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Factors Associated with Number of Present Teeth in Adults in Japanese Urban City

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Abstract

The purpose of this study was to identify which factors were associated with number of present teeth (PT) in older adults as their clarification might contribute to maintaining the number of PT in this population. These factors were investigated by means of a questionnaire on oral health condition, general health behavior, and anamnesis of diabetes mellitus together with a dental examination. Data were obtained from a total of 7,741 Japanese subjects (2,623 males and 5,118 females), all of whom were aged 40, 50, or 60 years. Significant differences were observed in the mean number of PT between a positive or negative response to questions on anamnesis of diabetes mellitus, current smoking, and having loose teeth in all age groups in males; significant differences were also observed for current smoking, lower intake of dairy milk products, having loose teeth, no experience of tooth brushing instruction, and poor oral hygiene status in all age groups in females. Stepwise logistic regression analysis revealed having loose teeth (odds ratio [OR], 1.82), gingival swelling (OR, 1.40), an anamnesis of diabetes mellitus (OR, 1.72), current smoking (OR, 1.86), lower intake of dairy milk products (OR, 1.22), preference for salty seasonings (OR, 1.23), frequent sweet intake (OR, 1.29), no experience of tooth brushing instruction (OR, 1.38), and poor oral hygiene (OR, 2.04) as significant risk factors for the number of PT being <24 after adjusting for age and sex. These results indicate that an anamnesis of diabetes mellitus, a history of smoking, the presence of loose teeth, and poor oral hygiene status in a self-reported evaluation of oral health might correlate with <24 PT in older adults.

Key words: Present teeth—Self-reported health—Health behavior—Cross sectional study—Adults

Introduction

Many studies have clearly shown that maintaining the number of present teeth (PT)

plays a significant role in health-related quality of life in elderly and younger adults^{1,2,13,34,40,44,49,50,53,54,62}. More recently, a number of studies have focused on tooth loss as a risk

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factor in general health conditions, such as cardiovascular disease and stroke^{1,6,8,15,16,19,20,27,29,30,35–37,51,59}, dementia⁵², diabetes mellitus^{11,31,41,42,45,56,57}, hypertension⁵⁵, and gastrointestinal cancer¹. Taken together, this indicates the potential of number of PT as an indicator of oral and general health status which can be used for comparisons both domestically and internationally.

Numerous studies on patterns and the mean number of lost teeth in adult populations have used cross-sectional surveys^{5,7,23,26,39,40,60}. However, relatively few epidemiological studies on self-reported oral health conditions and lifestyles in populations aged between 40 and 60 years have investigated factors related to PT^{3,7,24,32,62}.

The purpose of this study was to determine how self-reported oral health conditions, lifestyles, oral health behaviors, and oral hygiene status correlated with tooth loss in adults aged between 40 and 60 years. We believe that clarifying this relationship may be useful to maintaining PT in the elderly.

Materials and Methods

1. Subjects

Dental checkups were conducted on subjects aged between 40 and 60 years in one of the cities that make up the Tokyo Metropolis. The population of the city targeted was over 650,000. The main purpose of the checkups was to identify individuals at high risk of lifestyle-related diseases such as diabetes mellitus, myocardial infarction, and cerebrovascular disease. The checkups were performed on subjects aged 40, 50, or 60 years. The following factors were determined in each age group: number of PT; oral hygiene status; and treatment needs. The examinations were performed at 5 public health centers. Questionnaires were administered before each checkup. Data were obtained from a total of 7,741 subjects (male, 2,623; female, 5,118) in 2005 and 2006. The subjects comprised individuals who were unable to undergo health checkups at their place of work, housewives,

and adults without regular employment. All were residents of the city targeted and covered by the National Health Insurance system (*Kokumin Kenko Hoken*). This study did not include those covered by the Employees' Health Insurance system (*Kenko Hoken*).

2. Statistical analysis

The following items were surveyed to investigate their potential correlation with risk of having <24 PT: (anamnesis) diabetes mellitus, yes or no; (self-reported oral health) presence or absence of gingival swelling and loose teeth, yes or no; (lifestyle) smoking habits—smoker, or never or quit; weekly milk intake, <4 times or ≥ 4 times; weekly intake of sweets and sweet beverages, <7 days or 7 days; preference for salty seasonings, yes or no; (oral health behavior) experience of brushing instruction, yes or no; and regular dental checkups, yes or no. In addition, the oral hygiene status and number of PT were determined by a dentist in each patient. Oral hygiene status was categorized as good, or fair or poor; the number of PT was categorized as <24 or ≥ 24 .

An unpaired *t*-test was used to determine significant differences in the number of PT depending on the responses to the questions on anamnesis, self-reported oral health, lifestyle, oral health behavior, and oral hygiene status.

Stepwise logistic regression analysis was used to identify which parameters with a significant association with the probability of <24 PT had an independent effect and to assess the predictive value of their combined effect. The independent variables for the stepwise logistic regression analysis were significantly different parameters identified using an unpaired *t*-test. All parameters that had a *p*-value of less than 0.05 were entered into the analysis. To generate an odds ratios (OR) that could be compared across independent variables, all parameters were entered in a binary format coded as 0 or 1.

The datasets were compiled and statistical analyses performed using SAS, Ver. 9.1 for Windows (SAS Institute, Cary, NC, USA).

Results

The number of females was almost double that of males in each of the 3 age groups.

Table 1 shows the mean and distribution in the number of PT by age and sex. There was no significant difference in the mean number of PT between sexes. These results were similar to those of the Report on the Survey of Dental Disease issued by the Dental Health Division of the Health Policy Bureau, Ministry of Labour, Health, and Welfare Japan in 2005¹⁴⁾.

The mean number of PT and its relationship with each parameter targeted is shown in Table 2 for males and Table 3 for females. The mean number of PT in subjects who smoked and had loose teeth was significantly lower than in those who had never smoked or had quit smoking and had no tooth loss over all ages and in both sexes. Males with anamnesis of diabetes mellitus had significantly lower values than those without. Females with the most frequent intake of dairy milk products and experience of tooth brushing instruction had a significantly higher number of PT than those without. However, subjects who had regular dental checkups had a significantly lower number of PT than those who did not at age 40 years in both males and females.

Table 4 summarizes the adjusted OR for anamnesis, self-reported oral health, lifestyle, oral health behavior, and oral hygiene status obtained using the stepwise logistic regression model controlled for age and sex. Anamnesis of diabetes mellitus (OR, 1.72), smoking (OR, 1.86), lower intake of dairy milk products (OR, 1.22), preference for salty seasoning (OR, 1.23), frequent sweet intake (OR, 1.29), gingival swelling (OR, 1.40), loose teeth (OR, 1.82), no experience of tooth brushing instruction (OR, 1.38), regular dental checkups (OR, 1.33), and poor oral hygiene status (OR, 2.04) were identified as significant risk factors for <24 PT.

Table 1 Mean number and distribution of present teeth by sex and age

	Mean \pm SD	≥ 24 teeth	<24 teeth
Age: 40 y Males	27.7 \pm 2.7	94.4%	5.6%
Females	27.6 \pm 2.7	95.2%	4.8%
Age: 50 y Males	26.1 \pm 4.1	82.6%	17.4%
Females	25.9 \pm 3.8	83.2%	16.8%
Age: 60 y Males	22.9 \pm 7.2	62.0%	38.0%
Females	23.4 \pm 6.0	63.5%	36.5%

Discussion

Eklund and Burt reported that patients with 1–7 PT at the beginning of their survey were at 20 or more times greater risk of edentulism than those who had 24 or more PT for 10 years, regardless of age. They emphasized the importance of early tooth loss as a determinant of total tooth loss¹⁸⁾. The same results were also obtained by Worthington *et al.*⁶¹⁾ and Burt *et al.*⁸⁾. The percentile curve for PT in adults in employment indicated that the number of PT decreased rapidly, bordering on 24–25 PT⁶³⁾. This was why 24 was set as the cut-off point for the number of PT in the present study.

The present results revealed that an anamnesis of diabetes mellitus, current smoking and having loose teeth in a self-reported evaluation significantly correlated with the number of PT being <24. Lower intake of milk products, preference for salty seasoning, frequent sweet intake, gingival swelling, tooth brushing instruction, poor oral hygiene status, and regular checkups were also significant factors correlating with the number of PT being <24.

Many reports have indicated smoking as a risk factor for tooth loss^{3,4,22,24,28,32,38,46,63)}. Hanioka *et al.* investigated the association between smoking and tooth loss in approximately 4,000 records obtained from patients aged 40 years or more by using two combined national databases: The National Nutrition Survey and the Survey of Dental Disease conducted in 1999. They reported that the adjusted OR for

Table 2 Mean number of present teeth by each parameter in males

Parameters	Age: 40 y			Age: 50 y			Age: 60 y			Total number of subjects
	n	Mean \pm SD	p-value	n	Mean \pm SD	p-value	n	Mean \pm SD	p-value	
Anamnesis of diabetics										
No	1,108	27.7 \pm 2.68	0.0221	649	26.2 \pm 4.03	0.0248	712	23.2 \pm 6.96	0.0055	2,469
Yes	19	26.3 \pm 3.13		41	24.7 \pm 4.42		94	21.0 \pm 8.26		154
	n: 1,127			n: 690			n: 806			2,623
Smoking										
Never or quit	483	28.1 \pm 2.37	<.0001	327	28.1 \pm 3.49	0.0001	483	23.5 \pm 6.98	0.0047	1,293
Smoking	631	27.4 \pm 2.90		355	27.4 \pm 4.27		316	22.0 \pm 7.39		1,302
	n: 1,114			n: 682			n: 799			2,595
Milk products (4 more times/week)										
Every day or 4-6 days/week	735	27.8 \pm 2.79	n.s.	427	26.6 \pm 3.55	0.0103	485	23.4 \pm 6.59	n.s.	1,647
Never or 1-3 days/week	392	27.6 \pm 2.64		262	25.8 \pm 4.33		321	22.6 \pm 7.49		975
	n: 1,127			n: 689			n: 806			2,622
Preference for salty seasoning										
Thin	619	27.8 \pm 2.56	0.0453	396	26.3 \pm 4.10	n.s.	493	23.0 \pm 7.10	n.s.	1,508
Common, deep, or not concerned	468	27.5 \pm 2.83		274	25.8 \pm 4.04		275	22.8 \pm 7.34		1,017
	n: 1,087			n: 670			n: 768			2,525
Intake of sweets (almost everyday)										
<7 days	539	27.8 \pm 2.50	0.0495	401	26.3 \pm 3.96	n.s.	519	23.4 \pm 6.93	0.0079	1,459
7 days	588	27.5 \pm 2.86		289	25.8 \pm 4.19		286	22.0 \pm 7.49		1,163
	n: 1,127			n: 690			n: 805			2,622
Gingival swelling										
No	880	27.8 \pm 2.65	0.0003	513	26.4 \pm 3.93	0.0022	609	23.3 \pm 7.26	n.s.	2,002
Yes	247	27.1 \pm 2.79		177	25.3 \pm 4.34		197	21.8 \pm 6.71		621
	n: 1,127			n: 690			n: 806			2,623
Having loose teeth										
No	1,031	27.7 \pm 2.58	0.0007	585	26.5 \pm 3.61	<.0001	626	23.4 \pm 7.13	0.0003	2,242
Yes	96	26.8 \pm 3.59		105	24.1 \pm 5.60		180	21.2 \pm 6.98		381
	n: 1,127			n: 690			n: 806			2,623
Brushing instruction										
Yes	638	27.6 \pm 2.21	n.s.	334	25.9 \pm 3.97	n.s.	422	23.4 \pm 6.42	0.0495	1,394
Never	488	27.7 \pm 3.01		355	26.3 \pm 4.16		382	22.5 \pm 7.66		1,225
	n: 1,126			n: 689			n: 804			2,619
Regular dental checkups										
No	951	27.7 \pm 2.63	0.0352	550	26.2 \pm 4.07	n.s.	590	23.1 \pm 7.12	n.s.	2,091
Yes	175	27.3 \pm 3.01		139	25.6 \pm 4.02		213	22.5 \pm 7.07		527
	n: 1,126			n: 689			n: 803			2,618
Oral hygiene status										
Good	185	28.1 \pm 2.03	0.0223	119	27.5 \pm 2.53	<.0001	97	24.4 \pm 6.74	n.s.	401
Fair or poor	940	27.6 \pm 2.65		569	25.9 \pm 4.11		694	23.1 \pm 6.54		2,203
	n: 1,125			n: 688			n: 791			2,604

n.s.: not significant

the number of PT being <19 according to smoking status was 2.22 (males) and 2.14 (females) among current smokers²⁴⁾. Although the percentage of current smokers was

Table 3 Mean number of present teeth by each parameter in females

Parameters	Age: 40 y			Age: 50 y			Age: 60 y			Total number of subjects
	n	Mean \pm SD	p-value	n	Mean \pm SD	p-value	n	Mean \pm SD	p-value	
Anamnesis of diabetics										
No	2,217	27.6 \pm 2.69	n.s.	1,247	26.0 \pm 3.81	n.s.	1,535	23.4 \pm 5.89	0.019	4,999
Yes	13	28.4 \pm 1.67		24	24.6 \pm 5.04		82	21.9 \pm 6.63		119
	n: 2,230			n: 1,271			n: 1,617			5,118
Smoking										
Never or quit	1,593	27.8 \pm 2.61	<.0001	925	26.3 \pm 3.43	<.0001	1,394	23.8 \pm 5.50	<.0001	3,912
Smoking	628	27.1 \pm 2.76		338	25.0 \pm 4.68		217	20.4 \pm 7.46		1,183
	n: 2,221			n: 1,263			n: 1,611			5,095
Milk products (4 more times/week)										
Everyday or 4-6 days/week	956	27.7 \pm 2.16	0.0002	576	26.2 \pm 3.54	0.0041	674	23.7 \pm 5.73	0.007	2,206
Never or 1-3 days/week	1,273	27.3 \pm 3.23		695	25.6 \pm 4.15		943	22.9 \pm 6.20		2,911
	n: 2,229			n: 1,271			n: 1,617			5,117
Preference for salty seasoning										
Thin	1,454	27.6 \pm 5.29	n.s.	843	26.2 \pm 3.56	0.0017	1,104	23.6 \pm 5.86	0.0384	3,401
Common, deep, or not concerned	703	27.4 \pm 5.14		383	25.5 \pm 4.10		446	22.9 \pm 5.93		1,532
	n: 2,157			n: 1,226			n: 1,550			4,933
Intake of sweets (almost everyday)										
<7 days	916	27.6 \pm 2.58	n.s.	571	25.9 \pm 4.08	n.s.	878	23.7 \pm 5.71	0.0078	2,365
7 days	1,313	27.6 \pm 2.75		700	25.9 \pm 3.63		739	22.9 \pm 6.19		2,752
	n: 2,229			n: 1,271			n: 1,617			5,117
Gingival swelling										
No	1,759	27.7 \pm 2.69	<.0001	939	26.1 \pm 3.91	0.0022	1,184	23.4 \pm 6.17	n.s.	3,882
Yes	471	27.1 \pm 2.60		332	25.4 \pm 3.59		433	23.1 \pm 5.25		1,236
	n: 2,230			n: 1,271			n: 1,617			5,118
Having loose teeth										
No	2,114	27.6 \pm 2.67	0.0035	1,122	26.2 \pm 3.69	<.0001	1,373	23.6 \pm 6.00	<.0001	4,609
Yes	116	26.9 \pm 2.78		149	24.0 \pm 4.33		244	21.9 \pm 5.42		509
	n: 2,230			n: 1,271			n: 1,617			5,118
Brushing instruction										
Yes	702	27.7 \pm 2.12	0.0001	365	26.1 \pm 3.42	0.0044	589	24.0 \pm 5.06	<.0001	1,656
Never	1,528	27.2 \pm 3.59		904	25.5 \pm 4.69		1,017	22.3 \pm 6.70		3,449
	n: 2,230			n: 1,269			n: 1,606			5,105
Regular dental check ups										
No	1,641	27.6 \pm 2.72	0.0170	923	26.0 \pm 3.94	n.s.	1,087	23.3 \pm 5.96	n.s.	3,651
Yes	588	27.3 \pm 2.54		346	25.9 \pm 3.49		521	23.6 \pm 5.45		1,455
	n: 2,229			n: 1,269			n: 1,608			5,106
Oral hygiene status										
Excellent	801	27.8 \pm 1.84	0.0048	376	26.4 \pm 3.30	0.0087	390	24.7 \pm 5.03	<.0001	1,567
Fair or poor	1,424	27.5 \pm 2.74		894	25.8 \pm 3.93		1,203	23.3 \pm 5.55		3,521
	n: 2,225			n: 1,270			n: 1,593			5,088

n.s.: not significant

higher than that reported in the National Health and Nutrition Survey in Japan, the

same relationship was observed in the present study (Table 4)³³⁾.

Table 4 Multiple logistic analysis for less than 24 PT

Parameters	Adjusted odds ratio	95%CI	p-value
Age	1.13	1.12–1.14	<.0001
Sex	1.41	1.21–1.64	<.0001
Anamnesis of diabetes mellitus	1.72	1.30–2.28	0.0002
Current smoker	1.86	1.60–2.17	<.0001
Lower intake of milk products	1.22	1.06–1.40	0.0057
Preference for salty seasoning	1.23	1.07–1.41	0.0045
Frequent intake of sweets and sweet beverages	1.29	1.13–1.48	0.0002
Sometimes gingival swelling	1.40	1.20–1.63	<.0001
Having loose teeth	1.82	1.52–2.18	<.0001
No experience of brushing instruction	1.38	1.19–1.59	<.0001
Regular dental checkups	1.33	1.13–1.55	0.0004
Oral hygiene status (fair or poor)	2.04	1.70–2.44	<.0001
Sex	Females (1), Males (0)		
Anamnesis of diabetes mellitus	Yes (1), no (0)		
Smoking	Never (0), quit (0), yes (1)		
Intake of milk products per week	Never (1), one to three days (1), four to six days (0), everyday (0)		
Preference for salty seasoning	Thin (0), common (1), deep (1), and not concerned (1)		
Intake of sweets and sweet beverages per week	Never (0), within three days (0), within six days (1), every day (1)		
Sometimes gingival swelling	Yes (1), no (0)		
Having loose teeth	Yes (1), no (0)		
Experience of brushing instruction	More than three times (0), once to twice (0), never (1)		
Regular dental checkups	Yes (1), no (0)		
Oral hygiene status	Good (0), fair (1), poor (1)		

Although most studies have reported greater tooth loss in people with diabetes mellitus, the differences have been slight and not significant in several reports^{10,12,47,57,58}. However, many epidemiological and clinical studies have revealed diabetes mellitus as a risk factor for severe periodontal disease. This may explain why diabetes mellitus shows a high OR for having <24 PT. This suggests that providing dental health checkups incorporating professional mechanical tooth cleaning, tooth brushing instruction, and supportive therapy might be effective in preventing periodontal disease-induced tooth loss in diabetes mellitus patients^{9,17,25,48}.

Gilbert and Litaker investigated the correlation between self-reported and clinical oral health status in patients aged more than 45 years in a Florida dental care study and reported that self-reported gum health and presence of loose teeth were the only peri-

odontal measures showing a significant association with clinically determined periodontal status²¹. Burt *et al.* identified risk factors for total and partial tooth loss among 116 dentate persons in 1959 and 1987 using a historical cohort analysis. They reported that the predominant risk factors for partial tooth loss were baseline gingivitis and the number of PT⁸. The presence of swelling gums and loose teeth were also identified as significant risk factors for tooth loss in the present study.

The present results revealed that poor oral hygiene status and lack of instruction in tooth brushing were significantly associated with <24 PT, as had been expected. Al-Shammari *et al.* reported that tooth loss due to periodontal disease was associated with a lack of professional maintenance, inadequate oral hygiene, diabetes mellitus, hypertension, and rheumatoid arthritis³. Taken together with the present results, this suggests that poor oral hygiene

status might have influenced tooth loss in the present population.

Contrary to our expectations, regular dental checkups was identified as a risk factor for <24 PT. In a study investigating the relationship between having a regular dentist and the status of oral health among workers at a government office, Murano *et al.* found that people who had regular dentists had more filled, decayed, or missing teeth and a lower total number of teeth than those without⁴³. Regular dental checkups are usually performed at private dental clinics in Japan. It might be assumed that coming to a dental clinic in itself is indicative of poor oral health status. This would explain why regular dental checkups constituted a risk factor for tooth loss in the present study.

As for food-related factors, lower intake of dairy milk products, a preference for salty seasoning, and frequent intake of sweets and sweet beverages were significantly associated with a lower number of PT. These factors might be considered as lifestyle indicators. Therefore, this finding suggests a correlation between lifestyle and tooth loss.

City residents were targeted in the present study as a means of securing a sufficiently large patient sample for the analysis. However, it has been reported that people in urban areas have a greater number of PT than those living in rural areas¹⁴. Therefore, the oral condition of the present study participants may not be representative of that of the Japanese population as a whole.

Having loose teeth and gingival swelling, an anamnesis of diabetes mellitus, smoking, a lower intake of dairy milk products, a preference for salty seasonings, and frequent sweet intake were identified as risk factors contributing to <24 PT, as were no experience of tooth brushing instruction and poor oral hygiene. This suggests that providing health guidance pertaining to these risk factors at health checkups might be effective in preventing tooth loss and maintaining the number of PT, and not only in patients with poor oral health status. In addition, including these risk factors into questionnaires might be use-

ful in screening for tooth loss.

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