# Perceived mental stress in relation to oral health over time in middle-aged Swedish women

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***Objectives:*** To study perceived mental stress in relation to oral health among Swedish middle-aged women over a 36-year period, including considerations concerning smoking and socioeconomic status (SES). ***Methods:*** This combined medical and dental study includes three cross-sectional (1968/9 N=746, 1980/1 N=432, 2004/5 N=500) surveys of 38- and 50-year-old women included in the Prospective Population Study of Women in Gothenburg, Sweden. Panoramic radiography was used to register the number of teeth, filled teeth and decayed teeth and the level of periodontal bone loss. The information concerning perceived mental stress, smoking and education (chosen to represent SES) was questionnaire-based. ***Results:*** Perceived mental stress increased over the 36-year period, but was not related to oral health. The time of examination year had a protective effect on oral health, with a larger number of remaining teeth, fewer decayed teeth and less periodontal bone loss in the later examination year, 2004/5, compared with 1968/9. Risk factors for poor oral health were smoking, greater age (50 vs. 38 years) and low educational level. Smokers had fewer filled teeth than non-smokers except in 2004/5, and there was a shift over time towards fewer filled teeth among highly educated women. ***Conclusions:*** A remarkable increase in perceived mental stress was seen among the women over time, but was not associated with oral health. Smoking, greater age and low educational were risk factors for poor oral health, whereas a later examination year was a protective factor.

**Key words:** *stress, oral health, women, epidemiology, periodontitis, socioeconomic status, Sweden*

## Introduction

Perceived mental stress affects general health in different ways (Cohen *et al*., 2007; Hange *et al*., 2013; Wiegner *et al*., 2015). Hange *et al*. found that women who reported perceived mental stress had a higher frequency of abdominal symptoms, headache/migraine, frequent infections and musculoskeletal symptoms than women who did not report perceived mental stress. Furthermore, perceived mental stress is associated with different conditions, such as depression, anxiety, cardiovascular disease and HIV/AIDS (Cohen *et al.*, 2007; Wiegner *et al.*, 2015). Cohen *et al.* also found that perceived mental stress seems to play a role in asthma, autoimmune diseases, upper respiratory tract infections, herpes virus infections and wound healing (Cohen *et al.*, 2007).

The topic of perceived mental stress's effect on oral health is not as well investigated as that of general health though there are studies by Genco *et al.* (1999) and Stabholz *et al.* (2010). Genco *et al.* found that psychosocial measures of stress (associated with financial stress) and depression are significant risk indicators for more severe periodontal disease, but that adequate coping behaviors may reduce the stress-associated risk. Stabholz *et al.* suggest that stress could affect periodontal disease progression and wound healing, mainly by two paths: health-impairing behavior, for instance, poor oral hygiene and smoking; and pathophysiological factors, such as higher glucocorticoid and catecholamine levels, which affect, for instance, inflammatory profiles that lead to an increased susceptibility to periodontal disease.

Moreover, Hugo *et al.* (2006) draw the conclusion that mental stress is a significant risk indicator of elevated levels of plaque and gingivitis. In a review article, Peruzzo *et al.* (2007) reported that most studies show a positive relationship between stress/psychological factors and periodontal disease. Psychosocial measures of stress, traumatic life events and elevated cortisol levels have been identified as risk indicators for severe periodontal disease. Furthermore, passive coping strategies were more pronounced in advanced disease. It was also found that the individual's ability to cope with stressful stimuli may play a role in the progression of periodontal disease. Other conditions of the mouth that seem to be related to mental stress are oral lichen planus (Sandhu *et al.*, 2014) and salivary gland hypofunction (Hugo *et al.*, 2008).

The literature contains few reports of studies of perceived mental stress and oral health. As society changes over time, it affects different individuals in different ways, also with regard to their perceived mental stress and oral health.

Hence, the aim of this study was to describe perceived mental stress in relation to oral health among Swedish middle-aged women, age 38 and 50 years, over a 36-year period, including considerations concerning smoking and socioeconomic status (SES).

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## Methods

The Population Study of Women in Gothenburg, Sweden, initiated in 1968/9, was a combined medical and dental health examination, to which 1,622 women, aged 38, 46, 50, 54 and 60 years, were invited among all Gothenburg residents selected from the Swedish Tax Agency Register by a systematic random sampling method based on their date of birth (Bengtsson *et al.*, 1973). The study was then repeated with the same design at 12-year intervals; i.e., in 1980/1, 1992/93 and 2004/5 when new groups of women aged 38 and 50 years old, were invited using the same inclusion criteria as previously to ensure comparability. Detailed information on the sampling procedure has been published previously (Bengtsson *et al.*, 1973; 1989; Bjorkelund *et al.*, 2008). This present repeated cross-sectional study's analysis includes women 38 and 50 years old, from the Population Study of Women in Gothenburg's 1968/9, 1980/1 and 2004/5 samples since they include data on perceived mental stress. The samples' numbers of participants and the participation rates are given in Table 1.

**Table 1.** Number of middle-aged women overall and in the age groups 38 and 50 years, participating in the dental examinations of the Prospective Population Study of Women in Gothenburg, and the overall participation rates for each of the 1968/9, 1980/1 and 2004/5 samples

|  |  | 1968/9 | 1980/1 | 2004/5 |
|---|---|---|---|---|
| Overall | Participants | 746 | 432 | 500 |
|  | Participation rate | 88.5% | 76.1% | 58.4% |
| Age 38 | Participants | 356 | 109 | 207 |
| Age 50 | Participants | 390 | 323 | 293 |

For each study year, non-participation analyses were carried out to investigate the representativeness of the study groups. In 1968/9, single women were overrepresented among the non-participants (Bengtsson *et al.*, 1973). In 1980/1, a higher proportion of the non-participants was edentulous, and among the dentate individuals, the non-participants had significantly fewer teeth as well as fewer filled teeth (Ahlqwist, 1989). Moreover, a higher proportion of the non-participating women were smokers. In 2004/5, the non-participants had lower incomes and more of them were immigrants (Bjorkelund *et al.*, 2008).

Data collection included dental radiographic examination (panoramic radiograph) and completion of questionnaires concerning oral health. Perceived mental stress was measured by the single unchanged questionnaire item categorized as shown in Figure 1.

Smoking was assessed in the same way across the three studies. For the present analysis, smoking was categorized into three groups: 0, never smoked; 1, ex-smokers who have not smoked for a year or more; 2, smokers and those who quit smoking during the past year.

The number of teeth, filled teeth, decayed teeth (approximal and/or occlusal caries) and the level of periodontal bone loss were assessed from the radiographs.

The Schei ruler assessed the level of periodontal bone loss (Lira-Junior *et al.*, 2013) with the ruler divided into five equal parts to measure marginal bone loss for each tooth. Grade 1 was categorized as no marginal bone loss and grade 5 as the greatest bone loss. The worst values

**Have you experienced any period of mental stress…** (one month or more), and by stress we mean that you have been: Irritable, Tense, Nervous, Anxious, Afraid, Anguished and/or Sleepless **...connected with concern for:** Your work, Your health, Your family, Conflict with the people around you (at home, at work) and/or another cause.     **Tick one option:**

☐ never experienced any period of stress — No perceived mental stress

☐ experienced a period of stress
☐ experienced a period of stress during the last 5 years — Moderate perceived mental stress

☐ experienced several periods of stress during the last 5 years
☐ living under constant stress during the last year
☐ living under constant stress during the last 5 years — High perceived mental stress

*Figure 1. Questionnaire item concerned with mental stress and its response categorization*

were calculated for each woman then categorized as: 0, no teeth; 1, healthy or minor bone loss (no bone loss or ≤1/5 of the root length); 2, moderate bone loss (2/5 of the root length); 3, high bone loss (≥3/5 of the root length).

Education was chosen to represent SES based on years of school attendance categorized as: low (1-9 years); medium (10-12 years); and high level of education (≥13 years).

The statistical analyses consisted of descriptive statistics and inference testing using the chi-square test and the one-way analysis of variance, including a post-hoc test ((LSD, least significant difference) using the SPSS v.21.0. The chosen level of significance was $p<0.05$. Inter-variation analyses were also made between the researchers applying the Schei ruler (kappa 0.64 for tooth surface 21 distally and 0.67 for tooth surface 36 mesially), as well as intra-variation analyses (kappa 0.65 for tooth surface 21 distally and 1.0 for tooth surface 36 mesially). The number of teeth, filled teeth and decayed teeth from panoramic x-rays had intra-class correlations of 1.0, 0.99 and 0.92, respectively, in the intra-variation analyses.

The multivariate analyses included three models with binary logistic regressions using the number of teeth, the number of decayed teeth and periodontal bone loss as the dependent variables, as an indication of oral health. The dependent variables were dichotomized. The number of teeth was divided into 0-20 vs. 21-32 teeth (a functional dentition was determined to be 20 teeth (Kayser *et al.*, 1987), periodontal bone loss into low and moderate bone loss vs. high bone loss, and the number of decayed teeth into 0 vs. 1 or more decayed teeth. The independent variables used were perceived mental stress, educational level, smoking, year of examination and age.

The Regional Ethical Review Board in Gothenburg, Sweden, approved the studies (Dnr 179-92, T-453-04). All participants provided written informed consent.

## Results

Overall descriptive data for the women concerning perceived mental stress, education and smoking are given in Table 2.

Perceived mental stress increased significantly over time, especially from 1980/1 to 2004/5 for the sample. In 1968/9, about a fifth of the women were in the high stress group and about half had never perceived any mental stress but these fractions were reversed in 2004/5. No association was found between perceived mental stress and education or smoking (data not shown).

**Table 2.** Proportion (%) of middle-aged women in the studies in 1968/9, 1980/1 and 2004/5 according to perceived mental stress, education and smoking

|  | 1968/9 n=746 | 1980/1 n=432 | 2004/5 n=500 |
|---|---|---|---|
| No perceived stress | 54.1 | 63.2 | 19.7 |
| Moderate perceived stress | 27.9 | 19.3 | 30.2 |
| High perceived stress | 18.0 | 17.5 | 50.1 |
| Low education | 86.3 | 81.0 | 8.1 |
| Medium education | 12.4 | 15.7 | 38.9 |
| High education | 1.3 | 3.3 | 52.9 |
| Non-smoker | 50.3 | 47.1 | 48.3 |
| Previous smoker | 7.9 | 13.5 | 29.7 |
| Smoker | 41.7 | 39.4 | 22.0 |

Significance ($p<0.05$) in sub-analyses $\chi^2$ between all study years in all groups

No associations were found between perceived mental stress and oral health, expressed as the number of teeth, number of filled teeth, number of decayed teeth and periodontal bone loss (Table 3) or with the four categories of periodontal bone loss (data not shown).

Women with low education (vs. higher educational levels) and smokers (compared with non- and ex-smokers) had significantly fewer remaining teeth as well as more periodontal bone loss in only the 1968/9 and 2004/5 samples (Table 3).

The number of filled teeth was lower among smokers and those with low education (vs. non-smokers and the two better educated groups) in 1968/9 and 1980/1. In the 2004/5 sample this pattern was reversed, with more filled teeth among smokers and women of lower educational levels. However, the proportion of filled teeth in relation to the total number of teeth revealed that smokers had proportionally more filled teeth than non-smokers in all three samples. Regarding education, there was a trend over time towards fewer filled teeth, especially among highly educated women, from 81% in 1968/9 to 47% in 2004/5 (proportion data not shown).

In 1968/9, the number of decayed teeth was higher among smokers than non-smokers; otherwise, no other differences were seen for the separate study years regarding education or smoking.

In multivariate analyses, perceived mental stress had no significant association with oral health, independently of which dependent variables were chosen; i.e., the number of teeth, number of decayed teeth or periodontal bone loss (Table 4). Year of examination and age were significant predictors of oral health in all three models. Greater age (50 vs. 38 years old) indicated a greater risk of having poor oral health, but the women's oral health improved across the years. Smoking and education showed the same pattern, with smoking and low educational level indicating a greater risk of more periodontal bone loss and fewer remaining teeth but not with the number of decayed teeth.

## Discussion

In this study, perceived mental stress increased significantly over time, but it was not related to oral health expressed as the number of teeth/filled teeth/decayed teeth and periodontal bone loss. The women's oral health has improved considerably over time as they have more remaining teeth, fewer decayed teeth and less periodontal bone loss.

**Table 4.** Logistic regression models: Model 1, periodontal bone loss- low and moderate bone loss vs. high bone loss; Model 2, number of decayed teeth- no vs. 1 or more decayed teeth; Model 3, number of teeth- 0-20 vs. 21-32 teeth

|  | Model 1 Periodontal bone loss | | Model 2 Number of decayed teeth | | Model 3 Number of teeth | |
|---|---|---|---|---|---|---|
|  | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Stress – ref. No |  |  |  |  |  |  |
| Moderate | 1.2 | 0.9-1.6 | 0.8 | 0.6-1.1 | 1.0 | 0.7-1.3 |
| High | 1.0 | 0.7-1.4 | 0.8 | 0.6-1.1 | 1.0 | 0.7-1.4 |
| Education – ref. High |  |  |  |  |  |  |
| Medium | 2.0* | 1.2-3.4 | 1.3 | 0.8-2.0 | 2.7 | 0.7-9.8 |
| Low | 2.3* | 1.4-4.0 | 1.1 | 0.7-1.7 | 7.3* | 2.0-26.3 |
| Smoking – ref. Non-smoker |  |  |  |  |  |  |
| Previous smoker | 1.2 | 0.8-1.7 | 1.0 | 0.7-1.3 | 1.3 | 0.8-2.1 |
| Smoker | 2.1* | 1.6-2.8 | 1.0 | 0.8-1.3 | 3.8* | 2.8-5.1 |
| Year of examination – ref. 2004/5 |  |  |  |  |  |  |
| 1980/1 | 3.7* | 2.4-5.8 | 6.4* | 4.2-9.7 | 7.9* | 3.5-17.9 |
| 1968/9 | 4.2* | 2.7-6.6 | 3.7* | 2.5-5.6 | 27.7* | 12.3-62.0 |
| Age in years – ref. 38 |  |  |  |  |  |  |
| 50 | 4.3* | 3.3-5.6 | 1.6* | 1.3-2.0 | 5.8* | 4.2-8.0 |
| Nagelkerke test statistic | 0.28 |  | 0.17 |  | 0.44 |  |

* significance of $p<0.05$

**Table 3.** Oral health measured as the mean number of teeth, filled teeth, decayed teeth and periodontal bone loss compared with perceived mental stress, education and smoking among middle-aged women in 1968/9, 1980/1 and 2004/5

| | 1968/9 | | 1980/1 | | 2004/5 | |
|---|---|---|---|---|---|---|
| | Mean | (SD) | Mean | (SD) | Mean | (SD) |
| **Number of teeth** | | | | | | |
| Total group | 18.2 | (9.3) | 21.9 | (7.1) | 28.0 | (3.1) |
| No perceived stress | 18.3 | (9.1) | 21.9 | (7.2) | 28.4 | (2.7) |
| Moderate perceived stress | 18.8 | (9.0) | 21.4 | (7.1) | 28.2 | (3.6) |
| High perceived stress | 17.1 | (10.0) | 22.2 | (7.1) | 27.7 | (2.9) |
| Low education | 17.5bc | (9.4) | 21.3bc | (7.3) | 25.5a | (5.1) |
| Medium education | 22.3b | (7.1) | 24.0b | (5.6) | 27.7a | (3.0) |
| High education | 24.5c | (7.5) | 27.2c | (2.8) | 28.6a | (2.2) |
| Non-smoker | 19.0bd | (9.3) | 23.9b | (5.3) | 28.5b | (2.7) |
| Previous smoker | 21.5cd | (8.3) | 22.5c | (7.5) | 28.3c | (2.1) |
| Smoker | 16.7bc | (9.2) | 19.3bc | (8.0) | 26.4bc | (4.4) |
| | | | | | | |
| **Number of filled teeth** | | | | | | |
| Total group | 13.9 | (8.1) | 17.2 | (6.6) | 14.0 | (5.5) |
| No perceived stress | 14.0 | (7.9) | 17.1 | (6.6) | 14.5 | (5.9) |
| Moderate perceived stress | 14.1 | (8.0) | 17.1 | (6.7) | 13.8 | (5.3) |
| High perceived stress | 13.2 | (8.4) | 17.6 | (6.6) | 14.1 | (5.4) |
| Low education | 13.4bc | (8.1) | 16.8b | (6.7) | 15.8c | (5.1) |
| Medium education | 17.0b | (6.7) | 19.2b | (5.6) | 14.6d | (5.2) |
| High education | 19.8c | (6.7) | 19.3 | (4.0) | 13.4cd | (5.7) |
| Non-smoker | 14.3b | (8.1) | 18.6b | (5.6) | 13.1bd | (5.7) |
| Previous smoker | 16.3c | (6.9) | 18.0c | (6.5) | 14.8d | (5.3) |
| Smoker | 13.9bc | (8.1) | 15.3bc | (7.2) | 15.1b | (4.9) |
| | | | | | | |
| **Number of decayed teeth** | | | | | | |
| Total group | 1.1 | (1.7) | 1.8 | (2.1) | 0.3 | (0.6) |
| No perceived stress | 1.1 | (1.8) | 1.9 | (2.0) | 0.3 | (0.7) |
| Moderate perceived stress | 1.2 | (1.9) | 1.7 | (2.3) | 0.3 | (0.6) |
| High perceived stress | 0.8 | (1.3) | 1.8 | (2.0) | 0.2 | (0.5) |
| Low education | 1.1 | (1.8) | 1.8 | (2.1) | 0.5 | (1.0) |
| Medium education | 1.0 | (1.5) | 2.0 | (2.2) | 0.3 | (0.6) |
| High education | 1.5 | (1.4) | 0.9 | (1.4) | 0.2 | (0.5) |
| Non-smoker | 0.9b | (1.4) | 2.1 | (2.3) | 0.3 | (0.6) |
| Previous smoker | 1.1 | (1.6) | 1.6 | (1.8) | 0.2 | (0.5) |
| Smoker | 1.3b | (2.1) | 1.6 | (1.8) | 0.3 | (0.7) |
| | | | | | | |
| **Periodontal bone loss** | | | | | | |
| Total group | 1.6 | (0.5) | 1.6 | (0.5) | 1.1 | (0.2) |
| No perceived stress | 1.6 | (0.6) | 1.5 | (0.4) | 1.1 | (0.2) |
| Moderate perceived stress | 1.6 | (0.5) | 1.5 | (0.4) | 1.1 | (0.2) |
| High perceived stress | 1.6 | (0.5) | 1.6 | 1(0.6) | 1.1 | (0.2) |
| Low education | 1.6b | (0.6) | 1.6 | (0.4) | 1.3a | (0.4) |
| Medium education | 1.4b | (0.4) | 1.6 | (0.6) | 1.1a | (0.2) |
| High education | 1.6 | (0.6) | 1.3 | (0.3) | 1.1a | (0.1) |
| Non-smoker | 1.5b | (0.5) | 1.4b | (0.3) | 1.1b | (0.1) |
| Previous smoker | 1.5c | (0.4) | 1.5c | (0.4) | 1.1c | (0.1) |
| Smoker | 1.7bc | (0.6) | 1.7bc | (0.6) | 1.3bc | (0.3) |

SD, standard deviation; Analysis of variance was applied including a post-hoc analysis (LSD, least significant difference); Educational level and number of teeth: a, $p<0.05$ between all education groups; b, $p<0.05$ between low and medium-level education groups; c, $p<0.05$ between low and high-level education groups; d, $p<0.05$ between medium and high-level education groups. Smoking and number of teeth: a, $p<0.05$ between all smoker groups; b, $p<0.05$ between non-smoker and smoker; c, $p<0.05$ between previous smoker and smoker; d, $p=0.05$ between non-smoker and previous smoker

Little is mentioned in the literature about mental stress' relationship to oral health, and even less on time trends in this relationship. The finding that stress/psychological factors were a risk factor for periodontal bone loss elucidated in previous studies (Genco *et al.*, 1999; Peruzzo *et al.*, 2007; Stabholz *et al.*, 2010) was not found in this study.

This study revealed a clear and important increase in middle-aged women's perceived mental stress. Between 1968/9 and 1980/1 the stress levels were more or less unchanged, but in 2004/5, the incidence and level of stress increased markedly (Table 2). It may be that the concept of mental stress became better known or better defined across the years or respondents may have interpreted the issue of stress differently over time. Another explanation may be that society has changed more and more rapidly during this last 24-year period. Studies support the notion that society changes over time, for instance, in terms of increased work-related stress (Wiegner *et al.*, 2015). As society has changed over time, there were more highly educated women in 2004/5 (Wennström *et al.*, 2013), with more women working outside the home (Hayghe, 1986) than in 1968/9. As better educated women are generally satisfied with their lives (Janssen *et al.*, 2012) this would presumably result in less mental stress but in this study women reported markedly increased stress levels in the last survey. A possible reason may be that, even though high education is satisfying, it is still demanding as it involves multiple roles for the women, with women getting more depressed and less satisfied as parents if they perceive their roles as conflicting (Tiedje *et al.*, 1990). In the 1990s, it was shown that working mothers still took greater responsibility than the fathers for the household and the children (Emmons *et al.*, 1990), and these differences persist between men and women in the 2000s (Hill, 2005). Further, women report and seek medical care for different complaints, experience higher levels of mental stress, suffer from symptoms of illness and report sick due to work-related stress more often than men (Holmgren *et al.*, 2009; Indregard *et al.*, 2013; Wiegner *et al.*, 2015).

It has been well established previously that smoking is a health behavior that is associated with SES - the better educated being less likely to smoke (Charafeddine *et al.*, 2013). SES, smoking and age are all well-known health-related factors. Smoking is seen as a risk factor for lung disease, lung cancer, heart disease and stroke (Levin and Kessler-Baruch, 2013), but it is also, together with age, a strong risk factor for tooth loss (Ahlqwist, 1989) and periodontal disease (Levin and Kessler-Baruch, 2013; Norderyd *et al.*, 1999). The current study revealed similar results with smoking, greater age (50 vs. 38 years) and low educational level all related to greater periodontal bone loss and fewer remaining teeth. No such association being observed with non-smokers and ex-smokers in this study, suggesting that quitting smoking may predict better oral health, as observed elsewhere (Levin and Kessler-Baruch, 2013).

The strengths of this study were the random selection of the middle-aged women, the moderate-to-high participation rate, and the cross-sectional design that was applied repeatedly over the 36-year period. This is important for identifying societal changes over time for generalizing the results in a Swedish urban population. Furthermore, the assessments of the variables remained unchanged though the single perceived stress question has not been tested with respect to validity and reliability. Other weakness could be that women may have changed their interpretation of the stress-question over time and the sample included only women in narrow age ranges. Furthermore, the participation rate over the years has been declining, even though it was still moderate in the study in 2004/5.

## Conclusions

This cross-sectional study of middle-aged women over a study period of 36 years showed that, irrespective of perceived mental stress, education, smoking and age, there was a gradient towards better oral health (more remaining teeth and less periodontal bone loss) in the later examination years. Furthermore, perceived mental stress among middle-aged women increased dramatically over time, even though it was not related to oral health. On the other hand, smoking, greater age and little educational were all revealed as risk factors for poor oral health.

## References

Ahlqwist, M. (1989): Women's teeth. A cross-sectional and longitudinal study of women in Gothenburg, Sweden, with special reference to tooth loss and restorations. *Swedish Dental Journal. Supplement* **62**, 1-84.

Bengtsson, C., Blohme, G., Hallberg, L., Hallstrom, T., Isaksson, B., Korsan-Bengtsen, K. and Westerberg, H. (1973): The study of women in Gothenburg 1968-1969--a population study. General design, purpose and sampling results. *Acta Medica Scandinavica* **193**, 311-318.

Bengtsson, C., Gredmark, T., Hallberg, L., Hallstrom, T., Isaksson, B., Lapidus, L., Lindquist, O., Lindstedt, S., Lurie, M., Nyström, E., Rybo, G., Samuelsson, S., Rafnsson, V., and Sigurdsson, J. (1989): The population study of women in Gothenburg 1980-81--the third phase of a longitudinal study. Comparison between participants and non-participants. *Scandinavian Journal of Social Medicine* **17**, 141-145.

Bjorkelund, C., Andersson-Hange, D., Andersson, K., Bengtsson, C., Blomstrand, A., Bondyr-Carlsson, D. and Lissner, L. (2008): Secular trends in cardiovascular risk factors with a 36-year perspective: observations from 38- and 50-year-olds in the Population Study of Women in Gothenburg. *Scandinavian Journal of Primary Health Care* **26**, 140-146.

Charafeddine, R., Demarest, S., Van der Heyden, J., Tafforeau, J. and Van Oyen, H. (2013): Using multiple measures of inequalities to study the time trends in social inequalities in smoking. *European Journal of Public Health* **23**, 546-551.

Cohen, S., Janicki-Deverts, D. and Miller, G.E. (2007): Psychological stress and disease. *JAMA,* **298**, 1685-1687.

Emmons, C-A., Biernat, M., Tiedje, L.B., Lang, E.L. and Wortman, C.B. (1990). Stress, support, and coping among women professionals with preschool children. In, *Stress between work and family*. New York: Springer, 61-93.

Genco, R.J., Ho, A.W., Grossi, S.G., Dunford, R.G. and Tedesco, L.A. (1999): Relationship of stress, distress and inadequate coping behaviors to periodontal disease. *Journal of Periodontology* **70**, 711-723.

Hange, D., Mehlig, K., Lissner, L., Guo, X., Bengtsson, C., Skoog, I. and Bjorkelund, C. (2013): Perceived mental stress in women associated with psychosomatic symptoms, but not mortality: observations from the Population Study of Women in Gothenburg, Sweden. *International Journal of General Medicine* **6**, 307-315.

Hayghe, H. (1986): Rise in mothers' labor force activity includes those with infants. *Monthly Labor Review* **109**, 43-45.

Hill, E.J. (2005): Work-family facilitation and conflict, working fathers and mothers, work-family stressors and support. *Journal of Family Issues* **26**, 793-819.

Holmgren, K., Dahlin-Ivanoff, S., Bjorkelund, C. and Hensing, G. (2009): The prevalence of work-related stress, and its association with self-perceived health and sick-leave, in a population of employed Swedish women. *BMC Public Health,* **9**, 73.

Hugo, F.N., Hilgert, J.B., Bozzetti, M.C., Bandeira, D.R., Goncalves, T.R., Pawlowski, J. and de Sousa Mda, L. (2006): Chronic stress, depression, and cortisol levels as risk indicators of elevated plaque and gingivitis levels in individuals aged 50 years and older. *Journal of Periodontology* **77**, 1008-1014.

Hugo, F.N., Hilgert, J.B., Corso, S., Padilha, D.M., Bozzetti, M.C., Bandeira, D.R., Pawlowski, J. and Goncalves, T.R. (2008): Association of chronic stress, depression symptoms and cortisol with low saliva flow in a sample of south-Brazilians aged 50 years and older. *Gerodontology* **25**, 18-25.

Indregard, A.M., Ihlebaek, C.M. and Eriksen, H.R. (2013): Modern health worries, subjective health complaints, health care utilization, and sick leave in the Norwegian working population. *International Journal of Behavioral Medicine* **20**, 371-377.

Janssen, I., Powell, L.H., Jasielec, M.S., Matthews, K.A., Hollenberg, S.M., Sutton-Tyrrell, K. and Everson-Rose, S.A. (2012): Progression of coronary artery calcification in black and white women: do the stresses and rewards of multiple roles matter? *Annals of Behavioral Medicine* **43**, 39-49.

Kayser, A.F., Witter, D.J. and Spanauf, A.J. (1987): Overtreatment with removable partial dentures in shortened dental arches. *Australian Dental Journal* **32**, 178-182.

Levin, L. and Kessler-Baruch, O. (2013): Cigarette smoking and the alveolar bone around teeth and dental implants. *New York State Dental Journal* **79**, 53-59.

Lira-Junior, R., Freires Ide, A., de Oliveira, I.L., da Silva, E.S., da Silva, S. and de Brito, R.L. (2013): Comparative study between two techniques for alveolar bone loss assessment: A pilot study. *Journal of Indian Society of Periodontology* **17**, 87-90.

Norderyd, O., Hugoson, A. and Grusovin, G. (1999): Risk of severe periodontal disease in a Swedish adult population. A longitudinal study. *Journal of Clinical Periodontology* **26**, 608-615.

Peruzzo, D.C., Benatti, B.B., Ambrosano, G.M., Nogueira-Filho, G.R., Sallum, E.A., Casati, M.Z. and Nociti, F.H., Jr. (2007): A systematic review of stress and psychological factors as possible risk factors for periodontal disease. *Journal of Periodontology* **78**, 1491-1504.

Sandhu, S.V., Sandhu, J.S., Bansal, H. and Dua, V. (2014): Oral lichen planus and stress: An appraisal. *Contemporary Clinical Dentistry* **5**, 352-356.

Stabholz, A., Soskolne, W.A. and Shapira, L. (2010): Genetic and environmental risk factors for chronic periodontitis and aggressive periodontitis. *Periodontology 2000* **53**, 138-153.

Tiedje, L.B., Wortman, C.B., Downey, G., Emmons, C., Biernat, M. and Lang, E. (1990): Women with multiple roles: Role-compatibility perceptions, satisfaction, and mental health. *Journal of Marriage and the Family* **52**, 63-72.

Wennström, A., Ahlqwist, M., Stenman, U., Bjorkelund, C. and Hakeberg, M. (2013): Trends in tooth loss in relation to socio-economic status among Swedish women, aged 38 and 50 years: repeated cross-sectional surveys 1968-2004. *BMC Oral Health* **13**, 63.

Wiegner, L., Hange, D., Bjorkelund, C. and Ahlborg, G., Jr. (2015): Prevalence of perceived stress and associations to symptoms of exhaustion, depression and anxiety in a working age population seeking primary care - an observational study. *BMC Family Practice* **16**, 38.