

Original

Relationship between amount of overtime work and untreated decayed teeth in male financial workers in Japan

Koichi Yoshino¹, Seitaro Suzuki¹, Yoichi Ishizuka¹, Atsushi Takayanagi¹, Naoki Sugihara¹ and Hideyuki Kamijyo²

¹Department of Epidemiology and Public Health, Tokyo Dental College, Tokyo, Japan and ²Department of Social Security for Dentistry, Tokyo Dental College, Tokyo, Japan

Abstract: Objective: Continuous or frequent overtime work has been shown to have harmful effects on human health. Meanwhile, one of the main reasons for tooth loss is caries. The aim of this study was to assess the relationship between overtime work and untreated decayed teeth in male financial workers. **Methods:** The participants were recruited by applying screening procedures to a pool of Japanese registrants in an online database. Participants filled out a questionnaire about their oral health, behavior, and working conditions. Participants comprised a total of 951 financial male workers, aged 25-64 years. **Results:** The likelihood of tooth decay increased with amount of overtime work ($p=0.002$). After adjusting for age, income, educational background, oral hygiene behavior, snacking behavior, regular dental visitation, bad interpersonal relationships at work, and smoking habit, a multiple logistic regression analysis found that participants with 45-80 h of overtime work (odds ratio [OR], 2.56; 95% confidence interval [CI], 1.23-5.33) or over 80 h of overtime work (OR, 3.01; 95% CI, 1.13-7.97) were more likely to have untreated tooth decay. The percentage of participants who gave "too busy with work" as the reason for leaving decayed teeth untreated increased with amount of overtime ($p<0.001$). **Conclusion:** These results indicate that overtime work is strongly related to untreated decayed teeth. In addition to oral health education and dental checkups, decreasing stress and decreasing the amount of overtime work may also have a positive effect on oral health in the workplace.
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Introduction

There is a relationship between working long hours and poor health. Long working hours have been linked to all-cause mortality, circulatory disease, diabetes mellitus, metabolic syndrome, depressive state, anxiety, other psychological disorders, sleep condition, cognitive function, and health-related behavior¹⁻³. It is clear that overtime work affects various aspects of a person's lifestyle and that presumably includes oral health behavior. Therefore, it is reasonable to assume that overtime work increases the risk of caries and reduces the frequency of dental visitation. Our hypothesis was that workers who have more overtime work have more caries that are left untreated. However, to the best of our knowledge, there has been no research investigating the relationship between duration of work and oral diseases.

Caries and periodontitis are the most common causes of loss of permanent teeth, and this tendency holds true in Japan as well as globally^{4,6}. Aida et al.⁴ showed that caries and complications thereof (43.3% altogether) and periodontal disease (41.8%) were the main reasons for tooth extraction in Japan. Extractions due to caries or root fracture were commonly observed in all age groups over 15 years of age⁴. Furthermore, the incidence of vertical root fracture is increasing, and it is mainly caused by endodontically treated teeth⁶. Therefore, it is important for people to treat decayed teeth earlier if possible.

The aim of this study was to assess the relationship between the amount of overtime work and untreated decayed teeth in male financial workers in Japan.

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Correspondence to: K. Yoshino, D.D.S, Ph.D., Department of Epidemiology and Public Health, Tokyo Dental College, 2-9-18 Misaki-cho, Chiyoda-ku, Tokyo 101-0061, Japan (e-mail: ko-yoshi@d8.dion.ne.jp)

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, and insurance), employment location in the Kanto area of Japan, aged 25-64 years, male, and full-time worker. 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, and 55-64) were collected and analyzed in this study. Our goal was to analyze data from 200 respondents in each age group for a total of 800 participants. However, although we collected a total of 951 data sets, we were unable to collect the desired number of responses from each age group. For the 25- to 34-year age group in particular, there were not enough respondents registered in the database to begin with.

Questionnaire items

Respondents were asked to report their annual personal income, annual household income, number of people in the household, marital status, educational background, smoking status (current smoker or not), diabetes and hypertension status (yes or no), and height and weight (body-mass index (BMI) was then calculated and categorized as <25 or ≥ 25), as well as whether they had an untreated cavity (yes or no). Concerning oral health behavior, respondents were asked how frequently they brush their teeth every day (<2 or ≥ 2), whether they brush before going to bed (yes or no), whether they use an interdental brush one or more times per week (yes or no), whether they eat between meals (yes or no), whether they have a regular dental clinic (yes or no), whether they usually visit a dental clinic for checkup or cleaning one or more times per year (yes or no), and why they have untreated caries (no pain, not a problem, unable to go to a dentist during the hours the clinic is open, cost of treatment, too busy, multiple visits required for treatment, do not like treatment, no clinics nearby). Equivalent household income was calculated as the total household income divided by the square root of the number of people in the household.

Job stress was assessed in this study based on the Brief Job Stress Questionnaire^{12,13)} as follows:

1. Amount and difficulty of work (Yes response to ≥ 6 or <6 items): "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."

2. Control and freedom at work (no response to ≥ 2 or <2 items): "I can work at my own pace," "I can choose how and in what order to do my work," and "My opinions are reflected in workplace policy."

3. Interpersonal relationships at work (Yes response to ≥ 2 or <2 items): "There are differences of opinion within my department," "My department does not get along well with other departments," and "The atmosphere in my workplace is not friendly."

4. Suitability of job (no response to 2 or <2 items): "This job suits me well," and "My job is worth doing."

5. Degree of job satisfaction: "I am satisfied with my job."

The response choices were "very much so," "moderately so," "somewhat," and "not at all." Responses on the job stress questionnaire were divided into two groups using a simple scoring method⁸⁾ 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 were asked to report the average number of overtime hours they worked per month during the last 3 months, and they were divided into four groups (0, ≤ 45 , ≤ 80 , and >80) based on their response.

Statistical analyses

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 groups. A one-way ANOVA was used to compare the means of the different groups.

Odds ratios (ORs) and 95% confidence intervals (CIs) were determined using multiple logistic regression analyses (forced entry method). The presence of untreated decayed teeth was set as the dependent variable. The model included known risk factors and variables that may be associated with the presence or absence of untreated decayed teeth. Age, equivalent household income, educational background, overtime hours per month, brushing two times or more per day, eating between meals, having a regular dental clinic, interpersonal relationships in the workplace, and smoking habit 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 IBM SPSS Statistics, Version 23.0 (IBM Corp., Armonk, NY, USA).

Cochran-Armitage trend analyses were used to assess the significance of the correlation between overtime hours

Table 1. Basic characteristics of participants

	Total n=951		Overtime hours per month								<i>p</i> *
			0 n=108		Over 0 to 45 n=634		Over 45 to 80 n=164		Over 80 n=45		
	n	%	n	%	n	%	n	%	n	%	
Annual personal income (million yen)											<0.001
under 6	177	18.6	31	28.7	122	19.2	20	12.2	4	8.9	
6-10	353	37.1	35	32.4	260	41.0	47	28.7	11	24.4	
10 and over	339	35.6	27	25.0	203	32.0	85	51.8	24	53.3	
unknown	82	8.6	15	13.9	49	7.7	12	7.3	6	13.3	
Equivalent household income (million yen)											<0.001
under 5	300	31.5	37	34.3	221	34.9	35	21.3	7	15.6	
5-7	308	32.4	36	33.3	205	32.3	53	32.3	14	31.1	
7 and over	282	29.7	24	22.2	172	27.1	67	40.9	19	42.2	
unknown	61	6.4	11	10.2	36	5.7	9	5.5	5	11.1	
Current smoker	288	30.3	36	33.3	191	30.1	47	28.7	14	31.1	0.872
Diabetes	58	6.1	5	4.6	44	6.9	9	5.5	0	0	0.253
Hypertension	209	22.0	31	28.7	133	21.0	37	22.6	8	17.8	0.294
BMI 25 or over	295	31.0	31	28.7	187	29.5	60	36.6	17	37.8	0.231

*Statistical analyses were conducted with Chi-squared test.

and untreated decayed teeth, as well as between overtime hours and reasons for leaving decayed teeth untreated. These analyses were performed with Excel Statistics 2012 version 1.11 (the add-in).

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

Results

The mean age of participants was 47.4 years (SD 8.6). The mean age of participants by number of overtime hours per month was as follows: no overtime, 51.6 years (SD: 8.1); 0-45 h, 47.0 years (8.8); 45-80 h, 46.6 years (7.7); and over 80 h, 45.5 years (8.6). Mean age decreased with amount of overtime per month ($p < 0.001$). The basic characteristics of the participants are shown in Table 1. The annual personal income ($p < 0.001$) and equivalent household income ($p < 0.001$) correlated with amount of overtime per month.

Participants with the following characteristics were more likely to have untreated decayed teeth than those who did not have the characteristic: highest completed educational level was high school or junior college ($p = 0.041$), higher number of overtime work hours per month ($p = 0.005$), brushing teeth fewer than twice per day ($p < 0.001$), not brushing teeth before bed ($p = 0.026$), not using interdental brush or using it less than once a week ($p = 0.035$), no regular dental clinic ($p < 0.001$), doesn't have a checkup or tooth cleaning at least once a year ($p = 0.002$), has bad interpersonal relationships at work ($p = 0.003$), not satisfied with job ($p = 0.022$), and smoking habit ($p <$

0.001). However, there were no relationships between the following characteristics and untreated decayed teeth: age ($p = 0.814$), annual personal income ($p = 0.875$), equivalent household income ($p = 0.890$), marital status ($p = 0.207$), eating between meals ($p = 0.052$), amount and difficulty of work ($p = 0.132$), control and freedom at work ($p = 0.485$), suitability of the job ($p = 0.580$), BMI ($p = 0.261$), diabetes ($p = 0.148$), and hypertension ($p = 0.349$). A Cochran-Armitage trend analysis also confirmed that the percentage of participants with untreated decayed teeth increased along with amount of overtime ($p = 0.002$).

Table 2 shows the factors contributing to the presence of untreated decayed teeth by multiple logistic regression analysis. Spearman's correlation coefficients revealed no strong relationships ($|r| > 0.3$) among the independent variables. The independent variables found to be correlated with tooth decay were completion of college or Master's degree (OR, 0.55; 95% CI, 0.34-0.89), 45-80 h of overtime (OR, 2.56; 95% CI, 1.23-5.33), over 80 h of overtime (OR, 3.01; 95% CI, 1.13-7.97), brushing two times or more per day (OR, 0.58; 95% CI, 0.40-0.84), eating between meals (OR, 1.57; 95% CI, 1.10-2.23), having a regular dental clinic (OR, 0.33; 95% CI, 0.23-0.47), bad interpersonal relationships at work (OR, 1.42; 95% CI, 1.00-2.01), and current smoker (OR, 1.96; 95% CI, 1.36-2.82).

Table 3 shows the reasons for leaving decayed teeth untreated. The main reasons were "no pain" (54%), "not a problem" (32%), and "too busy with work" (31%). The percentage of participants who gave "no pain" as the reason for leaving decayed teeth untreated decreased along

Table 2. Factors contributing to untreated decayed teeth, by multiple logistic regression analysis

Independent variable	n ¹	n ²	Proportion of participants with decayed teeth (%)	OR*	95%CI	p
Age						
25-34	94	18	19.1	1		
35-44	238	53	22.3	1.29	0.67-2.47	0.446
45-54	391	75	19.2	1.08	0.58-2.02	0.816
55-64	228	46	20.2	1.37	0.70-2.69	0.362
Equivalent household income						
Under 5 million yen	300	64	21.3	1		
5-7 million yen	308	61	19.8	0.98	0.64-1.50	0.934
7 million yen and over	282	57	20.2	0.96	0.62-1.48	0.835
Unknown	61	9	14.8			
Educational background						
High school or junior college	139	37	26.6	1		
College or Master's degree	812	155	19.1	0.55	0.34-0.89	0.015
Overtime hours per month						
0	108	14	13.0	1		
Over 0 to 45	634	119	18.8	1.76	0.91-3.39	0.092
Over 45 to 80	164	45	27.4	2.56	1.23-5.33	0.012
Over 80	45	14	31.1	3.01	1.13-7.97	0.027
Brushing 2 times or more per day						
No	233	67	28.8	1		
Yes	718	125	17.4	0.58	0.40-0.84	0.004
Eating between meals						
No	515	92	17.9	1		
Yes	436	100	22.9	1.57	1.10-2.23	0.013
Having a regular dental clinic						
No	356	111	31.2	1		
Yes	595	81	13.6	0.33	0.23-0.47	<0.001
Interpersonal relationships at work						
Good	542	91	16.8	1		
Bad	409	101	24.7	1.42	1.00-2.01	0.048
Smoking habit						
No	663	114	17.2	1		
Yes	288	78	27.1	1.96	1.36-2.82	<0.001

n¹: total number of participants for each item, n²: the number of participants who had untreated decayed teeth.

*The model included age, equivalent household income, educational background, overtime hours per month, brushing 2 times or more per day, eating between meals, having a regular dental clinic, interpersonal relationships at work, and smoking habit.

OR: Odds Ratio; 95%CI: 95% Confidence Interval.

with amount of overtime ($p=0.041$) and those giving “too busy with work” as the reason increased with amount of overtime ($p<0.001$), as shown by Cochran-Armitage trend analysis.

Discussion

It is well known that oral health status is influenced by educational background, socioeconomic status, job stress, and gender⁷⁻¹¹). Therefore, it is desirable to investigate par-

Table 3. Reasons for leaving decayed teeth untreated (n=192)

Reasons (multiple answers permitted)	Overtime hours per month										
	Total n=192		0 n=14		Over 0 to 45 n=119		Over 45 to 80 n=45		Over 80 n=14		<i>p</i> *
	n	%	n	%	n	%	n	%	n	%	
No pain	103	54	9	64	68	57	19	42	7	50	0.041
Not a problem	61	32	4	29	39	33	15	33	3	21	0.406
Too busy with work	60	31	1	7	32	27	18	40	9	64	<0.001
Cannot go when clinic is open	51	27	1	7	35	29	9	20	6	43	0.255
Do not like treatment	33	17	5	36	19	16	9	20	0	0	0.894
Multiple visits required for treatment	26	14	1	7	15	13	7	16	3	21	0.129
Cannot afford treatment cost	16	8	0	0	14	12	2	4	0	0	0.143
No dental clinics nearby	2	1	0	0	1	1	1	2	0	0	0.292

*Cochran-Armitage trend analysis was used.

participants with similar characteristics to avoid interference from confounding factors as much as possible. With this in mind, we selected male financial workers for this study.

This is the first study to have investigated the relationship between overtime work and tooth decay. There was a clear association between amount of overtime work and untreated decayed teeth in financial workers. The percentage of participants who gave “too busy with work” as the reason for leaving decayed teeth untreated increased with amount of overtime ($p < 0.001$). Meanwhile, the most common reason given for leaving decayed teeth untreated was “no pain” (54%). This implies that around half of the participants with decayed teeth could get treatment if they chose to do so. It is likely that they are making a time-trade-off¹⁴; that is to say, the merits of treatment are outweighed by other priorities.

Previous reports have revealed that the factors contributing to tooth decay in adults are low education, unemployment, low income, low social class, smoking, irregular dental attendance, being male, daily medication, and being single^{7-10,15,16}. Our results revealed no relationship between personal income and tooth decay. However, there was a relationship between educational background and tooth decay even though the participants were financial workers. This is in line with previous reports showing that less schooling is a risk factor for decayed teeth⁸⁻¹⁰. Oral health education may be necessary for financial workers even though they have a reputation as high-income, highly educated professionals.

Not having a regular dental clinic was associated with having at least one untreated decayed tooth (OR=0.33 for having a regular clinic). Previous reports have also shown a negative association between regular dental visits and decayed teeth^{7,10}. Edman et al.¹⁰ showed that irregular dental visitation was associated with at least one decayed surface (OR: 2.03). This means that regularly visiting a

dentist decreases the likelihood of untreated decayed teeth.

In this study, participants who indicated bad interpersonal relationships at work were more likely to have untreated decayed teeth (OR, 1.42; 95% CI, 1.00-2.01). The reason for this is not clear, but Mejía-Rubalcava et al.¹¹ showed that high levels of academic stress and younger age among university students are linked to lower salivary flow rate, which is a known risk factor for developing dental caries. Job stress may somehow make it less likely for employees to visit a dental clinic easily. However, the relationship between interpersonal relationships in the workplace and decayed teeth has not yet been clarified, so further research is needed.

Smoking correlated with untreated decayed teeth in this study. This is consistent with previous reports^{15,16}. Bernabe et al.¹⁶ investigated the relationship between daily smoking and caries increment in adults. They found that daily smoking was related to net decayed teeth (DT) increment over a 4-year period but not to net filled teeth (FT), missing teeth (MT), or DMFT increments. Smokers also had poor dental attendance, high sugar consumption, and infrequent tooth brushing.

Frequent brushing had a positive association and eating between meals had a negative association with the presence of untreated decayed teeth in this study. Stephan and Miller¹⁷ conducted the first pH measurements of dental plaque. Within 3 min after human teeth were rinsed with a glucose solution, the pH of plaque dropped from 6.5 to 5.0. However, in a second trial, pH did not drop on the side of the mouth that had been brushed. Reporting on sugar consumption and caries risk in a systematic review, Burt and Pai¹⁸ concluded that the relationship between sugar consumption and caries is much weaker in the modern age of fluoride exposure than it used to be. If those brushing two or more times per day in the current study were using fluoride toothpaste, that may explain why they

were less likely to have tooth decay¹⁹⁾.

There were several limitations in this study; the first of which is the possibility of selection bias due to the fact that the data were from an Internet survey. The second limitation is that the oral health status information was self-reported. Previous reports^{20,21)} 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. Silva et al. reported that self-reports underestimated the prevalence of dental caries by 9.3% in comparison with clinical evaluations²¹⁾. The third limitation is that it was a cross-sectional survey. In spite of these limitations, the results of this study show a significant relationship between overtime work hours and untreated decayed teeth. Therefore, oral health education and dental checkups in the workplace may be important for financial workers, regardless of their high income and high educational background.

Conclusion

After adjusting for age, income, educational background, oral hygiene behavior, snacking behavior, regular dental visitation, bad interpersonal relationships at work, and smoking habit, a multiple logistic regression analysis found that overtime work was strongly related to untreated decayed teeth. Oral health education and dental checkups, as well as reducing both stress and overtime hours in the workplace, 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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