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Periodontal disease and quality of life in British adults

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Abstract

Aim: To explore the association between periodontal disease and quality of life in British adults, independently of demographic factors, socioeconomic position and other common oral conditions.

Materials and Methods: This is a cross-sectional study of 3122 dentate adults who participated in the 1998 Adult Dental Health Survey in the United Kingdom. The short-form oral health impact profile (OHIP-14) was used to assess oral health-related quality of life. Periodontal disease was defined as having at least two proximal sites with loss of attachment $\geqslant 4$ mm and one proximal site with pocket depth $\geqslant 4$ mm, not necessarily on the same tooth. The association between periodontal disease and the OHIP-14 score was assessed in unadjusted, partially adjusted and fully adjusted models.

Results: Periodontal disease was associated with the OHIP-14 score (rate ratio: 1.26, 95% CI: 1.16–1.38), even after adjustment for demographic factors (sex, age and English region or country), socioeconomic position (educational attainment and household income) and clinical conditions (number of teeth, partial denture use, dental caries, traumatic dental injuries and tooth wear).

Conclusion: Periodontal disease was associated with quality of life, independent of socio-demographic characteristics and other conditions present in the mouth.

Key words: adults; periodontal disease; quality of life

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The impact on quality of life of periodontal disease has received much less attention in comparison with other common oral conditions. A better understanding of the effects of periodontal disease from individuals' point of view is needed for the planning and evaluation of public health interventions and for allocation of resources (Allen 2003). Furthermore, this information can be used to demonstrate the burden of periodontal disease on the well-being of populations and to advocate for resources to improve access to oral health care services (Locker 2004, Rozier & Pahel 2008).

Current evidence on the impact of periodontal disease on quality of life is mostly limited to clinical studies (Reisine et al. 1989, Needleman et al. 2004, Brennan et al. 2007, Cunha-Cruz et al. 2007, Aslund et al. 2008a, Patel et al. 2008, Jowett et al. 2009, Araujo et al. 2010, O'Dowd et al. 2010, Tsakos et al. 2010), which restricts the ability to generalize findings to wider populations. On the other hand, the few population studies were confined to specific age groups or controlled for a limited number of covariates (Ng & Leung 2006, Brennan et al. 2007, Lopez & Baelum 2007, Lawrence et al. 2008, Marino et al. 2008). As socioeconomic position and demographic factors are closely related to both periodontal disease and quality of life, they may confound the association between periodontal disease and quality of life (Lopez & Baelum 2007, Lawrence et al. 2008).

Most previous studies used generic oral health-related quality of life (OHRQoL) measures, which aim to capture not only the impacts caused by periodontal disease but also those related to other oral conditions (Fletcher et al. 1992, Guyatt et al. 1993, Kind 2001, Allen 2003). As many people with periodontal disease may also have dental caries, tooth loss or even wear partial dentures, not considering the impact of the latter conditions can seriously affect the estimates of the association between periodontal disease and quality of life. Therefore, the problem arises not because of using a generic OHRQoL

Conflict of interest and sources of funding statement

The authors declare that they have no conflict of interests.

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measure per se but because of failing to recognize that other conditions occurring simultaneously in the mouth also explain variations in the levels of the OHRQoL measure. This concern has been acknowledged as a limitation for the interpretation of previous findings (Brennan et al. 2007, Cunha-Cruz et al. 2007, Lopez & Baelum 2007, Araujo et al. 2010).

Using data from the most recent nationwide dental health survey available in the United Kingdom, this study explored the association between periodontal disease and quality of life, independently of demographic factors, socioeconomic position and other common oral conditions.

Methods

Study sample

Data are from the 1998 ADHS in the United Kingdom. This cross-sectional survey was based on a representative sample of adults, aged 16 and over, living in the United Kingdom. Participants were selected by stratified random sampling. Briefly, 74% of all eligible households agreed to take part, and 92% of the 6764 adults in these households completed an interview. In total, 3817 of the 5281 interviewed adults with some natural teeth (72%) were clinically examined. A full report with details on sampling strategy and response rates has been published elsewhere (Kelly et al. 2000).

Ethical approval for the survey was obtained from the North Thames Multi-Centre Research Ethics Committee and by the Local Research Ethics Committees in all the areas covered by the survey.

Data collection

Data were collected through face-to-face interviews and dental examinations. During interviews, participants provided information on their demographic characteristics (sex and age), socioeconomic position (educational attainment and household income) and OHRQoL. Educational attainment was assessed as the highest level of qualification received (no qualifications, below degree level, and degree level and above). Weekly household income, from all sources and before deductions, was derived from responses to several questions. OHRQoL was measured using the short-form oral health impact profile (OHIP-14), which contains 14 questions on the frequency of adverse impacts caused by oral conditions during the preceding 12 months. For example, subjects were asked, ''How often during the past year have you had painful aching in your mouth because of problems with your teeth, mouth or dentures?'' OHIP-14 items are grouped into seven dimensions: functional limitation (trouble pronouncing words and worsened taste), physical pain (aching in mouth and discomfort eating foods), psychological discomfort (feeling self-conscious and feeling tense), physical disability (interrupted meals and unsatisfactory diet), psychological disability (difficulty relaxing and embarrassment), social disability (irritability and difficulty in doing usual jobs) and handicap (life less satisfying and inability to function). Respondents were asked to rate each item on a 5-point ordinal scale coded 0 ''never'', 1 ''hardly ever'', 2 ''occasionally'', 3 ''fairly often'' and 4 ''very often''. The OHIP-14 score is the sum of responses and ranges from 0 to 56, with higher scores indicating poorer OHRQoL (Slade 1997).

Dental examinations were conducted by 70 dentists, with participants seated on a chair and using light, mirror and CPITN-C probe. Examiners were recruited from the Community Dental Services and they were very experienced in epidemiological work and familiar with the criteria used. They examined for the existence and condition of teeth, wear of tooth surfaces, traumatic dental injuries (TDI), use of any dentures and the condition of the periodontium. All teeth, including third molars were examined. Dental caries was recorded at the surface level using the caries into dentine threshold (cavitated lesion). Periodontal examination included the assessment of pocket depth and loss of attachment at two sites (mesial and distal) per tooth, buccally on upper teeth and lingually on lower teeth. Only anterior teeth were examined for tooth wear and TDI. Tooth wear was assessed at three surfaces (buccal, incisal and lingual) per tooth and recorded as restricted to enamel, loss of enamel just exposing dentine, more extensive exposure of dentine (more than one-third of the buccal or palatal surface) or loss of dentine (incisal surface), and complete enamel loss with exposure of dental pulp or secondary dentine. An assessment of fractured teeth as a consequence of trauma, as distinct from loss of tooth tissue because of wear, was also included in this section. Reliability values were calculated for the condition of teeth, tooth wear and TDI, but not for periodontal conditions because of the difficulty of performing so with the large number of examiners. Kappa values for intra-examiner reliability varied from 0.88 to 0.96 for condition of teeth and from 0.44 to 0.96 for tooth wear and TDI (Kelly et al. 2000).

For this study, dental caries was defined as having one or more teeth with cavitated caries or teeth that were so broken down, possibly with pulpal involvement, that they were unrestorable. Periodontal disease was defined as having at least two proximal sites with loss of attachment $\geqslant 4$ mm and at least one proximal site with pocket depth $\geqslant 4$ mm, not necessarily on the same tooth (Borrell & Crawford 2008, 2009). Tooth wear was defined as having one or more anterior teeth with moderate-to-severe wear (extensive exposure of dentine or complete enamel loss with exposure of the dental pulp or secondary dentine). TDI was defined as having one or more anterior teeth with clear evidence of traumatic loss of tooth substance.

Statistical analysis

All analyses were weighted to take account of the survey design and possible non-response bias (Kelly et al. 2000). Negative binomial regression models were fitted as the OHIP-14 score was a count variable with over-dispersion. As for covariates, age and number of teeth were analysed in their continuous forms whereas household income was divided into quintiles.

The association between periodontal disease and the OHIP-14 score was assessed in unadjusted, partially and fully adjusted models. Partially adjusted models controlled for sex, age, English region or country (North, Midlands and South of England, Wales, Scotland and Northern Ireland), educational attainment, household income, number of teeth and partial denture use whereas the fully adjusted model additionally controlled for dental caries, TDI and tooth wear. Therefore, the fully adjusted model provided an assessment of the association between periodontal disease and the OHIP-14 score independent of other oral conditions (dental caries,

tooth wear and TDI) occurring simultaneously.

For the final part of the analysis, the associations of single measures of periodontal disease (i.e. the number of teeth with pocket depth ⩾4 mm and the number of teeth with loss of attachment ⩾4 mm) with the OHIP-14 score were also assessed in unadjusted, partially and fully adjusted models, as described above. As the two periodontal measures were not normally distributed, they were categorized into four groups for analysis: 0, 1–4, 5–9, and 10 or more teeth.

Results

The study sample included 3122 adults with complete data (50% women), with a mean age of 41.16 years [standard deviation (SD): 16.17, range: 16–93]. The mean OHIP-14 score was 5.30 (SD: 6.78, range: 0–48). While the study sample was slightly younger and had somewhat higher OHIP-14 scores than the full sample of dentate adults, there were no differences in other socioeconomic and demographic factors between both groups (Table 1). The mean number of teeth was 25.04 (SD: 5.97, range: 1–32) and 14% wore partial dentures. Dental caries was the most common oral condition (42%), followed by periodontal disease, tooth wear and TDI (31%, 11% and 4%, respectively). Moreover, the mean numbers of teeth with pocket depth ⩾4 mm and loss of attachment ⩾4 mm were 3.18 (SD: 4.73, range: 0–30) and 2.39 (SD: 4.35, range: 0–28), respectively.

Periodontal disease was associated with the OHIP-14 score after adjustment for sex, age, English region or country, educational attainment, household income, number of teeth and partial denture use (Table 2). This association was attenuated but remained significant after further adjustment for dental caries, TDI and tooth wear. Adults with periodontal disease had rates 1.26 (95% CI: 1.16–1.38) greater for the OHIP-14 score than their counterparts. The rate ratio for the association between periodontal disease and the OHIP-14 score decreased by 21% when the four oral conditions were analysed together.

Single measures of periodontal disease were also associated with the OHIP-14 score (Table 3). After adjustment for other oral conditions, the OHIP-14 score increased linearly with increasing numbers of teeth with pocket depth ⩾4 mm and loss of attachment ⩾4 mm, respectively. Adults with 10 or more teeth with pocket depth and those with 10 or more teeth with loss of attachment had rates of 1.40 (95% CI: 1.13–1.72) and 1.42 (95% CI: 1.41–1.44) greater for the OHIP-14 score compared with their corresponding reference groups (no teeth with pocket depth or loss of attachment, respectively).

Table 1. Characteristics of the study sample and comparison with full sample of dentate adults

Explanatory variables	All dentate ($n = 5281$)	Study sample ($n = 3122$)
Sex n^* (%)		
Men	2406 (50%)	1428 (50%)
Women	2875 (50%)	1694 (50%)
Mean age in years (SD)	42.23 (15.74)	41.16 (16.17)
Educational attainment, *n* (%)		
No qualification	1210 (22%)	627 (20%)
Below degree level	3253 (62%)	1956 (64%)
Degree level and above	809 (16%)	539 (16%)
Household income, *n* (%)		
1st quintile (£0–185)	961 (20%)	602 (19%)
2nd quintile (£190–325)	928 (19%)	609 (18%)
3rd quintile (£330–485)	968 (21%)	683 (22%)
4th quintile (£490–690)	864 (20%)	623 (20%)
5th quintile (£695–5288)	799 (20%)	605 (21%)
Mean OHIP-14 score (SD)	5.07 (6.51)	5.30 (6.78)

*All bases are unweighted.
OHIP, oral health impact profile.

Table 2. Regression models for the associations of periodontal disease, dental caries, traumatic dental injuries and tooth wear with OHIP-14 score ($n = 3122$)

Oral conditions	Model 1† RR‡ (95% CI)	Model 2† RR‡ (95% CI)	Model 3† RR‡ (95% CI)
Periodontal disease			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.19 (1.07–1.32)*	1.33 (1.18–1.50)**	1.26 (1.16–1.38)**
Dental caries			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.37 (1.33–1.41)**	1.42 (1.37–1.47)**	1.37 (1.32–1.42)**
Traumatic dental injuries			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.15 (1.09–1.23)**	1.24 (1.17–1.31)**	1.22 (1.17–1.27)**
Tooth wear			
No	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
Yes	1.12 (0.91–1.37)	1.11 (0.85–1.45)	1.09 (0.80–1. 48)

†Model 1 was unadjusted; model 2 was adjusted for sex, age (continuous), English region or country, educational attainment, household income (quintiles), number of teeth (continuous) and partial denture use; and model 3 was further adjusted for the other three oral conditions in the table.
‡Negative binomial regression was fitted and rate ratios (RR) were reported. Rate ratios represent changes in rates for the OHIP-14 score for adults with a particular oral condition compared to those without it.
*$p < 0.01$, **$p < 0.001$.
OHIP, oral health impact profile.

Discussion

Periodontal disease was independently associated with poor quality of life. The magnitude of this association was such that adults with periodontal disease had a 26% increase in the OHIP-14 score compared with those without periodontal disease. This finding is comparable with that found in the Dunedin Multidisciplinary Health and Development Study when the cohort was at age 32 years (14% increase), which is the only previous study reporting estimates adjusted for untreated caries (Lawrence et al. 2008). However, our findings are unique because we used a nationally representative sample of dentate adults and accounted for a number of other oral conditions. As the association between periodontal disease and the OHIP-14 score decreased by up to 21% when dental caries, TDI and tooth wear were considered simultaneously, previous

Table 3. Regression models for the associations of the numbers of teeth with pocketing 4 mm or greater and loss of attachment 4 mm or greater with OHIP-14 score ($n = 3122$)

Periodontal measure	Model 1† RR‡ (95% CI)	Model 2† RR‡ (95% CI)	Model 3† RR‡ (95% CI)
Number of teeth with pocket depth ⩾4 mm			
0 teeth	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1–4 teeth	1.20 (1.11–1.29)**	1.27 (1.12–1.43)**	1.21 (1.12–1.31)**
5–9 teeth	1.13 (1.05–1.22)*	1.30 (1.19–1.43)**	1.26 (1.20–1.31)**
10+teeth	1.26 (0.98–1.62)	1.49 (1.17–1.88)*	1.40 (1.13–1.72)*
[*p* for trend]	[<0.001]	[<0.001]	[<0.001]
Number of teeth with loss of attachment ⩾4 mm			
0 teeth	1.00 [Reference]	1.00 [Reference]	1.00 [Reference]
1–4 teeth	1.00 (0.86–1.17)	1.07 (0.90–1.28)	1.02 (0.90–1.17)
5–9 teeth	1.17 (0.89–1.54)	1.30 (1.07–1.59)*	1.27 (1.09–1.48)*
10+ teeth	1.18 (1.16–1.20)**	1.50 (1.47–1.52)**	1.42 (1.41–1.44)**
[*p* for trend]	[0.034]	[<0.001]	[<0.001]

†Model 1 was unadjusted; model 2 was adjusted for sex, age (continuous), English region or country, educational attainment, household income (quintiles), number of teeth (continuous) and partial denture use; and model 3 was further adjusted for the other three clinical conditions in the table.
‡Negative binomial regression was fitted and rate ratios (RR) were reported. Rate ratios represent changes in rates for the OHIP-14 score for adults with a particular oral condition compared to those without it.
*$p < 0.01$, **$p < 0.001$.
OHIP, oral health impact profile.

reports may have overestimated the magnitude of the association between periodontal disease and quality of life.

We also found evidence for a dose-response association between the severity of periodontal disease and quality of life. There were gradual deteriorations in quality of life scores as the numbers of teeth with pocket depth and loss of attachment increased, respectively. This means that not only those with generalized forms of periodontal disease but also those with localized periodontal disease had poorer quality of life than those with no signs of the disease. This finding is consistent with a previous study where patients with multiple teeth with periodontal pockets reported worse quality of life than those with few and no periodontal pockets (Cunha-Cruz et al. 2007).

Taken together, our findings suggest that periodontal disease may significantly affect the quality of life of individuals. Through inflammation and destruction of the periodontal tissues, periodontal disease causes a wide range of clinical signs and symptoms, such as bleeding, tooth mobility, receding gums, bad breadth and toothache, which may have a considerable impact on daily life (Needleman et al. 2004, Ng & Leung 2006, Cunha-Cruz et al. 2007). Consequently, it is possible that periodontal therapy improves the quality of life of periodontal patients, as it has been demonstrated recently by some clinical trials (Ozcelik et al. 2007, Aslund et al. 2008b, Jowett et al. 2009, Saito et al. 2010). However, further studies are required to better understand the type and quality of periodontal treatment that generate the greatest improvement in quality of life.

Some limitations of this study need to be discussed. First, the study sample included 3122 dentate adults who represent 82% of those participating in the interview and dental examination, and 59% of those participating in the interview only. These figures may raise concerns about representativeness of the data. However, the study sample was comparable with the full sample of dentate adults in terms of demographic characteristics, socioeconomic position and levels of quality of life, which provides support for its representativeness and the generalization of the findings. Second, due to logistic and financial constraints, periodontal data from an epidemiological study are not as comprehensive as data from a clinical study (Kingman & Albandar 2002, Leroy et al. 2010). Radiographs are considered unethical if solely taken for epidemiological purposes. Furthermore, the clinical norm for a full-mouth assessment of periodontal disease is not applicable to all epidemiological surveys due to short examination times and the requirement to minimize subject discomfort. Although partial-mouth assessments (i.e. half-mouth, index teeth or fixed sites) maximize the number of people examined in the time available and encourage subjects to comply with the study protocol, they underestimate the prevalence and severity of periodontal disease (Susin et al. 2005, Kingman et al. 2008). To address this concern, we used a case definition of periodontal disease in line with current recommendations of: (i) integrating pocket depth and loss of attachment measurements; (ii) using interproximal sites, in contrast to buccal or lingual sites, as the disease usually begins and is most severe at interproximal sites and because this minimizes the effects of gingival recession on the accuracy of pocket depth measurement; (iii) including at least two sites with loss of attachment because it is possible to have an abnormal loss of attachment and not have periodontal disease; and (iv) using thresholds on pocket depth and loss of attachment measurements that are greater than the normal biological variation (Burt 2005, Tonetti & Claffey 2005, Page & Eke 2007, Eke & Dye 2009, Savage et al. 2009, Leroy et al. 2010). Third, no reliability assessment for the periodontal examination was conducted because of the large number of examiners involved in the survey (Kelly et al. 2000, Morris et al. 2001). Although examiners were very experienced in epidemiological work and the criteria used (Kelly et al. 2000), they found it challenging to accurately record periodontal data under field circumstances (Morris et al. 2001). This implies that the levels of pocket depth and loss of attachment are probably under-recorded (Morris et al. 2001). Despite this limitation, we found that periodontal disease was strongly and independently associated with quality of life, suggesting that under-registration of periodontal conditions did not seriously affect the results.

In conclusion, periodontal disease was associated with poor quality of life. The association between periodontal disease and quality of life was not accounted for by socio-demographic factors and other common oral conditions. Future studies should give proper consideration to variations in quality of life scores associated with other conditions present in the mouth to avoid biased estimates.

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Clinical Relevance

Scientific rationale for the study: Evidence on the impact of periodontal disease on quality of life comes mainly from clinical studies. The few population studies assessed specific age groups or did not control for the impact of other oral conditions. No study has explored the impact of periodontal disease on the general population.

Principal findings: Data from British dentate adults shows that periodontal disease is negatively associated with quality of life, regardless of socio-demographic characteristics and other oral conditions.

Practical implications: Quality of life measures can be helpful to demonstrate the burden of periodontal disease on individuals and communities and to evaluate the outcome of periodontal interventions.