Determinants of the Utilization of Dental Services in a Community-Dwelling Elderly Japanese Population

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Oral health care is not only an effective strategy for the prevention, early diagnosis, and treatment of orofacial disease and disorders, but also an essential component of general health promotion programs. The current study aimed to identify the determinants of the utilization of dental services in an elderly population in Japan. A community-based comprehensive geriatric assessment, including the measurements of physical, mental, and social functioning, was conducted among elderly people aged ≥ 70 years residing in a suburban area of Sendai, Japan. Oral health status and functioning, their impact on the quality of life, and dental utilization were also surveyed. Of the 1,170 participants, 418 subjects who had specific treatment needs for dental problems and reported irregular dental attendance were recommended a dental visit, and 1 year later, their compliance with the recommendation was assessed by using questionnaire. Multiple logistic regression analysis demonstrated that a higher number of remaining teeth and the use of removable dentures were significant predictors of dental utilization within 1 year. Regular utilization was associated with a higher number of remaining teeth, younger age, presence of systemic disease, absence of depressive symptoms, and higher educational attainment. Conversely, non-compliance with the treatment recommendations was associated with fewer remaining teeth, smoking, and non-utilization of dental services during the previous year. The differences in the determinants of dental attendance behavior, which may be partially associated with the insurance coverage for dental services, suggest the need for specific strategies for oral health promotion for different behavior of dental utilization.
———— Elderly; Japanese; utilization of dental service; compliance; treatment recommendation.
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Oral health care is not only an effective strategy for the prevention, early diagnosis, and treatment of orofacial disease and disorders, but also an essential component of general health promotion programs. This concept has been advanced by recent reports on the association between oral health and physical and mental health (Österberg et al. 1990; Shimazaki et al. 2001), and the importance of a healthy oral status in the maintenance and improvement of systemic health has become apparent in recent years.

Previous studies have shown that the utilization of dental services is less among elderly people than among those of other age groups (Holtzman et al. 1990; McGrath et al. 1999; Wall and Brown 2003). Further, it has been reported that the utilization of medical services increases, while that of dental services tends to decrease as a popula-

tion ages (Atchison et al. 1993; Ettinger 1993). In Japan, people aged 70 years and above seem reluctant to visit dental services (http://www1.mhlw.go.jp/toukei/ h11hftyosa_8/ kekka7.html), and elderly Japanese people do not necessarily have a positive outlook towards dental care.

Previous studies have discussed the following 2 patterns of dental utilization — (1) utilization for treating pain or some emergency oral condition, generally within 1 year, and (2) regular utilization for preventing oral disease, for routine check-ups, or for maintaining oral health after treatment. Atchison et al. (1993) indicated the need to examine factors associated with the utilization of dental services for preventive care and to compare them with factors associated with illness-related utilization of these services. We propose that compliance (adherence) with a treatment recom-

mendation is a third pattern of dental utilization that differs from the other 2 patterns. We also hypothesize that the 3 utilization patterns have different predictors. However, the factors that prevent elderly Japanese from using dental services and those associated with the compliance of elderly people with recommended treatment have not been identified or understood in detail.

Given this background, the objective of the present study was to examine how dental services are utilized by a community-based elderly population in Japan and to identify the determinants of the utilization of dental services over 1 year, the regular utilization of such services, and compliance with treatment recommendations.

Subjects and Methods

Study population

The study was performed as a component of the Tsurugaya project (Hozawa et al. 2004), a community-based comprehensive geriatric assessment (CGA) conducted in 2002 and 2003 among elderly Japanese subjects living in Tsurugaya district, a suburban area of Sendai City in northern Japan. CGA is a structured approach to measuring physical, mental, and social functioning of elderly people to assess early deterioration to long-term care conditions and to promote healthy and active aging. A clinical dental examination was also performed as part of the CGA. The study was conducted with the permission of the institutional review board of Tohoku University Graduate School of Dentistry.

In 2002, 2,730 inhabitants aged ≥70 years were living in Tsurugaya. We dispatched informational letters to these inhabitants and invited them to participate in the health survey. Of those invited, 1,198 (43.9%) participated in the survey and 1,178 (43.2%) provided their written informed consent for inclusion in the subsequent analysis.

In the baseline survey (2002), we obtained data on the utilization of dental services during the previous year and on the regular utilization of these services from 1,170 participants. Of these, 418 subjects were recommended specific treatment on the basis of the baseline survey, but had not been utilizing dental services regularly. The compliance of these subjects with the treatment recommendation was assessed in a follow-up survey (2003).

Data collection

The clinical dental examinations were administered by 5 specially trained dentists. The examination included the determination of the following: the number of remaining teeth, presence of decayed teeth, utilization of removable dentures, and score on the Community Periodontal Index (CPI). The retained roots were excluded from the remaining teeth. CPI has been developed as an epidemiological tool to evaluate treatment needs for the prevention of periodontal disease in the population. The indicators for this evaluation are the depth of the dental sulcus, supra- and sub-gingival calculus, and bleeding after gentle probing. The examiners were familiar with the evaluation of these indicators in their daily dental practice. We confirmed the inter-examiner reliability of the CPI scores by the fact that the variation of the scores for each tooth was no greater than one between the examiners in a trial survey conducted before the baseline survey. Participants with decayed or missing teeth, those requiring periodontal treatment (CPI score: 1-4), and those with poorly fitting dentures or other treat-

ment requirements were advised to visit a dental care facility in the baseline survey.

The utilization of dental services was assessed by asking the following 2 questions: (1) Do you regularly visit a dental service even when there are no symptoms? (2) How much time has elapsed since your last dental visit? We considered subjects who utilized dental services within 1 year from the time when they received our treatment recommendation as compliant subjects.

To assess the oral health-related quality of life (QOL), we used the modified version of the 10-item Oral Impacts on Daily Performance (OIDP) (Adulyanon et al. 1996). The OIDP questionnaire focused on the impact of oral health on the performance of daily activities such as eating, speaking, cleaning teeth or dentures, undertaking light physical activities, going outdoor, sleeping, relaxing, smiling, enjoying contact with other people, and emotional stability. The subjects were classified into a normal group and an impaired group on the basis of the responses obtained for relevant items in the questionnaire. We examined whether the subjects experienced dissatisfaction while eating because of conditions such as dysphagia and gustatory disturbance and xerostomia. The presence or absence of self-assessed masticatory disability was measured using the Masticatory Index Scale (Maki et al. 1995), which was developed to evaluate the chewing function of elderly Japanese people. The ability to chew 10 types of food (boiled fish, rice, broiled fish paste, boiled fish paste, arum root paste, chicken, apples, Chinese cabbage, rice crackers, and peanuts) was determined, and the subjects were divided into those who could masticate all the foods and those who had difficulty masticating one or more of the foods.

The presence or absence of systemic diseases, including stroke, myocardial infarction, angina pectoris, hypertension, diabetes mellitus, hyperuricemia and hypercholesterolemia, was reported by the participants themselves. Self-reported physical function was assessed using the 6-item physical function scale of the Medical Outcome Study (MOS) Short-form General Health Survey (Stewart et al. 1988): MOS scores of 5 or 6 indicate subjects able to perform vigorous activity, and scores of 0-4 indicate those capable of moderate or low physical activity. The score well reflected physical performance, such as 10-meter maximum walk test, leg extension power, timed 'up and go' test, and functional reach (data not shown). The higher-level functional capacity required for living a socially independent life, the so-called instrumental activity of daily living (IADL) (Ishizaki et al. 2000), was evaluated on the basis of the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG index), which was specifically developed for Japanese people (Koyano et al. 1991). This index consists of 3 subscales: instrumental self-maintenance (5 questions), intellectual activity (4 questions) and social role (4 questions). The maximum score is 13 points, and lower scores indicate greater aggravation of higher-level functional capacity. The participants were classified as unrestricted (TMIG index score = 13) and restricted (< 13) on the basis of these scores.

Depressive symptoms were measured using the Japanese version of the 30-item Geriatric Depression Scale (GDS 30), with a cut-off of 11 (Brink et al. 1982). Each item was assessed by a one-sentence question requiring a yes-or-no answer. An answer that tended to be depressive scored 1 point, and the score was summed over the 30 items; therefore, the maximum score was 30 points. Cognitive function was evaluated using the Mini-Mental State Examination (MMSE) (Folstein et al. 1975; Mori et al. 1985). Higher MMSE scores indicate higher cognitive function, and the maximum score is 30 points. The

participants were classified as normal (MMSE score ≥28) or as slight cognitive impairment (MMSE score ≤ 27) (Kuriyama et al. 2006).

The various levels of social support were assessed by the following questions: Do you have someone (1) with whom you can consult when you are in trouble? (2) with whom you can consult when your physical condition is not good? (3) who can help with your daily housework? (4) who can take you to a hospital when your physical condition is not good? (5) who can take care of you when you are ill in bed? In addition, data on the subjects' educational background, smoking status, and alcohol consumption status were collected.

Statistical analysis

The baseline data (*n* = 1170) were used to identify factors associated with dental service utilization within the previous year and regular utilization. Data from the follow-up survey (*n* = 418) were used to identify factors influencing compliance. The associations between the utilization of dental services and the different variables were explored through bivariate analysis performed using chi-squared test. Further, multivariate logistic regression analysis was performed to identify factors that independently influenced the utilization of dental services. In the regression model, we regarded variables that were identified to be statistically significant in the bivariate analysis as covariates. All data analyses were performed using the SAS software, version 9.1 (SAS Institute Inc., Cary, NC, USA). A *p* value of <0.05 was accepted as statistically significant.

Results

Dental utilization during the previous year and regular dental utilization—the 2002 baseline survey

The baseline characteristics and dental service utilization of the 1,170 subjects who were examined in 2002 are presented in Table 1. The mean age of the subjects was 75.7 years (SD = 4.8 years), and 58.4% of them were female. The mean number of remaining teeth was 14.0, and 17.4% of the subjects were edentulous. Overall, 57.0% (*n* = 667) of the subjects had visited a dental service during the previous year, and 18.0% (*n* = 221) regularly visited such a facility.

Bivariate analysis revealed that the utilization of dental services during the previous year had a significant negative association with advanced age, female gender, and cognitive impairment. Vigorous physical activity, no restriction of IADL, higher educational attainment, more teeth remaining, and the use of removable dentures were positively associated with the utilization of dental services during the previous year. Furthermore, compared to subjects who did not utilize dental services regularly, those who did were more likely to have systemic disease, to have been older when they completed their education, to have more teeth remaining, and to have better oral health-related QOL. Regular users were less likely to be older and to have moderate/low physical activity, restriction of IADL, depressive symptoms, cognitive impairment, and self-assessed masticatory disability.

Multiple logistic regression analysis indicated that the number of remaining teeth and the use of removable dentures were independently associated with the utilization of a

dental service during the previous year (Table 2). The odds ratios (ORs) for utilization of dental services during the previous year gradually increased with a higher number of remaining teeth.

The results of the multiple logistic regression analyses for regular dental service utilization are shown in Table 3. Advanced age and depressive symptoms were identified as preventive factors for regular dental service utilization. The presence of systemic diseases, higher educational attainment, and a higher number of remaining teeth were identified as predictors of regular utilization. Similar to the ORs for the utilization of dental services during the previous year, those for regular utilization of these services increased with a higher number of remaining teeth.

Compliance with treatment recommendation—the 2003 follow-up survey

The compliance of 418 subjects with the recommended treatment was examined in a follow-up survey conducted in 2003; the profiles and compliance rates of these subjects are shown in Table 4. Of these subjects, 62.9% (*n* = 263) adhered to the treatment recommendation. Bivariate statistical analysis revealed that compliance with the treatment recommendation had a significant relationship with the current smoking status, number of remaining teeth, and the utilization of dental services during the year before treatment had been recommended. No other variable showed a significant association with compliance.

The results of the multiple logistic regression analyses with adjustments for age and gender are shown in Table 5. The current smoking status, number of remaining teeth, and the utilization of dental services during the year before treatment had been recommended remained independent factors associated with compliance. The OR for 10-19 remaining teeth, in relation to an edentulous state, was the most significant predictive factor for compliance with the treatment recommendation.

Discussion

In this study, 57.0% of the participants had used a dental service during the year before the baseline survey. A national survey on oral health conducted in Japan in 1999 (http://www1.mhlw.go.jp//toukei/h11hftyosa_8/kekka7.html) showed that 37.1% of the participants aged ≥70 years had utilized dental services during the previous year or were receiving dental treatment at the time. An investigation conducted in Japan in 1995-1998 (Ikebe et al. 2002) indicated that 59.9% of all independently living elderly people aged ≥ 60 years who were enrolled in the Senior Citizen's College had visited a dentist during the previous year. Moreover, previous surveys conducted in the USA (Skaar and Hardie 2006), UK (McGrath et al. 1999), Canada (Locker et al. 1991), Finland (Suominen-Taipale et al. 2001), and Australia (Slack-Smith and Hyndman 2004) on participants in the same age group as our study participants have indicated that 34.7%-75.6% of the subjects had uti-

Table 1. The association of dental service utilization within the previous year and regular utilization with baseline characteristics.

	N*	%	Within the previous year		Regular utilization	
			% of User	P^1	% of User	P^1
Total	1170	—	57.0		18.0	
Age				0.0005		<0.0001
70-79	930	79.5	59.6		20.8	
80-	240	20.5	47.1		7.5	
Gender				0.05		ns
Male	487	41.6	60.4		19.3	
Female	683	58.4	54.6		17.1	
Smoking				ns		ns
Never/Former	1000	87.1	57.4		18.0	
Current	148	12.9	52.7		16.9	
Alcohol consumption				ns		ns
Never/Former	665	59.6	58.0		16.8	
Current	450	40.4	56.0		19.8	
Systemic diseases[2]				ns		0.02
Absent	419	35.8	53.5		14.6	
Present	751	64.2	59.0		20.0	
Physical function[3]				0.05		0.006
Vigorous activity	735	63.1	59.2		20.4	
Moderate/Low activity	430	36.9	53.3		14.0	
IADL[4]				0.02		0.04
Unrestricted	580	49.6	60.3		20.3	
Restricted	590	50.4	53.7		15.8	
Depressive symptoms[5]				ns		0.0003
Absent	768	66.0	58.7		21.0	
Present	396	34.0	53.5		12.4	
Cognitive impairment[6]				0.006		0.01
Absent	653	56.0	60.6		20.5	
Present	513	44.0	52.6		14.8	
Social support[7]				ns		ns
"No" to all questions	567	48.5	59.6		20.1	
"Yes" to questions 1-4	420	35.9	55.2		15.7	
"Yes" to all questions	183	15.6	53.0		16.9	
Duration of education				0.006		0.001
≥18 years	653	56.4	60.5		21.1	
<18 years	505	43.6	52.7		13.9	
Number of remaining teeth				<0.0001		<0.0001
0	203	17.4	32.0		4.9	
1-9	257	22.0	55.6		12.8	
10-19	231	19.7	68.4		19.0	
≥20	479	40.9	62.8		25.9	
Use of removable dentures				0.02		ns
User	764	70.1	58.9		16.2	
Non-user	326	29.9	51.2		20.2	
Periodontal disease				ns		ns
CPI score 0	135	14.9	67.4		25.2	
CPI score 1-2	333	36.8	63.1		19.5	
CPI score 3-4	437	48.3	59.0		21.5	

Table 1. (Continued)

	N*	%	Within the previous year		Regular utilization	
			% of User	P^1	% of User	P^1
Oral health-related QOL[8]				ns		0.02
Normal	829	70.9	56.3		19.7	
Impaired	341	29.1	58.7		14.1	
Dissatisfaction experienced while eating[9]				ns		0.0005
Absent	379	32.4	57.8		20.1	
Present	791	67.6	56.6		17.1	
Self-assessed masticatory disability[10]				ns		0.0005
Absent	731	62.5	58.0		21.1	
Present	439	37.5	55.4		13.0	

[1]Determined by chi-squared test.

[2]Defined as a history of stroke, myocardial infarction, angina pectoris, hypertension, diabetes mellitus, hyperuricemia and hypercholesterolemia.

[3]Assessed using the 6-item physical function scale of the Medical Outcome Study (MOS) Short-form General Health Survey.

[4]Assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG index).

[5]Measured using the Japanese version of the 30-item Geriatric Depression Scale (GDS), with a cut-off of ≥ 11.

[6]Evaluated using the Mini-Mental State Examination (MMSE), with a cut-off of ≥ 28.

[7]Assessed using the following questions: Do you have someone (1) with whom you can consult when you are in trouble? (2) with whom you can consult when your physical condition is not good? (3) who can help with your daily housework? (4) who can take you to a hospital when your physical condition is not good? (5) who can take care of you when you are ill in bed?

[8]Assessed using the modified version of the 10-item Oral Impacts on Daily Performances (OIDP).

[9]For example, dysphagia, gustatory disurbance, bite wound and so on.

[10]We assessed the subjects' ability to chew 10 types of food (boiled fish, rice, broiled fish paste, boiled fish paste, arum root paste, chicken, apples, Chinese cabbage, rice crackers, and peanuts) and divided the subjects into those who could masticate all the foods and those who had difficulty masticating one or more of the foods.

ns, not significance.

*Numbers may not total 1,170 due to missing value.

Table 2. Multivariate Odds Ratios (ORs) and 95% confidence intervals (CIs) for the utilization of dental services within the previous year.

	OR	95% CI	P
Age (continuous variable)	0.99	0.96 - 1.02	ns
Female	0.91	0.70 - 1.20	ns
Vigorous physical activity	1.03	0.78 - 1.38	ns
Unrestricted IADL	1.05	0.80 - 1.38	ns
Cognitive impairment	0.81	0.62 - 1.06	ns
Duration of education (≥ 18 years)	1.23	0.94 - 1.61	ns
Number of remaining teeth			
0	1.00 (Reference)		
1-9	2.59	1.74 - 3.84	<0.0001
10-19	4.94	3.22 - 7.58	<0.0001
≥ 20	6.45	4.03 - 10.32	<0.0001
Use of removable dentures	2.96	2.03 - 4.32	<0.0001

These valuables were simultaneously included multiple logistic regression model.

lized dental services in the preceding year.

In the present study, multiple logistic regression analysis indicated that a higher number of remaining teeth and the use of removable dentures were strong predictors of a decision to use a dental service during the previous year.

The edentulous subjects were the most reluctant to use a dental service; this finding is consistent with those of other studies (Suominen-Taipale et al. 2001; Ikebe et al. 2002). However, the significant positive association that was found to exist between the use of removable dentures and the utili-

Table 3. Multivariate ORs and 95% CIs for regular utilization of dental services.

	Odds ratio	95% confidence interval	P
Age (continuous variable)	0.94	0.90 - 0.98	0.003
Systemic diseases	1.49	1.06 - 2.10	0.02
Vigorous physical activity	1.15	0.80 - 1.66	ns
Unrestricted IADL	0.92	0.66 - 1.29	ns
Depressive symptoms	0.64	0.45 - 0.97	0.02
Cognitive impairment	0.93	0.66 - 1.30	ns
Duration of education (≥18 years)	1.42	1.01 - 1.99	0.05
Number of remaining teeth			
0	1.00 (Reference)		
1-9	2.81	1.30 - 6.06	0.009
10-19	3.86	1.80 - 8.24	0.0005
≥20	4.83	2.33 - 10.00	<0.0001
Oral health-related QOL	0.95	0.63 - 1.42	ns
Self-assessed masticatory disability	0.85	0.57 - 1.25	ns

These valuables were simultaneously included multiple logistic regression model.

zation of dental services during the previous year is in contrast to the results of several previous studies (Atchison et al. 1993; Österberg et al. 1998). This finding suggests that compared to persons who wear complete dentures, dentate persons, including those who wear removable partial dentures use dental services more often and have more oral health problems or treatment needs. Ikebe et al. (2002) argued that compared to people who wear complete dentures, those who wear partial dentures might not be able to cope with the functional and psychological aspects of wearing them, or may have higher expectations of the removable partial dentures. In the present study, the ORs for dental service utilization during the previous year gradually increased with a higher number of remaining teeth; this finding was in agreement with Kiyak and Reichmuth (2005), who mentioned that older adults with more teeth make more dental visits than their counterparts with fewer teeth.

Overall, 18.0% of the subjects involved in this study regularly utilized dental services. We found that the regular utilization of these services was related to the age of the subjects, the duration of education received, and the number of remaining teeth; these results were in agreement with those of previous studies (Lundgren et al. 1995; McGrath et al. 1999). Interestingly, we found that the presence of systemic diseases contributed to an increase in the regular utilization of dental services. In contrast, previous studies conducted in other countries have suggested that chronic medical conditions do not influence the utilization of dental services (Atchison et al. 1993; Suominen-Taipale et al. 2001), while some other studies have revealed that an impaired functional health status negatively affects the utilization of dental services (Fiske et al. 1990; Lundgren et al. 1995). Compared to healthy persons, persons with impaired functional health may utilize dental services less frequently, possibly because of the restricted mobility associated with

their condition or, more likely, because their focus is directed towards managing their other health problems. The subjects involved in this study were sufficiently mobile and could participate in the CGA and they did not need to travel far to visit their family dentists in Tsurugaya district. The discrepancy between our results and those of studies conducted in other countries may be attributable to the characteristic features of the Japanese insurance system. Universal medical insurance has been implemented in Japan since 1961, and it covers dental health services for more than 98% of the population. However, routine dental health check-ups and oral care services for disease prevention are not covered by national health insurance. Therefore, people with systemic diseases might be more conscious about their health and may consequently have a positive approach towards utilizing dental services. We identified an inverse relationship between depressive symptoms and the regular utilization of dental services. Depressive symptoms are a common problem associated with mental function among elderly people and a rapidly growing public health concern due to aging of the population. Recently, associations between depressive symptoms and oral health status or oral health-related QOL have been reported (Anttila et al. 2001; Kressin et al. 2002). The listlessness in daily life that accompanies depressive symptoms may cause passive oral health behavior and lead to oral deterioration.

The follow-up survey we conducted revealed poor compliance among approximately one-third of the subjects. In Japan, the rates of compliance with a treatment recommendation are historically known to be lower among elderly people than among younger people. We hypothesize that this is because of the large gap that exists between the treatment requirements specified by professionals and the willingness of individuals to receive dental treatment. In fact, we found no apparent association between the CPI score

Table 4. The association between compliance with treatment recommendations and baseline characteristics.

	N*	%	Compliance with treatment recommendation	
			% of User	P
Total	418	—	62.9	
Age				ns
70-79	346	82.8	62.7	
80-	72	17.2	63.9	
Gender				ns
Male	187	44.7	63.6	
Female	231	55.3	62.3	
Smoking				0.007
Never/Former	366	88.6	65.0	
Current	47	11.4	44.7	
Alcohol consumption				ns
Never/Former	235	59.2	63.8	
Current	162	40.8	62.3	
Systemic diseases				ns
Absent	160	38.3	63.1	
Present	258	61.7	62.8	
Physical function				ns
Vigorous activity	294	70.7	64.3	
Moderate/Low activity	122	29.3	59.8	
IADL				ns
Unrestricted	243	58.1	63.4	
Restricted	175	41.9	62.3	
Depressive symptoms				ns
Absent	308	73.7	62.0	
Present	110	26.3	65.5	
Cognitive impairment				ns
Absent	254	60.9	66.5	
Present	163	39.1	57.7	
Social support				ns
"No" to all questions	60	14.4	55.0	
"Yes" to questions 1-4	144	34.4	59.7	
"Yes" to all questions	214	51.2	67.3	
Duration of education				ns
≥18 years	255	61.3	64.7	
<18 years	161	38.7	60.2	
Number of remaining teeth				<0.0001
0	42	10.0	28.8	
1-9	87	20.8	64.4	
10-19	96	23.0	76.0	
≥20	193	46.2	63.2	
Use of removable dentures				ns
User	261	67.1	66.7	
Non-user	128	32.9	57.0	
Periodontal disease				ns
CPI score 0	23	6.5	60.9	
CPI score 1-2	145	40.6	64.1	
CPI score 3-4	189	52.9	68.3	
Oral health-related QOL				ns
Normal	304	72.7	61.8	
Impaired	114	27.3	65.8	
Dissatisfaction experienced while eating				ns
Absent	145	34.7	64.1	
Present	273	65.3	62.3	
Self-assessed masticatory disability				ns
Absent	277	66.3	63.9	
Present	141	33.7	61.0	
Utilization of dental services within the previous year				<0.0001
User	223	53.4	78.0	
Non-user	195	46.6	45.6	

Table 5. Multivariate ORs and 95% CIs for compliance with a recommendation for dental consultation.

	Odds ratio	95% confidence Interval	P
Age (continuous variable)	1.00	0.95 - 1.01	ns
Female	0.75	0.47 - 1.09	ns
Currently smoking	0.41	0.20 - 0.85	0.02
Number of remaining teeth			
0	1.00 (Reference)		
1-9	2.74	1.14 - 6.59	0.02
10-19	4.03	1.64 - 9.91	0.002
≥20	2.36	1.03 - 5.37	0.04
Utilization of dental services within the previous year	3.48	2.22 - 5.46	<0.0001

These valuables were simultaneously included multiple logistic regression model.

and compliance with treatment recommendations.

Multivariate analyses revealed that compliance with treatment recommendations was better among individuals who had 10-19 remaining teeth than among the other subjects. In a study involving 1,582 Japanese people aged 72 years, Arikawa (2005) reported that those who possessed 10-19 teeth visited a dental service in the preceding year most frequently among the female, and the medical expenses incurred for dental care were found to be highest for both male and female with 10-19 teeth.

We found that smoking and lack of dental utilization during the previous year (baseline survey) were associated with noncompliance with the treatment recommendations. Österberg et al. (1998) conducted a study on 1,778 elderly Swedish individuals; they reported that smoking was significantly associated with a reduced probability of having visited a dentist during the previous year, and that this association was independent of age, gender, functional ability, and other socioeconomic covariates. Another study involving 7,544 elderly Australians also revealed that subjects who were currently smokers were significantly less likely to have visited dental services than non-smokers (Slack-Smith and Hyndman 2004). Therefore the health behavior and attitude of smokers appear to be less favorable for the utilization of dental services than those of non-smokers. The utilization of dental services during the previous year was statistically identified as the most important predictor of compliance with treatment recommendation: people who had visited a dentist during the previous year were more likely to adhere to the treatment recommendation as compared to people who had not visited a dentist for year or more. This finding raises the concern that people who do not utilize dental services for a prolonged duration may show an increased tendency to not visit a dentist at all.

Our study has several limitations. First, its observational design does not enable complete exclusion of residual confounding factors. For example, financial status and the attitudes toward oral health were not studied as variables. Previous studies have indicated that a subject's financial status might be related to his/her utilization of dental services (Atchison et al. 1993; McGrath et al. 1999; Suominen-Taipale et al. 2001; Ikebe et al. 2002). There is a possibility that financial status influences the dental utilization even in Japan, because most dental treatment is not free of charge although it is highly subsidized due to insurance. In a 6-month follow-up study, Kiyak (1987) reported that the best predictors of the decision to seek care were attitudinal variables. However, we conducted a CGA, which made it possible to correct for many potential confounding factors; hence, we believe that our findings are robust in this respect. Another limitation of our study is that the treatment recommendation was not made by a clinical dentist through a decision-making process but rather by the researchers on the basis of an initial diagnosis. When specific treatment is recommended in a clinical setting, the patient's health status and the importance of the treatment outcome should be considered (Kay and Nuttall 1995). Therefore, in the present study, we could not correct for the effect of the subjects' preferences and their perception of the importance of dental care. However, it should be noted that the aim of the treatment recommendations given during the baseline survey was to make the subjects aware of their oral health problems. The final limitation of our study is that in the follow-up survey, we regarded subjects who had utilized dental services within one year from the time of our treatment recommendation as compliant; therefore, we may have overestimated the proportion of compliant subjects.

This study is the first to identify factors associated with 3 patterns of dental utilization and to compare them in the same population. In summary, oral health (in terms of higher number of remaining teeth and the use of removable dentures) was identified as a predictive factor for the utilization of dental services within 1 year. Regular utilization of dental services was found to be associated with sociodemographic and general health factors (age, systemic diseases, depressive symptoms, and educational attainment) as well as with oral health (the number of remaining teeth). Fewer remaining teeth, smoking, and no utilization of dental ser-

vices during the previous year contributed to noncompliance with the treatment recommendations. Thus, we found that there are different determinants for the utilization of dental services for treating pain or an emergency oral health condition, regular utilization of these services for preventing oral diseases, and compliance with treatment recommendations in a community-dwelling independent elderly population in Japan. The differences in the determinants of different dental attendance behavior, as well as their nationality specificity, which may be partially associated with the insurance coverage for dental services, suggest the need for specific strategies for oral health promotion for different behavior of dental utilization.

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