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Relationship between Stress Factor and Periodontal Disease in a Rural Area Population in Japan

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Abstract

Objectives: Several studies conducted in Western countries have shown significant associations between stress factors and periodontal disease. However, there have been only a few studies conducted in Asian countries. The present study was designed to identify possible relationship between stress and periodontal disease in residents of a rural area in Japan.

Material and Methods: Data were collected from 1,089 adults with at least six natural teeth in a typical farming district of Japan. Subjects were asked to complete a questionnaire on daily stresses in various aspects of life. Data on gender, occupation, smoking, alcohol drinking habits, dental health behavior and systemic disease status were obtained from the questionnaires. Periodontal disease status was assessed using clinical attachment loss (CAL), and the subjects were dichotomized according to mean CAL <1.5 mm (control group) and ≥1.5 mm (diseased group). Logistic regression was applied to assess the associations between stress and other factors with periodontal disease, and odds ratios (ORs) as well as 95% confidence intervals were calculated. Results: In bivariate analysis, significant relationships were found between periodontal disease and stress within 1 month ($P<0.001$), job stress ($P<0.001$), self-health-related stress ($P<0.001$) and family health-related stress ($P<0.01$). Logistic regression analysis revealed that subjects who felt job stress (OR = 1.71, $P<0.05$) and those who felt stress due to self health (OR = 1.72, $P<0.05$) were more prone to have periodontal disease than were those who never or only rarely felt such stress. Significant correlations were also found between periodontal disease and smoking habit, frequency of dental clinic visits and hyperlipidemia (OR = 1.8, $P<0.05$, OR = 2.0, $P<0.001$, OR = 2.1, $P<0.05$, respectively).

Conclusion: The results suggest that stress related to self health and job might be potential risk indicators for development of periodontal diseases. Intervention measures including stress reduction may provide adjunctive approaches for preventing and treating periodontal disease.

Key words: Self health-related stress, Job stress, hyperlipidemia, clinical attachment level, periodontal disease.

Introduction

Periodontal diseases are oral disorders characterized by inflammation of the supporting tissues of the teeth (Fowler et al. 2001). The etiology of periodontal disease is multifactorial. Several factors are related to the development of periodontal diseases, such as virulence of the microorganism, host, and environmental conditions (Teng et al. 2003; Monteiro da Silva et al. 1996; Meyer 1989). Smoking, alcohol consumption, toothbrushing frequency, dental visits, and life events are also related to periodontal health (Aleksejuniene et al. 2002; Imaki et al. 1997; Genco et al. 1998; Genco et al. 1999; Shizukuishi et al. 1998; Hyman and Reid 2004). Therefore, the variation in severity of periodontal disease cannot be explained by only a few risk factors (Teng et al. 2003). The associations between stress factors and periodontal disease have been examined in several studies (Linden et al. 1996; Shizukuishi et al. 1998; Wimmer et al. 2002; Pistorius et al. 2002). Periodontal disease is more widespread and severe in subjects with higher levels of stress (Linden et al. 1996). The effects of various psychological and psychosocial factors such as emotional stress, a high level of work stress, dissatisfaction at work or stress from unemployment have been the focus of several investigations on oral diseases (Linden et al. 1996; Wimmer et al. 2002; Pistorius et al. 2002; Freeman and Gross 1993). Correlations have been found between these factors and advanced periodontal disease (Wimmer et al. 2002). Stress caused by events in the private life or at the work place may exert an unfavorable effect on the progression of periodontal diseases (Pistorius et al. 2002).

Although there have been many studies on the relationships of stress factors to periodontal diseases in Western countries, there have been few studies in Asian countries. Shizukuishi et al. (1998) found a significant association between mental stress and periodontal health status in Japanese workers. However, only one item related to subjective mental stress was examined in that study; individual stress-related factors such as job stress and health-related stress were not examined. Furthermore, the study population consisted of factory employees in one company. Sonoda and Mori (2003) examined the relationships between

lifestyle factors and subjective health, including periodontal health, in residents of an urban area. Rural areas have rapidly aging communities in which the lifestyles of residents are expected to be more typical and which might provide a more appropriate sample for epidemiological study. The aim of the present study was to evaluate the association between stress factors and periodontal disease in a typical rural area of Japan.

Materials and Methods

Study Population

All of the 2,359 residents ranging in age from 18 to 96 years of a farming village in the northernmost island of Japan were invited to take part in this study. This district has a total population of 3,055 and a land area of 665.53 km2. The subjects were selected through government census. Twenty-seven percent of the residents were aged 65 years or older, a higher percentage than the national average (18%). Regional health officers visited residents' homes to explain the purpose of the study. The residents were asked to answer self-administered questionnaires and to undergo periodontal examinations when as part of medical health check-ups. Verbal consent for participation in the study was obtained from all participants.

Questionnaire-based Measures

The first page of the questionnaire included questions on demographic factors, i.e., age, gender, employment status (employed or unemployed), smoking and alcohol consumption. Smoking was recorded according to number of cigarettes smoked per day, and subjects were divided into a group of subjects who smoked 1-20 cigarettes/day, a group of subjects who smoked >21 cigarettes/day, and a group of non-smokers (Vettore et al. 2003). Consumption of alcohol was recorded as ">Once/ day " and ">Once/day". Oral hygiene behavioral variables were investigated as frequency of regular dental visits for prevention of dental disease, toothbrushing and use of extra cleaning devices. Toothbrushing frequency was measured on a daily basis; frequency of using extra cleaning devices was recorded as "never", "sometimes" or "everyday" and frequency of regular dental clinic attendance was recorded as "once/ 6 months or less" or "more than once/6 months".

To estimate stress, a questionnaire based on the life events scale was used (Genco et al. 1999; Solis et al. 2004). First, participants were asked to indicate the extent (never, rarely, sometimes, often) to which they agree with a statement that had occurred in the last month. Levels of 8 types of stress in the life events, job stress, self health stress, family health-related stress, stress related to parenting, stress related to family care, stress related to neighborhood, financial stress, and stress related to other factors, were measured. Responses were coded as 'no' (stress negative) or 'yes' (stress positive). Subjects were asked to respond only to items that applied to them; i.e., those subjects who were unemployed at the time of the survey were requested to skip the questions related to job stress, and subjects who were unmarried were asked to skip questions related to parenting.

From the questions on health, the following variables were recorded: self-reported presence of cardiovascular disease, hypertension, hyperlipidemia, diabetes, cerebral hemorrhage and osteoporosis (Lagervall et al. 2003; Fowler et al. 2001). All self-reported diseases were coded as 1 (no disease) or 2 (self reported disease).

Clinical Investigations

Periodontal conditions have been assessed by clinical attachment loss (CAL). The clinical examinations were carried out in a public city hall with sufficient illumination provided by artificial light on buccal and mesiobuccal sites of each tooth in a randomly assigned upper quadrant and lower quadrant selected at the beginning of the examination excluding third molars (Vettore et al. 2003). Calculation of CAL was two measurements: (1) distance from the free gingival margin (FGM) to the cemento-enamel junction (CEJ) and (2) distance from the FMG to the bottom of the sulcus (probing depth; PD). CAL was calculated by subtracting the distance FGM-CEJ from PD (Tezal et al. 2004). Replicate examinations were conducted throughout the survey repeatedly to assess intra-examiner reliability. The examiner consistency of clinical recordings was estimated by the k index (0.82).

Statistical Analysis

Data from subjects with less than six teeth were not included in the analysis (Tezal et al. 2004). Data from subjects who had received periodontal therapy in the previous 3 months and those who had taken any type of antibiotics during the previous 6 months or had taken any immunosuppressive drugs were also excluded. The data were analyzed using the SPSS software package (SPSS Inc., version 11.5, Chicago, IL., USA). The dependent variable was presence of periodontal disease defined as a dichotomous variable according to clinical examination criteria, by which subjects with mean CAL <1.5 mm were assigned to a non-diseased group and those with mean CAL ≥1.5 mm were assigned to a diseased group (Tezal et al. 2004). The chi-square test was used to establish an association between prevalence of periodontal disease and other potential variables. Logistic regression analysis was used to identify stress factors and other independent variables related to periodontal disease. Probability levels at $P<0.05$ were considered statistically significant. The odds ratio with 95% confidence intervals was computed from regression results (Solis et al. 2004).

Results

Data from 1,089 subjects (531 males and 558 females; mean age, 55.0 ± 1.7 years), were used for analysis. Table 1 shows the percent distributions of periodontal disease-positive subjects by age, gender, employment status, alcohol consumption and smoking behavior. The percentage of periodontal disease-positive male subjects was significantly higher than that of periodontal disease-positive female subjects ($P<0.05$). The

Table 1. Prevalence of periodontal disease by age, gender, employment status, alcohol consumption and smoking behavior.

Variable		Number of subjects with periodontal disease (%)	
Age (years)	18-40	88	(27.4)
	41-96	245	(31.9)
Gender	Male	180	(33.9)*
	Female	153	(27.4)
Employment status	Employed	217	(33.3)*
	Unemployed	115	(26.3)
Alcohol consumption	≤Once/day	165	(28.7)
	>Once/day	154	(33.1)
Smoking behavior	Never	151	(28.5)
(No of cigarettes/day)	1-20	113	(29.1)
	>21	57	(45.2)***

*: P<0.05, ***: P<0.001 chi-square test

Table 2. Prevalence of periodontal disease according to various stress-related factors.

Stress-related variables		Number of subjects with periodontal disease (%)	
Stress within 1 month	Never, rarely	119	(24.2)
	Sometimes, often	205	(36.8)***
Job stress	No	213	(26.7)
	Yes	120	(41.1)***
Self-health-related stress	No	282	(29.0)
	Yes	51	(44.4)***
Family health-related stress	No	302	(29.6)
	Yes	31	(44.9)**
Stress related to parenting	No	306	(30.7)
	Yes	27	(29.0)
Stress related to family care	No	325	(30.4)
	Yes	8	(42.1)
Stress related to neighborhood	No	301	(30.1)
	Yes	32	(36.4)
Financial stress	No	306	(30.1)
	Yes	27	(37.5)
Stress related to other factors	No	319	(30.4)
	Yes	14	(36.8)

**: P<0.01, ***: p<0.001 chi-square test

prevalence of periodontal disease was significantly higher in subjects employed in various services than in subjects who were unemployed (P<0.05). A significant association was also found between periodontal disease and number of cigarettes smoked per day. The prevalence of periodontal disease was significantly higher in subjects who smoked more than 21 cigarettes per day than in subjects who smoked less then 20 cigarettes per day and in subjects who had never smoked (P<0.001). No significant association was found between age and periodontal disease or between alcohol consumption and periodontal disease.

Table 3. Prevalence of periodontal disease according to presence of systemic disease.

Systemic diseases		Number of subjects with periodontal disease (%)	
Hypertension	No	283	(30.2)
	Yes	50	(32.7)
Hyperlipidemia	No	314	(30.0)
	Yes	19	(44.2)*
Diabetes mellitus	No	310	(29.8)
	Yes	23	(46.9)**
Cerebral hemorrhage	No	327	(30.3)
	Yes	6	(54.5)
Osteoporosis	No	331	(30.6)
	Yes	2	(33.3)

*: P<0.05, **: P<0.01 chi-square test

Table 4. Prevalence of periodontal disease according to oral health behavior.

Oral health behavior		Number of subjects with periodontal disease (%)	
Toothbrushing frequency	≤1 time/day	152	(32.2)
	>1 time/day	181	(29.3)
Use of extra cleaning devices	Never	234	(31.0)
	Sometimes, Everyday	99	(29.6)
Frequency of dental attendance	≤Once/6 months	62	(44.3)***
	>Once/6 months	268	(28.7)

***: P<0.001 chi-square test

The associations between periodontal disease and various stress- related factors (bivariate analysis) are shown in Table 2. A Significantly higher prevalence of periodontal disease was found in subjects who felt stress within 1 month (P<0.001) than in subjects who did not feel any stress. Subjects with job stress had a significantly higher prevalence of periodontal disease than did subjects without job stress (P<0.001). than in subjects who had stress due to self health and family health showed higher prevalences of periodontal disease than did subjects who had no such stress (P<0.001 and P<0.01, respectively).

Relationships between periodontal disease and systemic disorders are presented in Table 3. The prevalences of periodontal disease in subjects with diabetes mellitus (46.9%) or hyperlipidemia (44.2%) were significantly higher than the prevalence in subjects without those diseases (30.0%). No significant association was found between other diseases and periodontal disease.

Table 4 shows the relationships between periodontal disease and dental health behavior. Subjects who visit-

Table 5. Results of multiple logistic regression analysis.

Factors		Odds Ratio (95% Confidence Interval)
Age (years)	18-40	1.00
	41-96	1.45 (1.03-2.02)*
Gender	Male	1.00
	Female	0.82 (0.57-1.19)
Occupation	Employed	1.00
	Unemployed	1.09 (0.77-1.53)
Smokers (no of cigarettes/day)	Never	1.00
	1-20	0.90 (0.63-1.30)
	>21	1.77 (1.09-2.88)*
Stress within 1 month	Never, rarely	1.00
	Sometimes, often	1.37 (0.89-2.11)
Job stress	No	1.00
	Yes	1.71 (1.10-2.67)*
Self-health-related	No	1.00
	Yes	1.72 (1.06-2.76)*
Family health-related stress	No	1.00
	Yes	1.66 (0.96-2.87)
Frequency of dental attendance	≤Once/6 months	1.00
	>Once/6 months	2.04 (1.38-3.00)***
Hyperlipidemia	No	1.00
	Yes	2.05 (1.04-4.04)*
Diabetes mellitus	No	1.00
	Yes	1.46 (0.75-2.84)

*: P<0.05, ***: P<0.001

ed a dental clinic more than once within 6 months for oral health care showed a significantly lower prevalence of periodontal disease than did subjects who visited a dental clinic once or less within 6 months (P<0.001). No significant association was found between tooth-brushing frequency and periodontal disease or between use of extra cleaning devices and periodontal disease.

Table 5 summarizes the results of multivariate analysis revealed by logistic regression analysis. Subjects who felt job stress showed a significant relation with increasing periodontal disease (OR = 1.71, P<0.05). Prevalence of periodontal disease was higher in subjects who felt stress due to self health than those who did not (OR = 1.72, P <0.05). The prevalence of periodontal disease was significantly higher in subjects aged 41-96 years than in subjects aged less than 40 years (OR = 1.45, P<0.05). Logistic regression models stratified for smoking status showed a significant increase in risk of periodontal disease for subjects who smoked more than 21 cigarettes per day than for those who smoked less than 20 cigarettes per day or those who never smoked (OR = 1.77, P<0.05). Subjects who visited a dental clinic only once or less within 6 months were about 2.0-times more predisposed to experience periodontal disease than were subjects who visited a dental clinic more than once within 6 months (P <0.001). The prevalence of periodontal disease was about 2.1-times higher in subjects with hyperlipidemia than in subjects without hyperlipidemia (OR = 2.1, P<0.05).

Discussion

There have been many studies on relationships of stress factors to general health status of an individual (Delongis et al. 1982; Cohen et al. 1986). The purpose of the present study was to investigate the effects of stress factors on periodontal health in a large survey in which potential confounding factors such as age, gender, smoking, systemic disease and dental attendance could be controlled.

In our study, the prevalence of periodontal disease in subjects who felt job stress was about 1.7-times higher than that in subjects without such stress. Job stress may arise from various sources, some of which are intrinsic to the job such as poor working conditions, long working hours, work overload or underload, individual's role in the organization, relationships at work, career development and general work climate. Job stress may depend on how a person handles and copes with the job strain he/she encounters since stress from the job is not the same experience for everyone or it may depend on the degree of social support (Genco et al. 1999). Kawakami and Haratani (1999) suggested that Japanese workers tend to suppress expression of positive feelings, resulting in apparently higher psychosocial stress level and lower job satisfaction level compared with those for workers in the US. They also showed that job stress from long working hours was associated with a higher risk of development of myocardial infarction, diabetes mellitus and hypertension in Japanese. In another study by Uehata (1991), an association between job stress and cardiovascular attacks was found. These studies using Japanese subjects showed associations of job stress with various systemic diseases rather than with periodontal disease. In this study, an additional consideration was proved in view of the fact that job stress has a possible influence on the presence of periodontal disease (Freeman and Gross 1993).

Our study showed that subjects who felt stress due to self health were more prone to develop periodontal disease than were subjects without stress. This finding is similar to the results of a one-year prospective study by Freeman and Gross (1993) showing that stress due to physical ill health was related to an increase in pocket depth. On the other hand, Linden et al. (1996) found no evidence of an association between self-assessed physical health status and periodontal disease progression. Their study was a longitudinal one, though the sample size was relatively small (n = 132).

Many epidemiological studies have demonstrated that most dentate older people have periodontal diseases (Miyazaki et al. 1989; Burt 1994; Fox et al. 1994). In our study, the prevalence of periodontal disease in the 41-96-yr-old age group was about 1.4-times higher than that in the 18-40-yr-old age group. As in other countries, periodontal disease might take a turn for the worse in the 30's and over in the Japanese population (Miyazaki et al. 1989). Therefore, to improve quality of life, the dental profession should prepare for meeting the increasing need and demand by the elderly for periodontal services.

Subjects in the present study who smoked more than 21 cigarettes per day were found to have a signifi-

cantly greater frequency of periodontal disease (OR = 1.77) than that in non-smokers. The result is supported by the results of another study showing a tendency for an increase in the severity of disease with increase in the number of cigarettes smoked per day (Imaki et al. 1997). A study by Grossi et al. (1994) showed that smoking is an indicator for risk of development of periodontal disease, with an odds ratio of 2.05 for light smokers (5.3-15.0 packyears) and 4.75 for heavy smokers (30.1-150.0 packyears) compared with non-smokers. The effect of smoking on periodontal health has been demonstrated by these past studies. In addition, subjects who experienced more undesirable life events and daily stress may have coped with these by smoking more (Genco et al.1999). Further studies are needed to determine if hostility may contribute to this relationship.

In the present study, the presence of hyperlipidemia was significantly associated with an increased frequency of periodontal disease. A significant association between periodontal disease and hyperlipidemia has been found in earlier studies (Culter et al. 1999; Noack et al. 2000; Losche et al. 2000; Morita et al. 2004), while other studies showed an absence of such a correlation (Fowler et al. 2001; Lagervall et al. 2003). The results of the present study showed that 44.2% of the subjects with hyperlipidemia were periodontal disease-positive, while the corresponding prevalences in other studies (Noack et al. 2000; Losche et al. 2000) were less than the value in our study (16.7%, and 39%, respectively). However, comparison of prevalences of disorders in different studies may be biased due to factors such as different age groups and methods of data collection.

A significant relationship was also found in the present study between presence of periodontal disease and frequency of visits to a dentist. Those who visited a dentist once or less per 6 months had a higher risk for development of severe periodontal disease than did those who visited a dentist more than once per 6 months. Mullally and Linden (1992) and Teng et al. (2003) reported that regular attendance for dental treatment is one of the factors that affect the level of periodontal disease and confirmed that severe periodontal disease was uncommon in regular dental attendants.

Alveolar bone loss estimated by radiograph is the gold standard for the measurement of periodontal disease. However, we were not able to measure the alveolar bone loss, as it was an epidemiological study. On the other hand, clinical attachment level and probing pocket depth is the other methods for measuring periodontal disease. Clinical attachment level represents the vertical distance in millimeters from the cemento-enamel junction to the point of clinical periodontal attachment. Probing pocket depth is the distance between free gingival margin and apical extent of pocket. With current technology, the best epidemiological measures of periodontal disease are clinical attachment level (Locker et al. 1998). Measures that rely on pocket depths substantially underestimate the prevalence of periodontal disease and are also insensitive to disease progression (Beck and Löe 1993). Therefore, we considered clinical attachment level for measuring periodontal disease.

Several limitations of our study should be considered when interpreting our findings. Stress factors might also result from low socioeconomic status and poor health knowledge, which might lead to the occurrence of periodontal disease. However, these factors were not analyzed in this study. Another limitation is the cross-sectional design of the study, which might have indicated temporal relationships between stress factors and periodontal disease. Therefore, it is necessary to conduct further longitudinal studies relating the sequence of risk factors to periodontal disease onset and progression in order to establish causal relations between potential stress factors and periodontal disease.

In conclusion, job stress and self-health-related stress may be predisposing factors for the onset of periodontal disease. Further work needs to be done to determine possible associations between specific stressors and their effects on periodontal disease. Intervention measures including stress reduction may provide adjunctive approaches for preventing and treating periodontal disease.

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