

Relationship between job stress and subjective oral health symptoms in male financial workers in Japan

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Abstract: **Objective:** The aim was to assess subjective oral health symptoms and job stress, as measured by self-assessment of how demanding the job is, in male financial workers. **Methods:** The participants were recruited by applying screening procedures to a pool of Japanese registrants in an online database. For the stress check, 7 items about how demanding the job is were selected from The Brief Job Stress Questionnaire (BJSQ). Participants comprised a total of 950 financial male workers, ages 25 to 64. **Results:** Participants who answered “I can’t complete my work in the required time” had more decayed teeth ($p=0.010$). Participants who felt that their job is highly demanding (answered affirmatively to 6 or all 7 items) were more likely to report “often get food stuck between teeth” ($p=0.030$), “there are some foods I can’t eat” ($p=0.005$), “bad breath” ($p=0.032$), and “jaw makes clicking sound” ($p=0.032$). The independent variable of total stress score of 24–28 was found to be correlated to at least three oral health symptoms (OR: 3.25; 95%CI: 1.66–6.35). **Conclusion:** These results indicate that certain job stress factors are associated with certain oral health symptoms, and that oral health symptoms are likely predictors of job stress.

Key words: Oral health, Subjective symptoms, Job stress, BJSQ, Stress check

Introduction

The Stress Check Program was initiated due to an amendment to the Industrial Safety and Health Law of 2014, which was implemented from December 1, 2015^{1,2}. The aims of this law were to reduce the risk of mental health disorders by encouraging self-awareness among workers. The 57 items in the Brief Job Stress Questionnaire (BJSQ) assess the following three components quantitatively: (1) psychological stressors, (2) psychological and physiological stress reactions, and (3) buffering factors

such as social support in the workplace². Categories of job stressors include how demanding the job is, how much control one has over the job, human relationships in the workplace, and suitability of the job. The category of how demanding the job is consists of 7 items³.

It is well known that stress causes oral health diseases^{4–8}. It has also been reported that job stress contributes to periodontal disease^{4,9–13}. The mechanisms by which stress affects periodontal disease progression and wound healing have been divided into two main categories: health-impairing behavior and pathophysiological factors^{4,13}. Therefore, it is reasonable to hypothesize that there will be predictable oral symptoms among workers who experience job stress. However, to the best of our knowledge, there has been little research about the relationship

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between subjective oral health symptoms and job stress.

Oral health status is also influenced by socioeconomic status^{14, 15} and gender¹⁶. Therefore, in this study, we assessed the relationship between subjective oral health symptoms and job stress, as measured by self-assessment of how demanding the job is, in male financial workers in Japan.

Methods

Selection of participants

Participants were selected from a pool of people who registered with an online research company called Intage (<http://www.intage.co.jp/>) who had agreed to participate in oral health-related surveys when they registered. These registrants were invited to participate in this survey and provided their informed consent by clicking the corresponding button, after which the screening survey began. This Internet-based survey was conducted in Japan from 17 to 19 February 2016. The questionnaire for this study was sent to registrants who met the following criteria: employed in the finance industry (bank, securities, insurance), employment in the Kanto area of Japan, age 25–64, male, full-time worker, and working during the daytime only. The registrants filled out the questionnaire and sent their responses via e-mail. The data from approximately the first 200 respondents in each age group (25–34, 35–44, 45–54, 55–64) were collected and analyzed in this study.

Of the 951 data sets collected, one was deleted because the annual income was reported as being under 2 million yen. The resulting 950 participants were analyzed in this study.

Questionnaire items

The BJSQ items assessed in this study were as follows: “I have an extremely large amount of work to do”, “I can’t complete my work in the required time”, “I have to work as hard as I can”, “I have to pay very careful attention”, “My job is difficult in that it requires a high level of knowledge and technical skill”, “I need to be constantly thinking about work throughout the working day”, and “My job requires a lot of physical work”. The response choices were “very much so”, “moderately so”, “somewhat”, and “not at all”.

Respondents were also asked to report their yearly personal income^{14, 15}, smoking status¹⁷ (current smoker or not), diabetes¹⁸ and hypertension status¹⁹ (yes or no), and height and weight²⁰ (BMI was then calculated and categorized as <25 or ≥ 25). Subjective oral health status

items elicited the number of present teeth (including third molars), experience of tooth loss excluding third molars (reason for tooth loss categorized as caries, periodontitis, or fracture), presence of untreated tooth with a cavity (yes or no), and presence or absence of the following symptoms: frequent stomatitis, frequent pain in the teeth or gingiva, pain when consuming something cold, gingival bleeding, gingival swelling, gingival recession, frequently get food stuck between teeth, loose teeth, cannot eat certain foods, dry mouth, slimy feel inside the mouth, bad breath, jaw makes clicking sound, jaw pain, difficulty opening the mouth, and teeth are worn down. The response choices for these items were “yes” or “no”.

Statistical analyses

First, responses on the job stress questionnaire were divided into two groups using a simple scoring method¹ in which “very much so” and “moderately so” responses were categorized as “yes”, while “somewhat” and “not at all” responses were categorized as “no”. Participants who responded “yes” to 6 or 7 items were considered to have indicated that they felt their job was highly demanding¹.

Second, to assess the dose-response relationship, responses on the job stress questionnaire were assigned a quantitative score based on level of positivity of the response, so that “very much so”, “moderately so”, “somewhat” and “not at all” were tallied as 4, 3, 2, and 1, respectively. There were 7 questions; therefore, the minimum total job stress score was 7 and the maximum was 28. The participants were then classified into four groups by total stress score as follows: 7–15, 16–19, 20–23, and 24–28. The rationale for this grouping system was that the mean total score was 19.2 (± 3.7).

A chi-squared test (or Fisher’s exact test in cases with fewer than five cells in the contingency table) was used to make comparisons between the two groups. The Mann-Whitney *U* test or Kruskal-Wallis test was used to compare the age and number of teeth.

Odds ratios (ORs) and 95% confidence intervals (CIs) were determined using multiple logistic regression analyses (forced entry method). The dependent variable was set as participants with at least three oral health symptoms among 16 items, because the upper 25 percentile value was 3 in descending order. Age, annual personal income, total stress score, smoking habit, diabetes, hypertension, experience of tooth loss, and presence of decayed teeth were set as the independent variables. Spearman’s correlation coefficient was used to investigate the relationships among the independent variables. The data were analyzed using the

IBM SPSS Statistics, Version 23.0, software (IBM Corp., Armonk, NY, USA).

Cochran-Armitage trend analysis was used to assess the significance of the correlation between the total job stress score and age or oral symptoms. These analyses were performed with Excel Statistics 2012 version 1.11 (the add-in).

P-values of less than 0.05 were regarded as signifying statistical significance.

This study was approved by the ethical committee of Tokyo Dental College (Approval Number 665).

Results

Table 1 presents the basic characteristics of the participants. The percentage of participants with over 600 million yen in annual income was 72.9%. Current smokers constituted 30.5% of participants, those with diabetes 6.1%, hypertension 22.0%, and 31.1% of participants had a BMI of 25 or over.

Table 2 shows the relationship between job stress and subjective oral health symptoms. Oral health problems that showed significant correlation with some of the stress indicators were frequent stomatitis, gingival swelling, gingival recession, slimy feel in the mouth, bad breath, clicking sound in the jaw, and worn down teeth.

Participants who felt that their job was highly demanding overall (answered 6 or 7 items in the affirmative) reported a higher incidence of food stuck between teeth ($p=0.030$), were more likely to not be able to eat some foods, ($p=0.005$), were more likely to have bad breath ($p=0.032$), and were more likely to report a clicking sound in the jaw ($p=0.032$).

Table 3 shows the dose-response relationship between job stress and subjective oral health symptoms. Higher total stress score correlated significantly with lower mean age ($p<0.001$) and lower experience of tooth loss ($p=0.016$). Higher total stress score was also associated with the presence of decayed teeth ($p=0.037$), pain when consuming something cold ($p=0.010$), loose teeth ($p=0.040$), clicking sound in the jaw ($p<0.001$), jaw pain ($p=0.044$), and difficulty opening the mouth ($p=0.013$).

Factors contributing to oral health symptoms, as assessed by multiple logistic regression analysis, are shown in Table 4. There were no strong relationships ($|r|>0.4$) among the independent variables by Spearman's correlation coefficient. The independent variables found to be correlated to at least three oral health symptoms were: annual personal income of 10 million yen or more (OR: 0.47; 95%CI: 0.29–0.74), total stress score of 16–19 (OR:

Table 1. Basic characteristics of participants

	25–34		35–44		45–54		55–64		55–64	
	%	n	%	n	%	n	%	n	%	n
	9.9	94	25.1	238	41.2	391	23.9	227	100	950
Annual personal income (millions of yen)										
2–6	45.7	43	18.9	45	11.0	43	19.8	45	18.5	176
6–10	31.9	30	45.4	108	31.7	124	40.1	91	37.2	353
10 and over	13.8	13	30.7	73	45.3	177	33.5	76	35.7	339
unknown	8.5	8	5.0	12	12.0	47	6.6	15	8.6	82
Current smoker	23.4	22	28.2	67	34.3	134	29.5	67	30.5	290
Diabetes	0	0	1.3	3	6.6	26	12.8	29	6.1	58
Hypertension	3.2	3	10.1	24	25.1	98	37.0	84	22.0	209
BMI 25 or over	13.8	13	27.7	66	38.1	149	29.5	67	31.1	295

2.23; 95%CI: 1.25–3.99), total stress score of 20–23 (OR: 2.73; 95%CI: 1.51–4.91), total stress score of 24–28 (OR: 3.25; 95%CI: 1.66–6.35), and BMI of ≥ 25 (OR: 1.70; 95%CI: 1.21–2.38).

Discussion

Previous reports^{21, 22)} have indicated that a self-reported questionnaire is a feasible option for measuring oral health conditions such as number of present teeth and decayed teeth.

In this study, participants who answered, “I can't complete my work in the required time” were more likely to have decayed teeth. The reasons are not clear, but Mejia-Rubalcava *et al.*⁸⁾ showed that high levels of academic stress, younger age among university students, and lower salivary flow rate represent risk factors for the development of dental caries in students. However, the relationship between job stress and caries has not yet been clarified, so further research is needed.

Gingival swelling, gingival recession, and frequently getting food stuck between the teeth may be related to periodontal disease. A relationship between job stress and periodontal disease has been reported in previous studies^{9–12)}. Marcenes and Sheiham⁹⁾ examined the relationship between periodontal health status and work stress and marital quality in 149 males aged 35 to 44. Higher scores for work-related mental demand were associated with pocketing and/or gingivitis, as were low scores in marital quality. Freeman and Goss¹⁰⁾ reported preliminary results of a follow-up study of 10 employed women and eight employed men with a mean age of 39 years. This report investigated periodontal attachment loss occurring over a 12-month period in the first molars and all incisors. There was a relationship between increased pocket depth and scores for type A personality (characterized by com-

Table 2. Relationship between job stress and subjective oral health symptoms (n=950)

	1. I have an extremely large amount of work to do.			2. I can't complete my work in the required time.			3. I have to work as hard as I can.			4. I have to pay very careful attention.		
	n	Yes	No	Yes	No	Test	Yes	No	Test	Yes	No	Test
Mean age		713	237	478	472		770	180		804	146	
Mean number of present teeth		46.7 ± 8.3	49.4 ± 9.1	45.6 ± 8.2	49.1 ± 8.6	<i>p</i> < 0.001	46.7 ± 8.4	50.1 ± 8.9	<i>p</i> < 0.001	47.1 ± 8.4	48.5 ± 9.6	n.s.
Experience of tooth loss		27.2 ± 6.7 %	26.7 ± 6.1 %	27.2 ± 7.0 %	27.0 ± 6.0 %	n.s.	27.3 ± 6.6 %	26.5 ± 6.4 %	n.s.	27.2 ± 6.6 %	26.8 ± 6.3 %	n.s.
Presence of decayed teeth (one or more)		42.5 303	54.0 128	38.7 185	52.1 246	<i>p</i> = 0.002	44.4 342	49.4 89	n.s.	45.4 365	45.2 66	n.s.
Oral problems		20.5 146	19.0 45	23.4 112	16.7 79	<i>p</i> = 0.010	20.4 157	18.9 34	n.s.	20.1 162	19.9 29	n.s.
Frequent stomatitis		12.1 86	9.3 22	13.8 66	8.9 42	<i>p</i> = 0.017	11.7 90	10.0 18	n.s.	11.4 92	11.0 16	n.s.
Frequent tooth or gingival pain		8.4 60	8.0 19	9.2 44	7.4 35	n.s.	8.8 68	6.1 11	n.s.	8.7 70	6.2 9	n.s.
Pain when consuming something cold		14.0 100	12.7 30	14.9 71	12.5 59	n.s.	14.7 113	9.4 17	n.s.	13.9 112	12.3 18	n.s.
Gingival bleeding		13.2 94	12.2 29	15.1 72	10.8 51	n.s.	13.6 105	10.0 18	n.s.	12.7 102	14.4 21	n.s.
Gingival swelling		8.7 62	8.0 19	9.2 44	7.8 37	n.s.	8.7 67	7.8 14	n.s.	8.2 66	10.3 15	n.s.
Gingival recession		11.9 85	9.7 23	13.0 62	9.7 46	n.s.	11.8 91	9.4 17	n.s.	11.8 95	8.9 13	n.s.
Often get food stuck between teeth		20.5 146	19.4 46	22.4 107	18.0 85	n.s.	21.2 163	16.1 29	n.s.	20.9 168	16.4 24	n.s.
Loose teeth		3.2 23	3.4 8	4.0 19	2.5 12	n.s.	3.5 27	2.2 4	n.s.	3.4 27	2.7 4	n.s.
Cannot eat some foods		1.1 8	1.3 3	1.9 9	0.4 2	n.s.	1.2 9	1.1 2	n.s.	1.2 10	0.7 1	n.s.
Dry mouth		7.2 51	8.4 20	8.4 40	6.6 31	n.s.	8.1 62	5.0 9	n.s.	7.5 60	7.5 11	n.s.
Inside of mouth feels slimy		18.0 128	11.0 26	18.8 90	13.6 64	<i>p</i> = 0.028	17.7 136	10.0 18	<i>p</i> = 0.012	16.8 135	13.0 19	n.s.
Bad breath		20.9 149	20.3 48	24.7 118	16.7 79	<i>p</i> = 0.003	22.2 171	14.4 26	<i>p</i> = 0.021	21.0 169	19.2 28	n.s.
Jaw makes clicking sound		6.5 46	3.8 9	6.9 33	4.7 22	n.s.	6.8 52	1.7 3	<i>p</i> = 0.007	6.2 50	3.4 5	n.s.
Jaw pain		1.4 10	0 0	1.5 7	0.6 3	n.s.	1.2 9	0.6 1	n.s.	1.2 10	0 0	n.s.
Difficulty opening mouth		2.0 14	1.3 3	2.1 10	1.5 7	n.s.	2.2 17	0 0	n.s.	2.1 17	0 0	n.s.
Teeth are worn down		5.6 40	6.8 16	5.2 25	6.6 31	n.s.	5.2 40	8.9 16	n.s.	6.0 48	5.5 8	n.s.

The Mann-Whitney *U* test or chi-squared test was used to compare between two groups.

Table 2. Continued

	5. My job is difficult in that it requires a high level of knowledge and technical skill.			6. I need to be constantly thinking about work throughout the working day.			7. My job requires a lot of physical work.			Overall level of how demanding the job is			
	Yes n	%	Test	Yes n	%	Test	Yes n	%	Test	Yes on 6 or 7 items	%	Test	Yes on fewer than 6 items
Mean age	47.3 ± 8.4	47.6 ± 9.2	n.s.	46.8 ± 8.4	48.6 ± 9.0	p=0.003	46.0 ± 8.7	47.7 ± 8.5	p=0.015	45.9 ± 8.3	48.3 ± 8.7	p<0.001	
Mean number of present teeth	27.2 ± 6.4	26.8 ± 6.9	n.s.	27.3 ± 6.5	26.7 ± 6.6	n.s.	26.8 ± 7.6	27.2 ± 6.3	n.s.	27.1 ± 7.1	27.1 ± 6.1	n.s.	
Experience of tooth loss	45.1 314	46.1 117	n.s.	43.5 287	49.7 144	n.s.	47.0 86	45.0 345	n.s.	41.0 152	48.2 279	p=0.002	
Presence of decayed teeth (one or more)	20.5 143	18.9 48	n.s.	21.2 140	17.6 51	n.s.	22.4 41	19.6 150	n.s.	22.6 84	18.5 107	n.s.	
Oral problems													
Frequent stomatitis	11.1 77	12.2 31	n.s.	12.3 81	9.3 27	n.s.	15.3 28	10.4 80	n.s.	13.7 51	9.8 57	n.s.	
Frequent tooth or gingival pain	8.8 61	7.1 18	n.s.	9.1 60	6.6 19	n.s.	11.5 21	7.6 58	n.s.	10.0 37	7.3 42	n.s.	
Pain when consuming something cold	14.5 101	11.4 29	n.s.	15.0 99	10.7 31	n.s.	16.9 31	12.9 99	n.s.	14.3 53	13.3 77	n.s.	
Gingival bleeding	12.9 90	13.0 33	n.s.	13.3 88	12.1 35	n.s.	15.8 29	12.3 94	n.s.	14.0 52	12.3 71	n.s.	
Gingival swelling	9.8 68	5.1 13	p=0.023	9.7 64	5.9 17	n.s.	9.8 18	8.2 63	n.s.	9.4 35	7.9 46	n.s.	
Gingival recession	11.6 81	10.6 27	n.s.	13.0 86	7.6 22	p=0.015	8.7 16	12.0 92	n.s.	12.1 45	10.9 63	n.s.	
Often get food stuck between teeth	21.1 147	17.7 45	n.s.	21.8 144	16.6 48	n.s.	21.9 40	19.8 152	n.s.	23.7 88	18.0 104	p=0.030	
Loose teeth	3.3 23	3.1 8	n.s.	3.5 23	2.8 8	n.s.	4.4 8	3.0 23	n.s.	4.0 15	2.8 16	n.s.	
Cannot eat some foods	1.4 10	0.4 1	n.s.	1.4 9	0.7 2	n.s.	1.6 3	1.0 8	n.s.	2.4 9	0.3 2	p=0.005	
Dry mouth	6.8 47	9.4 24	n.s.	7.0 46	8.6 25	n.s.	8.7 16	7.2 55	n.s.	7.8 29	7.3 42	n.s.	
Inside of mouth feels slimy	16.7 116	15.0 38	n.s.	17.0 112	14.5 42	n.s.	18.0 33	15.8 121	n.s.	18.9 70	14.5 84	n.s.	
Bad breath	20.7 144	20.9 53	n.s.	22.3 147	17.2 50	n.s.	24.0 44	19.9 153	n.s.	24.3 90	18.5 107	p=0.032	
Jaw makes clicking sound	5.9 41	5.5 14	n.s.	7.0 46	3.1 9	p=0.019	8.2 15	5.2 40	n.s.	7.8 29	4.5 26	p=0.032	
Jaw pain	1.0 7	1.2 3	n.s.	1.4 9	0.3 1	n.s.	1.6 3	0.9 7	n.s.	1.6 6	0.7 4	n.s.	
Difficulty opening mouth	2.2 15	0.8 2	n.s.	2.3 15	0.7 2	n.s.	3.3 6	1.4 11	n.s.	2.4 9	1.4 8	n.s.	
Teeth are worn down	6.3 44	4.7 12	n.s.	6.2 41	5.2 15	n.s.	1.6 3	6.9 53	p=0.005	4.9 18	6.6 38	n.s.	

Table 3. Dose-response relationship between job stress and subjective oral health symptoms (n=950)

Total score of job stress	7–15		16–19		20–23		24–28		Test
	n								
Mean age		50.0 ±9.4		48.1 ±8.6		46.3 ±8.1		44.9 ±7.8	<i>p</i> <0.001
Mean number of present teeth		26.5 ±6.3		27.2 ±6.2		27.2 ±7.0		27.4 ±6.6	n.s.
		% n		% n		% n		% n	
Experience of tooth loss		47.1 66		49.6 177		42.7 140		38.4 48	0.016
Presence of decayed teeth (one or more)		17.1 24		19.0 68		19.8 65		27.2 34	0.037
Oral problems (yes)									
Frequent stomatitis		9.3 13		10.9 39		12.5 41		12.0 15	n.s.
Frequent tooth or gingival pain		4.3 6		7.8 28		8.8 29		12.8 16	0.010
Pain when consuming something cold		7.9 11		14.0 50		15.9 52		13.6 17	n.s.
Gingival bleeding		7.9 11		13.4 48		13.7 45		15.2 19	n.s.
Gingival swelling		7.1 10		8.7 31		8.2 27		10.4 13	n.s.
Gingival recession		7.9 11		12.6 45		12.5 41		8.8 11	n.s.
Often get food stuck between teeth		17.9 25		19.3 69		21.3 70		22.4 28	n.s.
Loose teeth		2.1 3		2.5 9		3.7 12		5.6 7	0.040
Cannot eat some foods		0.7 1		0.6 2		1.8 6		1.6 2	n.s.
Dry mouth		7.9 11		7.0 25		6.7 22		10.4 13	n.s.
Inside of mouth feels slimy		7.9 11		18.5 66		17.1 56		16.8 21	n.s.
Bad breath		13.6 19		21.8 78		22.0 72		22.4 28	n.s.
Jaw makes clicking sound		2.1 3		3.6 13		8.8 29		8.0 10	<i>p</i> <0.001
Jaw pain		0 0		1.1 4		0.6 2		3.2 4	0.044
Difficulty opening mouth		0 0		0.8 3		4.0 13		0.8 1	0.013
Teeth are worn down		5.7 8		6.2 22		7.0 23		2.4 3	n.s.

The Kruskal-Wallis test or Cochran-Armitage trend analyses was used to compare the groups.

petitiveness, excessive drive, and an increased degree of importance or alertness). Linden *et al.*¹¹⁾ researched 23 regular dental attenders during 5.5 years. In the final regression model, an increase in loss of periodontal attachment was significantly predicted by increased age, lower socioeconomic status, lower job satisfaction, and type A personality. Based on the results of these studies, it is reasonable to assume that job stress correlates highly with periodontal disease and its symptoms.

A slimy feeling in the mouth and bad breath may be indicative of salivary secretion and flow rate. The saliva glands are connected to both parasympathetic and sympathetic nerves. Secretion is controlled mainly by parasympathetic impulses from the salivary nuclei. In stressful situations, dry mouth sometimes occurs as a result of the inhibitory effect of higher centers on salivary nuclei²³⁾. When stress causes sympathetic nerve activation, the saliva becomes slimy because the proportion of protein in the saliva increases²⁴⁾. A decrease in salivary flow reduces the protective function afforded by saliva, thereby increasing the feeling of sliminess as well as bad breath. Kleinberg *et al.*²⁵⁾ indicated that measuring oral dryness should make it possible to differentiate genuine malodour from dry mouth related pseudo-malodour, and in turn, to differentiate the latter from halitophobia. Quieroz *et al.*²⁶⁾ found a relation-

ship between stressful situations, salivary flow rate, and oral volatile sulfur-containing compounds (VSCs). On the day of a biochemistry examination, VSCs significantly increased and salivary flow decreased compared with baseline values.

A clicking sound in the jaw, pain in the jaw, and difficulty opening the mouth are symptoms indicative of temporomandibular joint disorder (TMD). It has previously been reported that stress is associated with exacerbation of TMD^{27–29)}. Kutila *et al.*²⁷⁾ analyzed 506 adult Finns and found that the necessity of TMD treatment was related to total stress score. Rollman *et al.*²⁸⁾ also showed that TMD patients often suffer from a high degree of stress in their daily life. Rugh and Solberg²⁹⁾ used an electromyographic recording unit to show that stressful situations correlated with high levels of tooth grinding. They proposed that stress increases the activity of the masticatory muscles, which consequently results in TMD. Although no clear causal association has been established, our results and these reports strongly suggest that TMD is exacerbated by job stress.

Our data revealed that job stress decreased with age (Table 3). The mean number of present teeth of participants with the lowest stress score (7–15) was lower than that of other groups. This is likely simply due to the fact

Table 4. Factors contributing to oral health symptoms by multiple logistic regression analysis (n=950)

Independent variable	n	Dependent variable: Participants with at least three oral health symptoms			
		n	(%)	OR (95% CI)	p-value
Age					
25–34	94	23	(24.5)	1	
35–44	238	46	(19.3)	0.76 (0.42–1.39)	0.370
45–54	391	87	(22.3)	0.98 (0.54–1.77)	0.936
55–64	227	55	(24.2)	1.18 (0.62–2.24)	0.613
Annual personal income					
2–6 million yen	176	51	(29.0)	1	
6–10	353	86	(24.4)	0.71 (0.46–1.09)	0.115
10 and over	339	61	(18.0)	0.47 (0.29–0.74)	0.001
unknown	82	13	(15.9)		
Total stress score					
7–15	140	17	(12.1)	1	
16–19	357	79	(22.1)	2.23 (1.25–3.99)	0.007
20–23	328	80	(24.4)	2.73 (1.51–4.91)	0.001
24–28	125	35	(28.0)	3.25 (1.66–6.35)	0.001
Current smoker					
No	660	137	(20.8)	1	
Yes	290	74	(25.5)	1.28 (0.91–1.79)	0.153
Diabetes					
No	892	192	(21.5)	1	
Yes	58	19	(32.8)	1.40 (0.75–2.59)	0.289
Hypertension					
No	741	163	(22.0)	1	
Yes	209	48	(23.0)	0.86 (0.57–1.28)	0.458
BMI 25 or over					
No	655	125	(19.1)	1	
Yes	295	86	(29.2)	1.70 (1.21–2.38)	0.002
Experience of tooth loss					
No	519	106	(20.4)	1	
Yes	431	105	(24.4)	1.09 (0.78–1.54)	0.615
Presence of decayed teeth (one or more)					
No	759	159	(20.9)	1	
Yes	191	52	(27.2)	1.27 (0.87–1.86)	0.220

that number of teeth decreases with age¹⁶⁾.

There were several limitations in this study, the first of which is the possibility of selection bias due to the fact that this was an Internet survey. Van Gelder³⁰⁾ pointed out that the advantages of Internet surveys are low cost and rapid response by participants. Disadvantages are relatively high non-response rates compared with traditional modes of data collection and concerns regarding the reliability and validity of the data obtained. Yasunaga *et al.*³¹⁾ indicated another disadvantage, namely that the age range of Internet users is more concentrated among younger people. In order to counteract these disadvantages, we used an online research company which already had an existing pool of participants in order to get a higher response rate and avoid age bias. According to Ando *et al.*, the reliability and validity of the

data is likely not weaker than traditional research³²⁾. Furthermore, the participants in this study are financial workers who use the Internet in their daily work and are therefore highly familiar with the medium. There is no data available regarding the oral health status and basic characteristics of male financial workers in Japan, other than the data collected in this study. Therefore, although such a comparison would be helpful for confirming that this is a representative sample, it is not possible at this time.

The second limitation of this study is that the oral health status information was self-assessed and self-reported. The third limitation of this study is that it was a cross-sectional survey. In spite of these limitations, the results of this study show several relationships between job stress and subjective oral health symptoms. These symptoms can serve as warning signs of high stress levels.

Conclusions

These results indicate that certain job stress factors are associated with certain oral health symptoms. Oral health symptoms can likely be used as predictors of job stress in workers. Dental health professionals and workplace health management officials should consider the possibility that oral health symptoms may be partially caused by underlying stress factors. Decreasing stress in the workplace and providing stress management training may have a positive effect on oral health.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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