making statistical significance difficult to detect.

No difference by education level was found regarding total-FTUs, which were more than 10 at all education levels. This high number could be explained by missing teeth being replaced with the artificial teeth of dentures, resulting in the recovery of FTUs when calculated as total-FTUs, as has also been reported in previous studies (30, 33). In fact, any Japanese person can afford to have dentures made regardless of their SES, because it is relatively inexpensive under the Japanese universal public health insurance system. On the other hand, a significant oral health gradient was found in n-FTUs and nif-FTUs, indicating that less educated people were more likely to lose posterior occlusal relations with natural, implanted, and fixed prosthetic teeth. A previous study reported that recovery of total-FTUs by removable prosthodontic treatments might not yield a significantly improved masticatory function. Therefore, maintenance of occluding pairs with as many n-FTUs or nif-FTUs as possible is important in reducing the likelihood of chewing difficulty (30).

This study had certain limitations. The subjects used in this study may not have been representative of the general adult population in Japan, because their participation was voluntary. Intra- or interexaminer reliability was not obtained because of a large number of participating dentists. In addition, we only used the education level as a proxy for SES. It would be preferable to use multiple indicators, because each indicator covers a different aspect of SES. The nonresponse analyses indicate

that there is a possibility that participants may have a little different socio-demographic characteristic from nonparticipants. Future research will be needed to confirm the current findings using a representative sample with multiple SES indicators.

This is the first study demonstrating that the level of education has an independent impact on dentition status, as a consequence of different treatment options by education level, in a group of Japanese adults. People with a lower education level tended to lose more teeth and wear removable prostheses, whereas those with a higher education level had more teeth and tended to receive treatments such as fillings, fixed prostheses, and implants.

The findings indicate that oral disease prevention strategies solely focusing on personal health behaviors may have a limited effect. Therefore, it is necessary to focus on the socioeconomic determinants of oral health that form the living and working environments in which oral health behaviors are created. Nine years of elementary and junior high school education are compulsory in Japan. The present study suggests that providing appropriate information from an early age through oral health education in compulsory school health programs is necessary to enhance health literacy and lessen the inequalities of dental health by educational level.

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## Prediagnostic Plasma Antibody Levels to Periodontopathic Bacteria and Risk of Coronary Heart Disease

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### SUMMARY

Many epidemiological studies have indicated that periodontitis is an important risk factor for coronary heart disease (CHD). We examined whether plasma antibody levels to 3 major periodontal pathogens, *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Prevotella intermedia* predicted the risk of CHD events.

A nested case-control research design (case:  $n = 191$ , control:  $n = 382$ ), by matching gender, age, study area, date of blood collection, and time since last meal at blood collection, was employed in a large cohort of Japanese community residents.

Antibody levels of periodontopathic bacteria were associated with risk of CHD after adjusting for BMI, smoking status, alcohol intake, history of hypertension, history of diabetes mellitus, exercise during leisure time, and perceived mental stress. The association was different by age subgroup. For subjects aged 40-55 years, the medium (31.7-184.9 U/mL) or high tertile plasma antibody level ( $> 184.9$  U/mL) of *A. actinomycetemcomitans* showed higher risk of CHD (medium: OR = 3.72; 95% CI = 1.20-11.56, high: OR = 4.64; 95% CI = 1.52-14.18) than the low tertile level ( $< 31.7$  U/mL). The ORs of CHD incidence became higher with an increase in IgG level of *A. actinomycetemcomitans* ( $P$  for trend = 0.007). For subjects aged 56-69 years, the high tertile level ( $> 414.1$  U/mL) of *P. intermedia* was associated with higher risk of CHD (OR = 2.65; 95% CI = 1.18-5.94) in a dose-response fashion ( $P$  for trend = 0.007).

The possible role of periodontopathic bacteria as a risk factor for CHD incidence was suggested by the results of this study by the elevated antibody level to these bacteria with the increased risk of CHD. (Int Heart J 2012; 53: 209-214)

**Key words:** Plasma antibody, Periodontopathic bacteria, Coronary heart disease

Periodontal diseases such as gingivitis and periodontitis are infectious disorders of the periodontal tissues caused by dental plaque accumulation. Gingivitis is a disease with reversible inflammation of the gingival tissues, whereas periodontitis is a chronic inflammation involving not only gingival tissues but also the periodontal membrane and alveolar bone.<sup>1)</sup> Specific gram-negative anaerobic bacterial species, including *Aggregatibacter actinomycetemcomitans* (*A. actinomycetemcomitans*), *Porphyromonas gingivalis* (*P. gingivalis*), *Prevotella intermedia* (*P. intermedia*), *Treponema denticola* (*T. denticola*), *Tannerella forsythia* (*T. forsythia*) and *Fusobacterium nucleatum* (*F. nucleatum*) have been consistently associated with periodontal diseases.<sup>2,3)</sup>

Periodontal diseases are highly prevalent dental diseases, along with dental caries.<sup>4)</sup> A Japanese national survey of dental diseases conducted in 2005 reported that more than 80% of Japanese aged 45 years or older had some periodontal disease symptoms (ie, gingival bleeding or calculus deposition) and 42.2% of those aged 45 to 55 years had periodontal pockets.<sup>5)</sup>

Coronary heart disease (CHD) is primarily caused by a

condition called atherosclerosis, which is the narrowing of the coronary arteries that supply blood and oxygen to the heart due to fatty buildup of plaque. According to the 2010 Japanese vital statistics, heart diseases ranked as the second leading cause of mortality in Japan after cancer, accounting for 15.8% of all deaths, approximately half of which were CHD.<sup>6)</sup>

CHD has a number of risk factors, including smoking, alcohol, and obesity.<sup>7-10)</sup> Furthermore, many epidemiological studies have indicated that periodontitis is involved in the initiation and progression of CHD. They showed a positive association between various measures of periodontal diseases and CHD risk, even after adjustment for a variety of potential confounders of these associations.<sup>11)</sup> However, the status of periodontal disease in most of the studies was based on clinical periodontal examinations or self-reporting. Therefore, the interpretation of such results should be made cautiously because standardized measures for periodontal disease were lacking.

The systemic immunological response to periodontitis can be measured as elevated serum antibody levels against cer-

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tain periodontopathic bacteria. Serum antibodies to such periodontal pathogens have been used to identify microbial species that are associated with status and progression of periodontal disease, and to define disease-susceptible or disease-resistant individuals.<sup>12)</sup>

Previous studies that employed the antibody levels of periodontal pathogens have provided evidence that infections caused by main periodontal pathogens like *A. actinomycetemcomitans* and *P. gingivalis* are associated with an increased risk of myocardial infarction and acute coronary syndrome.<sup>13,14)</sup> Pussinen, *et al* reported that high serum antibody levels to *A. actinomycetemcomitans* were associated with the subclinical, prevalent, and future incidence of CHD.<sup>15)</sup> A Japanese study demonstrated that serum antibody levels against periodontopathic bacteria were higher among periodontitis patients with CHD than those without CHD.<sup>16)</sup>

However, very few longitudinal studies have investigated a relationship between the systemic immune response to a particular strain of periodontopathic bacteria and the incidence of CHD. In particular, a large-scale prospective cohort study to assess the association between periodontitis and the development of CHD has not yet been conducted in Japanese populations. Therefore, the objective of the current study was to prospectively examine whether plasma antibody levels to 3 major periodontal pathogens, *A. actinomycetemcomitans*, *P. gingivalis* and *P. intermedia*, predicted the risk of CHD events in a large cohort of Japanese community residents.

## METHODS

**Study cohort:** Subjects in this nested case-control study were those who had participated in the Japan Public Health Center-based (JPHC) prospective studies I and II, which intended to prospectively follow the morbidity and mortality of various diseases, such as cancer and cardiovascular diseases, in a large population-based Japanese sample. The JPHC Study Cohort I was initiated in 1990 and included residents aged 40-59 years as of December 31, 1989 in 5 public health center areas. The second group (Cohort II) involved 6 public health center areas, was started in 1993 and included residents aged 40-69 years as of January 1, 1993. Details of this study are described in previous articles.<sup>17,18)</sup>

In this study, 191 subjects voluntarily provided 10 mL of blood samples at baseline from 1990 to 1992 in Cohort I or 1993 to 1995 in Cohort II and were diagnosed with CHD during the follow-up period. For each case, two controls were selected by matching gender, age (within 3 years), study area (city or town and village), date of blood collection (within 6 months), and time since last meal at blood collection (within 5 hours). Thus, the number of controls in this study was 382.

Ethical approval of this study was granted by the Ethics Committee of the National Cancer Center in Tokyo, and Ethical Committees of Osaka University and Tokyo Medical and Dental University, Japan.

**Socio-demographic and health behavioral information:** A self-administered questionnaire, which inquired about height, weight, smoking and drinking habits, medical history (hypertension and diabetes mellitus), leisure time physical activity, and perceived mental stress was distributed to all participants at baseline in 1990 or 1993. BMI was calculated using the for-

mula (weight (kg)/height (m)<sup>2</sup>).

**Confirmation of CHD incidence:** A total of 78 hospitals were registered within the sampling area of the JPHC cohort. They were all major hospitals at which CHD disease patients could be admitted. The medical records were reviewed by physicians, blinded to the patient's lifestyle data. CHD events were included in the study if they occurred after the date of return of the baseline questionnaire and before December 31, 2007. The details of the surveillance for CHD were described in a previous paper.<sup>7)</sup> Briefly, CHD was confirmed in the medical records according to the criteria of the Monitoring Trends and Determinants of Cardiovascular Disease (MONICA) project, which requires evidence from ECGs, cardiac enzymes, or autopsy.<sup>19)</sup>

**Plasma antibody titer measurement:** The plasma and buffy layer of the baseline blood sample were divided into 4 tubes holding 1.0 mL each (3 tubes for plasma and one for the buffy layer) and stored at -80°C until analysis.

Plasma samples were analyzed for the IgG antibody against cell surface antigens for the following 3 suspected periodontal pathogens: *A. actinomycetemcomitans* ATCC 33384, *P. gingivalis* ATCC 33277 and *P. intermedia* ATCC 25611, using an enzyme-linked immunosorbent assay (ELISA) with sonicated whole cell extracts of each periodontal pathogen. The microtiter plates coated with sonicated extracts (100 µL) were stored for 1 day at 4°C and washed 3 times with PBS-T (0.05% Tween-20/PBS), following which they were blocked with 350 µL of 2% BSA + 5% Sucrose + 0.1% Na<sub>3</sub>N/PBS (pH = 7.0) solution. The plates were incubated for 4 hours at 37°C.

Plasma samples were diluted 420-fold with 1% BSA (Sigma, A-4503) + 0.4% hydrolyzed gelatin (Sigma, G-0262) + 0.1% Na<sub>3</sub>N + 5mM magnesium chloride + 5mM EDTA-Na<sub>2</sub>O.1M phosphoric acid buffer solution (pH 7.0) and 6 different concentrations of reference solution were prepared with the same diluted solution.

Subsequently, 100 µL of the diluted plasma sample and reference solution were applied to each well, stored for 1 hour at 20-30°C, and washed with 350 µL of 0.05% (w/v) Tween-20/PBS 6 times. To each well was added 100 µL of labeled antibody (IgG antibody: anti-human IgG (rabbit) conj. POD (DAKO), Antibody Aa: 7500IgG, Antibody Pg: 3000IgG, Antibody Pi: 2000IgG), stored 1 hour at 20-30°C and washed with 350 µL of 0.05% (w/v) Tween-20/PBS 8 times.

After adding 100 µL of enzyme substrate solution (DAKO, TMB+) and stopping the reaction with 100 µL of 2N sulfuric acid, the absorbance of each well was read using a Microplate Reader (SOFT MaxTM) at 450 nm with a 650 nm reference wavelength. Individual plasma antibody levels of periodontal pathogens (U/mL) were calculated from the reference curves of antibody concentrations of periodontal pathogens and absorbance density.

**Statistical analysis:** Baseline characteristics of the cases and controls were evaluated by the Mantel-Haenszel test with matched set strata. Crude odds ratios (ORs) and 95% confidence interval (CIs) for CHD risk were estimated by the tertile level of plasma antibody of the 3 periodontopathic bacteria using a conditional logistic regression model. Tertile cutoff points of each bacterium were based on the frequency distribution of all subjects: *A. actinomycetemcomitans* (< 31.7, 31.7-184.9, > 184.9), *P. gingivalis* (< 57.0, 57.0-134.9, > 134.9) and *P. in-*

termedia (< 235.9, 235.9-414.1, > 414.1). Adjusted ORs were computed by entering the following potential confounding variables:

BMI (continuous), smoking status (never, past, current), alcohol intake (nondrinkers or former drinkers, less than week-

**Table I.** Characteristics of Cases and Matched Control Subjects

	Cases (n = 191)		Controls (n = 382)		P
	Mean / N	SD / %	Mean / N	SD / %	
Age, years	56.7	7.7	56.6	7.6	-
Gender (male), %	119	62.3	238	62.3	-
BMI, kg/cm <sup>2</sup>	24.5	3.2	24.3	9.6	0.824
Current smoking, %	78	40.8	105	27.5	0.002
Heavy alcohol intake (≥ 450 mg/week), %	16	8.4	45	11.8	0.271
History of hypertension, %	61	31.9	58	15.2	<0.001
History of diabetes mellitus, %	35	18.3	34	8.9	0.002
Leisure exercise time (≥ 1-2 times/week), %	42	22.0	69	18.1	0.313
High mental stress, %	39	20.4	49	12.8	0.018
Aggregatibacter actinomycetemcomitans IgG, U/mL	269.7	441.5	249.6	439.7	0.606
Porphyromonas gingivalis IgG, U/mL	148.2	164.1	136.8	144.3	0.397
Prevotella intermedia IgG, U/mL	395.9	248.8	358.1	233.6	0.075

**Table II.** Odd Ratios (95% CI) of CHD According to Tertiles of Antibody Levels to Periodontopathic Bacteria

	Antibody Tertiles			P for Trend
	Low	Medium	High	
<i>Total subjects</i>				
Aggregatibacter actinomycetemcomitans, U/mL	< 31.7	31.7-184.9	> 184.9	
Cases / Controls	56 / 135	68 / 123	67 / 124	
Crude OR (95% CI)	1.00	1.34 (0.87-2.07)	1.31 (0.85-2.03)	0.227
Adjusted OR (95% CI)	1.00	1.19 (0.71-1.99)	1.65 (0.98-2.80)	0.061
Porphyromonas gingivalis, U/mL	< 57.0	57.0-134.9	> 134.9	
Cases / Controls	62 / 129	67 / 124	62 / 129	
Crude OR (95% CI)	1.00	1.13 (0.74-1.72)	1.00 (0.65-1.53)	0.993
Adjusted OR (95% CI)	1.00	1.04 (0.63-1.71)	1.00 (0.59-1.70)	0.998
Prevotella intermedia IgG, U/mL	< 235.9	235.9-414.1	> 414.1	
Cases / Controls	54 / 137	60 / 131	77 / 114	
Crude OR (95% CI)	1.00	1.18 (0.75-1.86)	1.81 (1.15-2.86)	0.010
Adjusted OR (95% CI)	1.00	1.39 (0.81-2.39)	1.89 (1.10-3.23)	0.021
<i>Age 40-55 years</i>				
Aggregatibacter actinomycetemcomitans, U/mL	< 31.7	31.7-184.9	> 184.9	
Cases / Controls	16 / 61	24 / 33	32 / 50	
Crude OR (95% CI)	1.00	2.55 (1.14-5.72)	2.51 (1.16-5.43)	0.019
Adjusted OR (95% CI)	1.00	3.72 (1.20-11.56)	4.64 (1.52-14.18)	0.007
Porphyromonas gingivalis, U/mL	< 57.0	57.0-134.9	> 134.9	
Cases / Controls	28 / 51	18 / 46	26 / 47	
Crude OR (95% CI)	1.00	0.73 (0.35-1.52)	0.90 (0.46-1.76)	0.757
Adjusted OR (95% CI)	1.00	0.81 (0.27-2.42)	0.94 (0.36-2.46)	0.894
Prevotella intermedia IgG, U/mL	< 235.9	235.9-414.1	> 414.1	
Cases / Controls	26 / 54	22 / 42	24 / 48	
Crude OR (95% CI)	1.00	1.21 (0.58-2.52)	0.86 (0.42-1.79)	0.695
Adjusted OR (95% CI)	1.00	1.67 (0.62-4.46)	1.19 (0.41-3.47)	0.747
<i>Age 56-69 years</i>				
Aggregatibacter actinomycetemcomitans, U/mL	< 31.7	31.7-184.9	> 184.9	
Cases / Controls	40 / 74	44 / 90	35 / 74	
Crude OR (95% CI)	1.00	0.90 (0.53-1.53)	0.85 (0.48-1.48)	0.556
Adjusted OR (95% CI)	1.00	0.65 (0.33-1.26)	0.96 (0.47-1.94)	0.904
Porphyromonas gingivalis, U/mL	< 57.0	57.0-134.9	> 134.9	
Cases / Controls	34 / 78	49 / 78	36 / 82	
Crude OR (95% CI)	1.00	1.29 (0.75-2.23)	0.97 (0.55-1.71)	0.910
Adjusted OR (95% CI)	1.00	1.19 (0.60-2.37)	0.96 (0.45-2.04)	0.907
Prevotella intermedia IgG, U/mL	< 235.9	235.9-414.1	> 414.1	
Cases / Controls	28 / 83	38 / 89	53 / 66	
Crude OR (95% CI)	1.00	1.31 (0.71-2.43)	2.45 (1.29-4.65)	0.004
Adjusted OR (95% CI)	1.00	1.74 (0.76-3.94)	2.65 (1.18-5.94)	0.007

Adjusted for BMI, smoking status, alcohol intake, history of hypertension, history of diabetes mellitus, exercise during leisure time, and perceived mental stress.

ly, < 150 g/week, 150-299 g/week, 300-449 g/week, and  $\geq$  450 g/week), history of hypertension (yes/no), history of diabetes mellitus (yes/no), exercise during leisure time (rarely, 1-3 times/month, 1-2 times/week, 3-4 times/week, almost every day) and perceived mental stress (low, moderate, high) into the conditional logistic regression model. Since the interaction term suggested that the relationship of periodontopathic bacteria and CHD varied by age, ORs were further computed stratified by two baseline age subgroups using the mean age: 40-55 years and 56-69 years ( $P$  for interaction by age: *A. actinomycetemcomitans* = 0.022, *P. gingivalis* = 0.878, and *P. intermedia* = 0.004). All statistical analyses were performed with SAS software, version 9.2.

## RESULTS

The basic characteristics of cases and matched controls at baseline are presented in Table I. The mean age at baseline in the cases was 56.7 ( $\pm$  7.7 SD) and that in controls was 56.6 ( $\pm$  7.6 SD). The percentage of males was 62.3% in each group.

The cases (40.8%) smoked more than the controls (27.5%,  $P$  = 0.002) and also had higher percentages of history of hypertension (31.9%) and diabetes mellitus (18.3%) compared to controls (15.2%,  $P$  < 0.001 and 8.9%,  $P$  = 0.002, respectively). Further, the cases (20.4%) were more likely to perceive high mental stress than controls (12.8%,  $P$  = 0.018).

No differences were detected regarding BMI, alcohol intake, exercise during leisure time, and the 3 periodontopathic bacterial antibody titers in the plasma.

Table II shows ORs and 95% CIs of CHD incidence risk according to tertile antibody values of the 3 periodontopathic bacteria in the plasma. Subjects with the high tertile of *P. intermedia* antibody titer had a higher incidence of CHD (crude OR = 1.81; 95%CI = 1.15-2.86 and adjusted OR = 1.89; 95% CI = 1.10-3.23) than those with a low tertile, and there was a dose-dependent increase in incidence of CHD ( $P$  for trend = 0.010 for crude OR,  $P$  for trend = 0.021 for adjusted OR) with the plasma antibody of *P. intermedia*. There were no associations of CHD incidence with plasma antibody levels of *A. actinomycetemcomitans* and *P. gingivalis*.

The associations between the bacteria antibody titers and risk of CHD were analyzed for two baseline age subgroups: 40-55 years and 56-69 years. For subjects aged 40-55 years, a medium tertile (crude OR = 2.55, 95% CI = 1.14-5.72; adjusted OR = 3.72; 95% CI = 1.20-11.56) or a high tertile plasma antibody level (crude OR = 2.51; 95% CI = 1.16-5.43; adjusted OR = 4.64; 95% CI = 1.52-14.18) for *A. actinomycetemcomitans* showed a higher incidence of CHD than a low tertile plasma antibody level. The ORs of CHD incidence became higher with an increase in IgG titer level of *A. actinomycetemcomitans* ( $P$  for trend = 0.019 for crude OR,  $P$  for trend = 0.007 for adjusted OR). No associations with CHD incidence were observed for antibody levels of *P. gingivalis* and *P. intermedia*.

For subjects aged 56-69 years, a high tertile titer of *P. intermedia* (crude OR = 2.45, 95% CI = 1.29-4.65 and adjusted OR = 2.65, 95% CI = 1.18-5.94) had a higher incidence of CHD compared to a low tertile titer, and the titer of *P. intermedia* was associated with a dose-dependent increase in incidence of CHD ( $P$  for trend = 0.004 for crude OR, and  $P$  for trend = 0.007 for adjusted OR). Antibody levels of *A. actinomycetem-*

*comitans* and *P. gingivalis* were not related with the incidence of CHD.

## DISCUSSION

In this population-based, longitudinal study, higher levels of periodontopathic bacteria *A. actinomycetemcomitans* and *P. intermedia*, measured as the plasma antibody titer, were significantly associated with an increased risk of CHD events. The association was different by age subgroup, ie, the relationship with *A. actinomycetemcomitans* was accentuated in subjects aged 40-55 years and that with *P. intermedia* in those aged 56-69 years.

The link between periodontal disease and CHD is complex and many publications have provided support to the hypothesis of a causal association.<sup>3,20,21</sup> Hypothesized mechanisms include the direct effect of a subgingival biofilm or an indirect effect through an immunologic response and activation of inflammation is involved in the pathogenesis of atherosclerotic plaque formation.<sup>20,21</sup> Endothelial dysfunction is the first step in the development of atherosclerosis. Periodontitis has been demonstrated to be related with endothelial dysfunction.<sup>22</sup> Dorn, *et al* show that periodontopathic bacteria such as *P. gingivalis* and *P. intermedia* invade coronary artery cells at a significant level.<sup>23</sup> Further, an elevated serum IgG level of *A. actinomycetemcomitans* is reported to be associated with atherosclerosis.<sup>24</sup>

The possible relationship of *A. actinomycetemcomitans* with CHD incidence has been documented in several studies. Spahr, *et al* measured subgingival pathogens in subjects aged 43 to 73 years with DNA-RNA hybridization, and found a positive association of the amount of *A. actinomycetemcomitans* with risk of CHD (OR = 2.70; 95% CI = 1.79-4.07).<sup>25</sup> Pussinen, *et al* reported significant associations between elevated levels of IgG antibodies against *A. actinomycetemcomitans* and cardiovascular disease events in subjects aged 25 to 64 years (OR = 1.64, CI = 1.00-2.69).<sup>26</sup>

*A. actinomycetemcomitans* is the major etiologic agent of localized aggressive periodontitis, and an increased level of serum antibody to *A. actinomycetemcomitans* is considered to represent a destruction of the periodontal structures; thereby posing a systemic challenge that disseminates the bacteria, leading to vascular activation.<sup>27</sup> Individuals who carry *A. actinomycetemcomitans* have a higher risk of periodontitis, particularly among a younger age population (35 years or younger), because this species possesses certain disease-relevant virulence.<sup>27</sup> *A. actinomycetemcomitans* is also reported to be an etiological agent in early-onset periodontal disease.<sup>15,28,29</sup> Thus, the augmented association of CHD with *A. actinomycetemcomitans* observed in the younger age subgroup of this study implies that people who already develop advanced periodontal disease at an early age may have a higher risk of CHD.

A previous study demonstrated that the presence of *P. intermedia* in periodontal pockets was associated with an increased risk of myocardial infarction (OR = 1.40 and 95% CI = 1.02-1.92) in subjects aged 35 to 69 years, after adjusting for potential confounding factors.<sup>30</sup> A case-control study among males aged 48 to 80 years by Nonnenmacher, *et al* documented a significantly higher frequency of subgingival *P. intermedia* in patients with coronary artery disease when compared to the

controls, after adjusting for smoking.<sup>31)</sup> Further, Spahr, *et al* found a markedly higher number of *P. intermedia* in the subgingival biofilm of 43 to 73 year-old patients with CHD compared to age- and sex-matched controls. All these findings support our current results.<sup>25)</sup>

However, the above studies were based on the amount of *P. intermedia* in the subgingiva. Few reports have used the antibody level of *P. intermedia*, in contrast to other periodontopathic bacteria, to examine the relationship with CHD. In a population-based study conducted for 45 to 64 year-olds in the United States, a high serum IgG antibody level to *P. intermedia* was associated with risk of CHD among never smokers.<sup>32)</sup>

A relationship between *P. intermedia* and CHD was only detected in subjects aged 56-69 years in this study. This might be linked to the fact that *P. intermedia* play a major role during chronic periodontitis, with which older people are more likely to be afflicted, by regulating diverse inflammatory and immune responses to tissue destruction.<sup>33)</sup>

Since no studies have investigated the association between bacteria antibody and CHD by stratifying for age, it is unknown why different pathogens play a role in the different age groups. Therefore, further research will be needed to clarify the molecular-biological mechanisms of the age-related relationships between CHD and *P. intermedia* and *A. actinomycetemcomitans* found in this study.

Serological evidence confirms that an infection caused by *P. gingivalis* is a contributor to an increased risk for CHD. Pussinen, *et al* reported in a dentate male population aged 45 to 74 years that CHD was more common among subjects who were seropositive for *P. gingivalis* compared to those who were seronegative.<sup>34)</sup> However, we found no association between the plasma antibody to this species and risk of CHD. Similarly, several studies showed no significant connection between the presence of IgG antibodies to *P. gingivalis* and CHD, especially after adjusting for confounding variables.<sup>15,32,35)</sup>

In spite of the similar infectious capability of *P. gingivalis* strains, the risk of CHD differs depending on the strain; a particular genotype of *P. gingivalis* with strong virulence is considered to be involved more in the mechanisms linking periodontitis and CHD.<sup>16)</sup> The existence of different genotypes of *P. gingivalis* with different virulence may also contribute to the inconsistent relationship with CHD.

Our study had several strengths. We used antibodies to bacteria in examining the association between periodontal disease and CHD. Defining periodontal disease by clinical periodontal parameters, such as pocket depth or clinical attachment level, has been criticized when investigating the relationship with CHD, where long-standing exposure to the bacteria is the hypothesized risk factor, because they do not represent any systemic effect incurred by the periodontal disease. The most commonly used surrogates for systemic exposure are antibody titers, which indicate an immunological response against the periodontopathic bacterial infection and are thought to be a marker of inflammation. Antibody levels to serum periodontopathic bacteria are also closely related to the distribution of organisms in gingival plaque.<sup>32)</sup>

Further, the control of important confounders that would strongly affect both periodontal health and cardiovascular outcomes is important in interpreting the findings. We used controls and cases, individually matched for age, sex and other related factors, and a sampling ratio of 1:2 was intended to

ensure adequate statistical power. We also attempted to reduce potential confounding variables by statistically controlling for a number of CHD-related health indicators. In addition, the current prospective case-control design allows assessment of the causal role of periodontal pathogens in the development of CHD.

There are also limitations of our study that deserve consideration. Although serum antibody levels are considered stable over time, clinical periodontal status was not available, and it is not known whether the levels of antibody to periodontal organisms are the result of a prior incident or to active infection in the study population. In addition, information on remaining teeth, an important confounder for the antibody values,<sup>31)</sup> was missing. Further, only 3 periodontopathic species were investigated in this study, and antibody responses to other kinds of bacteria and their role in CHD incidence are unknown.

The possible role of periodontopathic bacteria as a risk factor for CHD incidence was demonstrated in this prospective study, where the elevated antibody level to these bacteria appeared to increase the risk of CHD. Therefore, a close relationship between oral disease and systemic disease was confirmed. From a public health standpoint, our result on periodontal disease as a risk factor for CHD is important, because periodontal disease can be prevented or treated. Given the high prevalence of both periodontal disease and CHD globally, the prevention and treatment of periodontal disease by appropriate oral health interventions might contribute to the prevention of CHD.

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調査報告  
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韓国の歯学教育事情  
——教育白書からみた歯科大学の状況——

森尾郁子 鶴田 潤 竹原祥子 川口陽子

日本歯科医学教育学会雑誌 第28巻 第2号 (平成24年) 別刷

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表 1 韓国の歯科大学一覧

図 1 内の番号	日本語名称	英語名称	所在地	電話 FAX	ホームページ
1	ソウル大学	Seoul National University School of Dentistry	110-749 Yeongeon-Dong Jongno-Gu, Seoul	(02) 740-8611 (02) 745-1906	<a href="http://dentistry.snu.ac.kr">http://dentistry.snu.ac.kr</a>
2	慶北大学	Kyungpook National University School of Dentistry	700-412 #2177 Daigubeol-Daero, Jung-Gu, Daegu	(053) 660-6801 (053) 425-6025	<a href="http://dent.knu.ac.kr">http://dent.knu.ac.kr</a>
3	全北大学	Chonbuk National University School of Dentistry	561-756 #664-14 1Ga Deokjin-Dong, Jeonju, Jeonbuk	(063) 270-4001 (063) 270-4004	<a href="http://dent.jbnu.ac.kr">http://dent.jbnu.ac.kr</a>
4	全南大学	Chonnam National University School of Dentistry	500-757 #77 Yongbong-Ro, Buk-Gu, Gwangju	(062) 530-5800 (062) 530-5810	<a href="http://dent.jnu.ac.kr">http://dent.jnu.ac.kr</a>
5	釜山大学	Pusan National University School of Dentistry	626-870 #10 Ami-Dong-1-Ga, So-Gu, Pusan	(051) 510-8206 (051) 510-8210	<a href="http://dent.pusan.ac.kr">http://dent.pusan.ac.kr</a>
6	江陵原州大学	Gangneung-Wonju National University College of Dentistry	210-702 #120 Gangneung Daehag-Ro, Gangneung, Gangwon Province	(033) 640-2443 (033) 642-6410	<a href="http://dentistry.gwnu.ac.kr">http://dentistry.gwnu.ac.kr</a>
7	慶熙大学	Kyung Hee University School of Dentistry	130-701 #26 Kyunghee-Daero, Dongdaemun-Gu, Seoul	(02) 961-0114 (02) 960-1457	<a href="http://www.khu.ac.kr">http://www.khu.ac.kr</a>
8	延世大学	Yonsei University College of Dentistry/School of Dentistry	120-752 #50 Yonsei-Ro, Seodaemun-Gu, Seoul	(02) 228-3012 (02) 362-8618	<a href="http://dentistry.yonsei.ac.kr">http://dentistry.yonsei.ac.kr</a>
9	朝鮮大学	Chosun University School of Dentistry	501-759 #375 Sesuk-Dong, Dong-Gu, Gwangju	(062) 230-6862 (062) 232-6896	<a href="http://dentistry.chosun.ac.kr">http://dentistry.chosun.ac.kr</a>
10	檀國大学	Dankook University College of Dentistry	330-714 San #29 Anseo-Dong, Cheonan, Chungnam	(041) 550-1114 (041) 550-1859	<a href="http://dentistry.dankook.ac.kr">http://dentistry.dankook.ac.kr</a>
11	圓光大学	Wonkwang University School of Dentistry	570-749 #460 Iksandae-Ro, Iksan, Jeonbuk	(063) 850-5114 (063) 850-6666	<a href="http://www.wku.ac.kr">http://www.wku.ac.kr</a>

が与えられる。教育年限が6年制の大学が3校、他学部を卒業した学士を入学させる4年制の大学が7校、両者併設が1校となっている。2015年には歯科大学5校が4年制から6年制の教育課程に戻る計画であり、以降は6年制の大学が8校、4年制の大学が3校（ソウル大学、全南大学、釜山大学）となる予定である。

韓国の国立大学のなかで最も古い歴史をもち、最大規模のソウル大学歯学部の前身は、1922年に設立された京城歯科医学専門学校である。もともとは高校卒業後に歯科大学に入学し、2年間の予科（教養課程）と4年間の本科（専門課程）で計6年間歯学を学び、卒業後に国家試

験に合格して歯科医師免許を取得するという日本とほぼ同様なシステムになっていた。

近年、米国の歯学教育のように、ほかの学部を卒業した学士を入学させて4年間の歯学専門教育を行うシステムに変革する大学が増えてきた。しかし、いくつかの課題も表面化し、4年制を選択した5大学は、2015年には6年制の教育に戻す計画であるという。

このように韓国の歯学教育制度に混乱が生じた原因の1つに、韓国における大学受験競争の厳しさが挙げられる。医学部、歯学部入試は競争率が非常に高く、大きな社会問題になったため、こうした学部を学士入学制度に

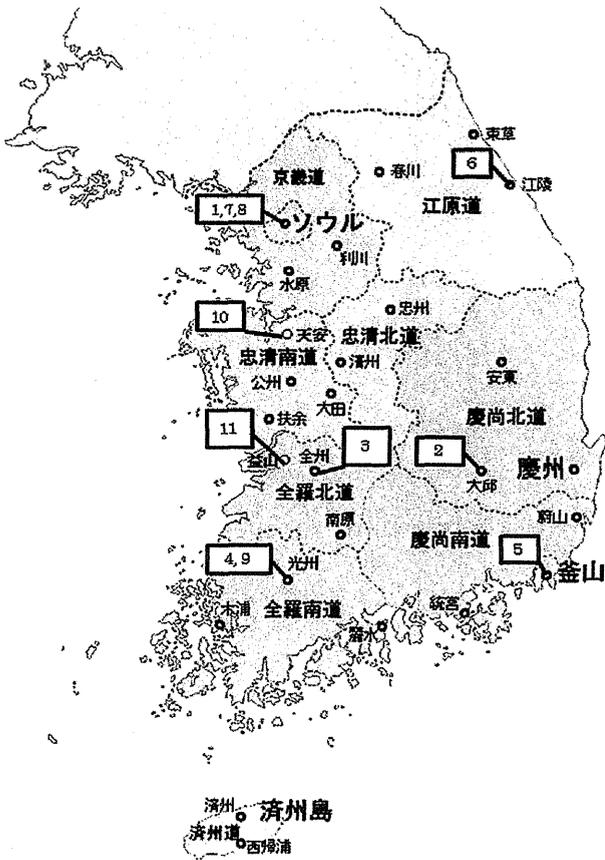


図1 韓国の歯科大学 (番号は表1左欄の番号)

変換することで、高校卒業直後の受験戦争を緩和しようとする目的もあったらしい。しかし、歯学部の人気は依然として高いため、厳しい受験戦争が単に4年先送りになっただけで、政府が意図したような効果は得られなかったようである。

また、4年制教育に変革する際、理学部、工学部などの出身者が、将来、基礎歯学分野の研究者になり、多彩な人材を歯科界に呼び入れることを期待していたが、現実には卒業後に大学の基礎系分野に残る者は少なく、年齢が高くなっている分、早く開業する者が多いそうである。韓国では、日本のような卒後の臨床研修制度はなく、卒業後、すぐに開業することも可能である。

韓国の男性には兵役が義務づけられているが、これまでは大学卒業後に、地方の保健所で公衆衛生歯科医師として約3年間働くことで兵役が免除されていた。しかし、4年制の大学に入学する学士の入学時の平均年齢は30歳を超えており、多くの学生が、他学部を卒業後にすでに兵役を終了している。したがって、歯科大学卒業後に兵役免除として保健所勤務をする者は少なくなり、近い将来、韓国では保健所勤務をする歯科医師の数が減少することが危惧されている。

歯科医師という職業の人気が高いこと、厳しい受験戦争があること、兵役があるといった韓国特有の事情が、4年制の教育制度に変換した大学が再び6年制の歯学教育に戻そうと計画している背景の1つにあると考えられた<sup>2)</sup>。

表2 韓国の歯科大学の設立年度、募集定員、卒業生総数、教育年限 (2011年2月現在)

国立 私立	大学名	設立年度 (年)	卒業回数 (回)	募集定員 (名)	卒業生 総数 (名)	男性* (名)	女性* (名)	現行の教育 年限 (年)	2015年 以降の教育 年限 (年)
国立	ソウル大学	1946	65	90	5,575	-	-	4	4
国立	慶北大学	1973	32	60	2,026	1,266	760	4	6
国立	全北大学	1978	27	40	1,102	711	391	4	6
国立	全南大学	1978	27	70	1,956	1,177	779	4	4
国立	釜山大学	1979	25	80	2,141	1,417	724	4	4
国立	江陵原州大学	1994	14	40	529	428	101	6	6
私立	慶熙大学	1967	40	80	2,863	-	-	4	6
私立	延世大学	1967	38	60	2,685	1,984	701	6・4	6
私立	朝鮮大学	1973	32	80	2,579	1,929	650	4	6
私立	檀國大学	1979	26	70	1,898	1,519	379	6	6
私立	圓光大学	1979	27	80	2,168	1,778	390	6	6
合計				750	25,522	12,209	4,875		

\*: 男女別の合計はソウル大学と慶熙大学を除外した数である。

韓国の歯科医師国家試験は全部で340問からなり、合格するには204問以上の正解が必要である（合格基準は正解率60%以上、絶対基準）。基礎歯科学、予防歯科学、保存修復学、歯周病学、歯科補綴学、口腔外科学など、各領域別にも合格基準が定められており、各領域別の合格基準は40%以上となっている。設問はすべて多選択肢問題形式で5つの選択肢から正解を1つ選ぶタイプである。韓国の歯科大学卒業生の最近の合格率は、再受験者を合わせて90~97%となっている。

韓国には、1999年、韓国歯医学教育学会（Korean Dental Education Association, KDEA, 会長：ソウル大学のKim Kack-Kyun教授）が設立されている。

また、韓国には日本にはない歯学教育の認証機関として韓国歯医学教育評価院（KIDEE：Korean Institute of Dental Education and Evaluation, 会長：慶熙大学のShin Je-Won教授）があり、事務局を大韓歯科医師会本部にしている。そのなかには歯学教育認証委員会（委員長：ソウル大学のKim Kack-Kyun教授）も設置されている。KIDEEは歯学教育の認証機関として6年前に設立され、米国の歯学教育認証制度に準じた形で2010年に2校、2011年に4校の歯科大学の認証を行っており、2012年に5校の認証を行って11校すべての歯科大学の認証作業を終了する予定である。韓国国内の歯科大学の認証評価を進める一方で、米国歯科医師会歯学教育認証委員会（American Dental Association, Commission on Dental Accreditation）やオーストラリア歯科評議会（Australian Dental Council）といった海外の歯学教育認証機関を訪問したり、東南アジア歯科医学教育学会から機関として招聘を受けたりするなど、対外的にも活発な活動を行っている。

### 歯学教育白書による調査

日本の歯科大学・歯学部長会議に相当する韓国歯科大学長協議会の下部組織である韓国歯医学教育協議会には、韓国にあるすべての歯科大学11校が加盟している。この協議会では、慶北大学のChoi Jae-Kap教授が中心になって各大学の歯学教育関連情報を収集し、2011年12月に韓国の歯学教育白書である『歯科大学・歯医学専門大学院の教育現況 第9集（2007~2010年度）』を発行した（図2）。

原本である韓国語の教育白書では、大学別に共通の調査項目に関する結果が詳細に示されているが、本調査では、大学間の比較が行いやすいように、調査項目ごとに11大学の状況をまとめて一覧表にして比較検討を行った。

以下にその調査項目と、主な項目に関する結果を示す。

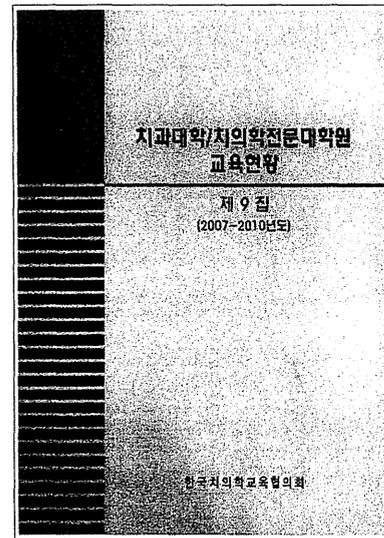


図2 『歯科大学・歯医学専門大学院の教育現況 第9集（2007~2010年度）』

### 1. 『歯科大学・歯医学専門大学院の教育現況 第9集（2007~2010年度）』の調査項目

#### 1) 大学全体

大学全体の教育理念、歯学部教育目的と教育目標、歯学部長の任命とその手続き、歯学部長の人事権、歯学部長の裁定権、歯学部事務の行政構造、教室主任教授。

#### 2) 教育課程

教育課程委員会の有無、構成、機能など、教育課程の特性、学年別教育時間数と単位数【講義、基礎実習（実験室）、臨床実習（実習室）、臨床実習（病院）別】、学生診療室の運営実態、校外臨床実習およびその他の現場教育、年度別選択教育課程運営の現況、その他の教育課程の開設状況（医療倫理、歯学史、法歯学、行動科学、保健医療法規、医療情報学、医療経営学）、学生参加型授業（自律学習）の運営状況、学生の評価、年度別留年者および退学者の現況、開設科目【予科（教養課程）、本科（専門課程）】。

#### 3) 学生

入学制度【専門大学院の場合の新入生の卒業学部の専攻分野：生物学、工学、化学、物理学、看護学、薬学、医学、漢医学、人文学、社会学、経済学、法学、芸術・体育、その他】、学生数（2010年）、歯科医師国家試験の合格率、卒業生の進路、学生のクラブ活動、学生寄宿舎、学生自律学習空間の有無、定期健康診断の有無。

#### 4) 教員

専任教員と非常勤教員の現況（2010年12月31日現在）、教員の研究実績、教員の研究費、専任教員名簿。

#### 5) 施設・設備

表 3 歯学部長の任期と推薦方法

大学名	任期の有無	任期の年数 (年)	任期延長の 可否	任期延長 回数 (回)	任命権者	推薦方法			
						直接選挙	間接選挙	総長指名	その他
ソウル大学	○	2	○	*	総長			○	
慶北大学	○	2	○	-	総長	○			
全北大学	○	2	○	1	総長	○			
全南大学	○	2	○	1	総長	○			
釜山大学	○	2	○	*	総長			○	
江陵原州大学	○	2	○	*	総長			○	
慶熙大学	×	-	-	-	総長			○	
延世大学	○	2	○	-	総長				**
朝鮮大学	○	2	○	-	総長	○			
檀國大学	○	2	○	1	総長			○	
圓光大学	○	2	***	-	総長				***

\* : 回数の制限なし, \*\* : 歯学部による直接選挙で2名を選出し, そのなかから総長が指名する, \*\*\* : 規定改正中.

表 4 歯学部長の人事権および裁定権

大学名	教授			助教 任用	行政職		予算 作成権	予算 執行権	教授の給与 決定権	学部長による 1回の専決可能 金額
	新規採用	昇進・ 再任用	定年保障		新規採用	昇進・ 再任用				
ソウル大学	○	○	○	○	×	×	○	○	×	無制限
慶北大学	○	○	○	○	×	×	○	○	×	記載なし
全北大学	○	○	○	○	○	○	○	○	×	無制限
全南大学	×	×	×	○	×	×	○	○	×	無制限
釜山大学	○	○	○	○	×	×	○	○	×	2億ウォン
江陵原州大学	×	○	○	○	×	×	○	○	×	2千万ウォン
慶熙大学	×	×	×	○	○	×	○	○	×	1千万ウォン未満
延世大学	○	○	×	○	×	○	○	○	×	1億ウォン未満
朝鮮大学	○	○	×	○	×	○	○	○	×	1千万ウォン
檀國大学	○	○	○	×	×	○	○	○	×	100万ウォン
圓光大学	○	○	○	○	○	○	○	○	×	1千万ウォン

(千ウォン≒76円, 2012年1月現在)

歯科大学専用および共用建物面積, 歯学専門図書館, 実験動物飼育施設.

6) 財政

実験実習費, 学生登録金(授業料), 歯科大学(歯医学専門大学院)発展基金の現況, 行政職員の現況, 歯科大学(歯医学専門大学院)の機構組織図.

2. 調査結果

1) 大学全体

歯学部長の任期と推薦方法についてまとめた結果を表

3に示す. 任期2年がほとんどで, 任期更新に制限がある大学と無制限の大学がある. 歯学部長の人事権および裁定権については, 学部長による1回の専決可能金額が無制限という大学が3校あった(表4).

2) 教育課程

(1) 歯学専門課程における教育時間数と単位数

4年間の歯学専門課程における教育について講義, 基礎実習(実験室), 臨床実習(実習室), 臨床実習(病院)に分けた, 大学ごとの時間数と単位数を表5に示す.

11歯科大学の時間数の平均は, 講義が1,680時間

表 5 歯学専門課程における教育時間数と単位数

国立 私立	大学名	講義		基礎実習 (実験室)		臨床実習 (実習室)		臨床実習 (病院)		総計	
		時間	単位	時間	単位	時間	単位	時間	単位	時間	単位
国立	ソウル大学	1,775	119	569	45	985	42	1,728	36	5,057	157
国立	慶北大学	1,302	88	357	11	680	19	1,344	44	3,683	162
国立	全北大学	2,720	-	224	-	576	-	1,728	-	5,248	164
国立	全南大学	1,605	107	120	8	315	21	360	24	2,400	160
国立	釜山大学	1,536	99	768	17.5	576	12.5	1,536	32	4,432	161
国立	江陵原州大学	1,552.5	103.5	450	7.5	600	10	2,160	38	4,762.5	159
私立	慶熙大学	1,608	95	480	16	976	24	1,448	34	4,512	169
私立	延世大学	1,989	123.5	294	-	671	-	2,233	41	5,187	164.5
私立	朝鮮大学	809	54	922	44.5	803	31	1,406.9	36	3,940.9	165.5
私立	檀國大学	1,680	112	1,170	26	180	4	1,305	28	4,335	170
私立	圓光大学	1,904	120	816	3	832	13	1,152	24	4,704	160
	平均	1,680.0	102.1	560.9	19.8	654.0	19.6	1,491.0	33.7	4,387.4	162.9

表 6 歯学教育課程の特徴および学生評価

国立 私立	大学名	教育の 週数	試験の 週数	統合科目の 有無(数)	選択科目の 有無(数)	シラバスの 配布 1. 全科目 2. 一部科目	臨床実習 指針書の 配布	学籍簿の 成績表示法 1. ABC 2. 100点 絶対評価, 相対評価	留年基準 の有無	退学基準 の有無
国立	ソウル大学	34	2	○(40)	○(42)	○1	○	1-相対	○	○
国立	慶北大学	40	-	○(16)	○(6)	○-	○	1-相対	○	○
国立	全北大学	36	4	○(-)	○(2)	○2	○	2-絶対	○	○
国立	全南大学	30	4	○(34)	○(11)	○1	○	2	○	○
国立	釜山大学	32	4	○(18)	○(22)	○1	○	1-絶対	○	○
国立	江陵原州大学	30	4	○(72)	○(61)	○1	○	1-絶対	○	○
私立	慶熙大学	32	2	○(11)	×	○1	○	1	○	○
私立	延世大学	32	4	○(22)	○(12)	○1	○	1-両方	○	○
私立	朝鮮大学	32	4	○(20)	○(3)	○-	○	1-相対	○	○
私立	檀國大学	30	4	○(5)	○(11)	○1	○	1-絶対	○	○
私立	圓光大学	32	2	○(2)	○(-)	○1	○	1-相対	○	○

(102.1 単位), 基礎実習(実験室)が560.9時間(19.8 単位), 臨床実習(実習室)が654時間(19.6 単位), 臨床実習(病院)が1,491時間(33.7 単位)で, 総計は4,387.4時間(162.9 単位)となっている。大学により総計は2,400~5,248時間, 単位は157~170と異なっている。時間数には2倍以上の差が認められた。

#### (2) 歯学教育課程の特徴および学生評価法

各大学の歯学教育課程の特徴および学生評価について

表6に示す。韓国では, 1学期が3~8月, 2学期が9~2月の2学期制で授業を実施している大学がほとんどであり, 1学期に15~20週の教育を実施している。

すべての大学で, シラバスや臨床実習指針書を学生に配布して授業を行っている。学籍簿への成績の評価法は, 100点満点の評価法を採用している大学は2校, ABC評価法を採用している大学が9校で, 絶対評価, 相対評価, 両者の併用など, 成績評価法は各大学によって異なっ