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Association of oral health-related quality of life measures with aggressive and chronic periodontitis

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Abstract

Background and Objective: Evidence suggests that periodontitis has a negative effect on the quality of life of an individual, with increased impacts by greater disease severity. The aim of this study was to assess the association between quality of life and the presence of different severity and forms of periodontitis (aggressive and chronic), compared to a disease-free control group.

Materials and Methods: Four hundred and seventy one study participants were classified according to periodontal diagnosis using the 1999 Consensus Classification into chronic periodontitis (CP), aggressive periodontitis (AgP) and periodontally healthy. Oral health-related quality of life was assessed using the OHIP-14 questionnaire. Outcomes consisted of the prevalence of oral impacts reported occasionally, fairly often or very often (OFOVO) as well as fairly often or very often (FOVO), OHIP-14 total and domain scores. Logistic and linear regression analyses were carried out to test associations between periodontal diagnosis and quality of life outcomes, adjusted for smoking, age, ethnicity and body mass index.

Results: Over 90% of periodontitis patients reported at least one oral impact experienced occasionally, fairly often or very often (OFOVO) compared with 53.8% of periodontally healthy controls ($P < .001$). After adjustment for covariates, significant differences were found between the periodontitis groups and healthy controls for OHIP-14 outcome scores ($P < .001$) and across all of the OHIP-14 domains ($P < .005$). These differences were clinically meaningful as they were higher than the measurement errors. No significant differences were identified between AgP and CP in adjusted analysis when comparing OHIP-14 scores.

Conclusion: Patients with periodontitis have worse quality of life than periodontally healthy individuals, with differences being clinically meaningful. AgP patients reported worse OHRQoL overall compared to CP patients, but these moderate and meaningful differences were explained through the adjustment process.

KEYWORDS

aggressive periodontitis, chronic periodontitis, periodontitis, quality of life

1 | INTRODUCTION

Evidence published over the last two decades suggests that presence of periodontitis has a detrimental effect on the quality of life of affected individuals.[1] This effect can be assessed by measuring patient-reported outcomes (PROMs), which are a way for the patient's own perception of disease or health to be part of their examination and overall care. There is also evidence that periodontal treatment as well as improving clinical measures of disease, such as probing pocket depths (PPD) and clinical attachment level (CAL), can also improve subjective outcomes, such as patient-reported quality of life measures.[2]

Questionnaires on health-related quality of life (HRQoL) and oral Health-related quality of life (OHRQoL) can be used as a measure of PROMs. The Oral Health Impact Profile-14 (OHIP-14) assesses the impacts of oral diseases on the daily life of people in a pre-determined period[3] and contains 14 questions spanning 7 domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap.[4] To answer each question, participants report whether the impact has affected them never, hardly ever, occasionally, fairly often or very often. The OHIP-14 has been used widely and validated in studies for the assessment of QOL, including in periodontal patients.[5]

Symptoms of periodontitis such as pain, gingival recession and halitosis have been reported to impact physical and psychological discomfort as well as leading to functional limitation.[6,7] Recent systematic reviews have reported a significant association between periodontal disease and OHRQOL.[1,8] However, there was considerable heterogeneity in the primary studies included in the reviews. A number of the included studies in both reviews used partial mouth recording or screening indices to diagnose periodontal disease, for example the Community Periodontal Index, which could potentially overestimate disease presence and lead to reduced validity of the results. In addition, studies included in the reviews lacked a disease-free control group, thereby questioning whether the outcome (OHRQoL) was actually attributed to the disease presence. It has been suggested that future research should include a full-mouth PPD and CAL assessment, utilize globally accepted definitions of periodontal disease and OHRQOL and include a periodontally healthy control group.[1] Furthermore, it is important to interpret the clinical significance and not just statistical significance of PROMs, for example by using the "minimally important difference" (MID),[7] which has been applied to longitudinal periodontal studies to assess responses to treatment.[8,9] To the authors' knowledge, MID has not been reported in cross-sectional studies to assess the impact of periodontal disease.[7,9,10]

There is currently a lack of evidence as to whether the classification of periodontal disease has an impact on OHQoL. It has been proposed that severe forms of periodontitis affecting young individuals, classified until recently as "aggressive periodontitis" (AgP) in contrast to the more common form of "chronic periodontitis" (CP),[11] may have a more profound effect on quality of life. The significance of these differences, however, was not explored.[7]

Results from previous studies indicate that there may be increasingly worse OHRQoL with greater attachment loss.[8] In the literature, studies on this subject have grouped periodontitis patients together, for example in a large scale study of 767 participants, the control group contained participants who were periodontally healthy or had low attachment loss under 2 mm with a test group of moderate-severe attachment loss.[5] In a study that did assess the impact of the severity of chronic periodontal disease, Meusel et al[12] used the OHIP-14Br and showed that patients with severe periodontitis had worse OHQoL than those with mild/moderate periodontitis, although no disease-free control group was used. Therefore, a large study including well-characterized data from patients with different levels of periodontal disease severity, as well as healthy periodontium, would be beneficial.

The aim of this study was to investigate the association between oral health-related quality of life, measured by the OHIP-14, and the presence of different severity and forms of periodontitis (aggressive and chronic), compared to a periodontal disease-free control group.

2 | MATERIALS AND METHODS

2.1 | Patient population

This study had a case-control design, and participants were recruited from patients referred to the Eastman Dental Hospital, University College London by general dental practitioners. Periodontally healthy controls were recruited among patients referred to other Departments of the same hospital. All participants gave written informed consent, and the study was reviewed and approved by the Joint UCL/UCLH Committees on the Ethics of Human Research (reference 05/Q0502/84).

Inclusion criteria for periodontitis patients were the presence of at least one site with ≥5 mm PPD and CAL (not on third molars or distal surfaces of second molars). Inclusion criteria for control subjects were absence of any site with ≥5 mm PPD and CAL (excluding third molars or distal surfaces of second molars) or history of periodontitis and periodontal treatment.

Exclusion criteria for all study participants included (a) known systemic diseases (cardiovascular, respiratory, renal, malignancy, etc), (b) history and/or presence of any other infections, (c) systemic antibiotic treatment in the preceding 3 months, (d) long-term treatment with any medication suspected to affect the periodontium (eg non-steroidal anti-inflammatory drugs), (e) pregnant or lactating females and (fi) <20 teeth present.

2.2 | Patient characteristics

Demographic data were self-reported and included age, gender, ethnicity, smoking status and medical history. Patients' height and weight were measured to obtain their BMI. Socio-economic factors obtained from the patients' postcode as quintiles from the Index of

Multiple Deprivation 2015, which is the official measure of relative deprivation for small areas in England.

2.3 | Clinical examination

One clinician (author LN) assessed all subjects and assigned a diagnosis. A comprehensive clinical examination was performed by three examiners, previously calibrated to ≥98% agreement for PPD and CAL within 2 mm in repeated measurements of 10 patients each. Full-mouth measures of PPD, recessions (REC) and LCAL were obtained at six points per tooth. Diagnosis of alveolar bone loss was confirmed by radiographic assessment from each patient. Patients were diagnosed as having localized aggressive periodontitis (LAgP), generalized aggressive periodontitis (GAgP) or chronic periodontitis (CP), according to the 1999 Consensus Classification.[11] The differential diagnosis between AgP and CP was conducted as described before.[13] Briefly, diagnosis of AgP was generally given to systemically healthy patients ≤45 years old who had at least 3 teeth with CAL ≥6 mm and BOP. Therefore, "rapid" progression was based on young age, in the absence of previous radiographic records.

The cases were also subdivided according to CAL and PPD as no periodontitis, mild, moderate or severe periodontitis according to the American Academy of Periodontology (AAP) 2007 definition.[14]

2.4 | Oral health-related quality of life

Subjects were asked how often they had experienced impacts due to oral health symptoms in the OHIP-14 questionnaire during the previous month. The OHIP-14 was given to all patients following consent and history taking and prior to clinical examination.

2.5 | Statistical analysis

Data from all participants who took part in the study were entered into a spreadsheet by independent staff not involved in the study, proofed for entry errors and analysed by statistical package IBM SPSS 25.0. Continuous variables are reported as means and standard deviations. Associations were first sought independently between periodontal status (AgP vs CP vs healthy; periodontitis (AgP + CP) vs healthy using protocol criteria; periodontitis vs healthy using the AAP 2007 criteria) and potential confounding factors (age, gender, BMI, ethnicity, smoking, socio-economic factors) and OHIP-14 outcomes by chi-squared (for categorical outcomes) and ANOVA (for continuous outcomes). OHIP-14 outcomes consisted of: (a) FOVO prevalence (presence of at least one answer "fairly often" or "very often" to any question), (b) OFOVO prevalence (presence of at least one answer of "occasionally," "fairly often" or "very often" to any question), and (c) total OHIP-14 score [the sum of all scores from 0 (never) to 4 (very often)]. The total OHIP-14 score was log-transformed for analysis, as it was not normally distributed. Adjusted analyses for age, gender, BMI, ethnicity, smoking and socio-economic factors were carried out by logistic regression (for categorical outcomes) or linear regression (for continuous outcomes).

To estimate the MID, effect size (ES) and standard error of measurement (SEM) were used. ES is calculated as a ratio of the mean change score and baseline standard deviation score. The results are interpreted using conventional benchmarks: small (≤0.2), moderate (0.3-0.7) or large (≥0.8).[15] SEM is calculated by multiplying the standard deviation of the baseline score with the square root of 1 minus the reliability of the PROM, the latter calculated by Cronbach's alpha.[16] SEM is a fixed measurement value, which indicates what is likely to be due to measurement error. If the value of the difference in PROMs between groups is less than the SEM, it could represent measurement error.[17]

3 | RESULTS

A total of 471 patients took part in the study. Table 1 shows demographic and periodontal characteristics of recruited patients divided by periodontal diagnosis (AgP vs CP vs healthy). Patients with CP were older at a mean age of 45 years, compared with an average age of 34 years in patients diagnosed with aggressive periodontitis and 38 years in healthy individuals. Average plaque scores were considerably lower in the AgP group than the chronic and healthy groups. The AgP group also had more severe disease with an average PPD of 4.16 mm (±1.17) compared with CP at 3.40 mm (±0.77) (Table 2).

Only 27 patients had one or more missing fields on the OHIP-14 form; however, none of them had missing data for all fields, so they were still included in the analysis.

Tables 3 and 4 show the unadjusted associations between OHIP-14 scores and periodontal status. Over 90% of periodontitis patients reported at least 1 item in the OFOVO category (occasionally, fairly often or very often) compared with 53.8% of controls ($P < .001$). Similarly, 46.3% of CP and 60% of AgP patients had at least 1 item scored as "fairly often" or "very often" (FOVO), compared with only 13.3% of controls ($P < .001$ for periodontitis vs healthy and $P = .041$ for AgP vs CP). The total OHIP score ranged from 6.6 in healthy to 12.9 in CP and 16.5 in AgP ($P < .001$ for periodontitis vs healthy and $P = .009$ for AgP vs CP). The MID estimates are shown in Table 5. The mean difference in OHIP-14 scores between healthy and periodontitis was 8.13 and between CP and AgP was 3.63. These differences were higher than the estimated SEM (2.08 and 2.81, respectively), showing that they were above what could be considered as measurement error. In the comparison between healthy controls and periodontitis patients, the difference was much larger than the SEM. Similarly, the ES was large for healthy compared to periodontitis patients (ES: 1.10) and moderate for CP vs AgP (ES: 0.37). When cases were divided by the AAP criteria,[14] statistically significant differences were found across all groups for OFOVO, FOVO and OHIP scores ($P = <.001$).

Adjusted analyses showed associations between periodontitis[10] and prevalence of OFOVO (3.59 times more likely to report

TABLE 1 Characteristics of included cases based on periodontal diagnosis

		AgP (n = 125)	CP (n = 121)	Healthy (n = 225)	*P*
Gender	Male	44 (35.2%)	50 (41.3%)	104 (46.2%)	.133
	Female	81 (64.8%)	71(58.7%)	121 (53.8%)	
Smoking status	Never	66 (52.8%)	61(50.4%)	152 (67.6%)	.013
	Current	25 (20.0%)	27 (22.3%)	32 (14.2%)	
	Former	34 (27.2%)	33 (27.3%)	41 (18.2%)	
Ethnicity	Caucasian	55 (44.0%)	71 (58.7%)	168 (74.7%)	<.001
	Asian	19 (15.2%)	25 (20.7%)	35 (15.6%)	
	African	23 (18.4%)	2 (1.7%)	11 (4.9%)	
	Afro-Caribbean	23 (18.4%)	16 (13.2%)	13.3 (2.7%)	
	Other	5 (4%)	5 (4.1%)	4 (1.8%)	
IMD quintile	1	27 (23.5%)	20 (17.1%)	30 (14.2%)	.017
	2	31 (27.0%)	43 (36.8%)	74 (34.9%)	
	3	29 (25.2%)	20 (17.1%)	57 (26.9%)	
	4	21 (18.3%)	13 (11.1%)	29 (13.7%)	
	5	7 (6.1%)	21 (17.9%)	22 (10.4%)	
Age		33.79 ± 6.18	45.12 ± 10.05	37.65 ± 11.52	<.001
BMI		26.94 ± 6.80	26.49 ± 5.00	24.26 ± 4.17	<.001

Note: For categorical data, total numbers and frequency within classification are shown. For continuous data, mean values and standard deviation are shown. Comparisons between categorical and continuous data were analysed with chi-squared and ANOVA, respectively. Please note that some of the IMD data were not available.

Abbreviations: BMI, body mass index; ID, Index of Multiple Deprivations.

TABLE 2 Mean data and standard deviation for clinical dental parameters for patients divided by periodontal diagnosis

	AgP (n = 125)	CP (n = 121)	Healthy (n = 225)	Comparison *P* =
FMPS (%)	39.23 ± 24.25	52.95 ± 26.14	51.11 ± 22.21	<.001
FMBS (%)	125 ± 26.64	121 ± 25.68	225 ± 13.09	<.001
Full-mouth PPD (mm)	4.16 ± 1.17	3.40 ± 0.77	1.97 ± 0.27	<.001
No of sites with PPD > 4 mm	63.99 ± 38.04	37.57 ± 26.67	0.29 ± 0.84	<.001

Note: Comparisons analysed with ANOVA.

Abbreviations: FMBS = Full-Mouth Bleeding Score; FMPS = Full-Mouth Plaque Score; PPD = probing pocket depth.

oral impacts occasionally, fairly often or very often, 95% CI 2.64, 4.86; *P* < .001), FOVO (3.33 more likely to report oral impacts fairly often or very often, 95% CI 2.42, 4.58; *P* < .001) and total OHIP scores (adjusted 1.40 higher in periodontitis patients, 95% CI 1.17, 1.66; *P* < .001). Using the AgP-CP classification, adjusted analyses revealed non-statistically significant differences for prevalence of OFOVO (0.94 times more likely in AgP, 95% CI 0.29, 3.05; *P* = .922), FOVO (0.73 times more likely in AgP, 95% CI: 0.38, 1.42; *P* = .357) and total OHIP scores (1.22 points higher in AgP, 95% CI: −0.96, 1.58; *P* = .107).

The relevant scores for the OHIP-14 domains for AgP, CP and healthy subjects are shown in Figure 1. The highest mean scores were recorded for physical pain, psychological discomfort and psychological disability. When adjusting for confounders, statistically significant differences for all domains were detected when comparing periodontitis patients and healthy controls. AgP had higher OHIP-14 values for physical pain compared to CP (average 3.6 for AgP vs 2.5 for CP, *P* = .007), while no statistically significant differences were detected in other domains.

4 | DISCUSSION

In this study including 471 participants, individuals with periodontitis had worse quality of life as measured by the OHIP-14. The association between periodontitis and OHRQOL was found to be robust even after adjustment for smoking, gender, age, ethnicity and BMI. More importantly, these differences between periodontitis patients and healthy controls were clinically meaningful as they were higher than what could be considered as measurement error. When

TABLE 3 OFOVO and FOVO prevalence and OHIP score results by periodontal diagnosis

		AgP	CP	Healthy	Comparison Perio vs healthy *P* =	Comparison AgP vs CP *P* =
OFOVO	0	9 (7.2%)	11 (9.1%)	104 (46.2%)	<.001	.646
	1	116 (92.8%)	110 (90.9%)	121 (53.8%)		
FOVO	0	50 (40.0%)	65 (54.7%)	195 (86.7%)	<.001	.041
	1	75 (60.0%)	56 (46.3%)	30 (13.3%)		
OHIP-14 score		16.54 ± 11.26	12.91 ± 9.83	6.63 ± 7.25	<.001	.009

Note: Total number and frequency within classification shown for categorical data, comparison within group analysed by chi-squared. For continuous data, mean and standard deviation are shown and analysed with ANOVA. Comparisons shown for periodontal disease vs healthy and AgP vs CP.

TABLE 4 OFOVO and FOVO prevalence and OHIP score results by AAP 2007 criteria

		No perio	Mild perio	Moderate to severe perio	Comparison *P* =
OFOVO	0	73 (52.9%)	31(33.3%)	20 (8.3%)	<.001
	1	65 (47.1%)	62 (66.7%)	220 (91.7%)	
FOVO	0	126 (91.3%)	73(78.5%)	111 (46.3%)	<.001
	1	12 (8.7%)	20 (21.5%)	129 (53.8%)	
OHIP-14 score		5.20 ± 6.62	8.94 ± 7.61	14.89 ± 10.76	<.001

Note: Total number and frequency within classification are shown for categorical data, comparison within group analysed by chi-squared. For continuous data, mean and standard deviation are shown and analysed with ANOVA.

TABLE 5 The minimally important differences using the 1999 classification

	Healthy vs periodontitis	CP vs AgP
Mean score change	8.13	3.63
Effect size (ES)	1.10	0.37
Standard error of measurement (SEM)	2.08	2.81

analysing the difference between CP and AgP, increased "FOVO" and total OHIP scores were found for AgP. These differences between CP and AgP were moderate in size and still clinically meaningful as they were higher than the measurement error. However, adjusting for confounders largely explained those differences, highlighting the role of demographic, socio-economic and behavioural factors in that association.

It is interesting that differences between periodontitis and healthy subjects were consistent almost irrespective of the way OHRQoL was categorized (eg whether the threshold was on occasionally reported oral impacts or on often reported oral impacts). Significant differences were found for all dimensions of the OHIP-14 when comparing periodontal disease and healthy controls using the 1999 classification and AAP definition. Oral impacts can comprise a range of functional and psycho-social aspects; the results from this study are in line with other studies that reported that individuals with a higher level of periodontal attachment loss have significantly worse measures of functional limitation, physical pain, psychological discomfort and physical and psychological disability when compared to those with lower levels of attachment loss.[6,7,18,19] In this study, the highest impacts were noted in the domains of psychological discomfort, physical pain and psychological and social disabilities (Figure 1). The study participants with periodontitis reported being more self-conscious and tense due to problems in their mouth and experienced more pain and discomfort with eating. They also perceived more psychological and social problems, such as being embarrassed and having difficulty performing usual tasks. The lowest scoring domain in the periodontitis and control groups was for functional limitation, which is at odds with the results of a different study,[7] this domain encompassed questions related to trouble in speaking and a worsened sense of taste. In two separate studies comparing AgP and CP with control groups, it was found that physical pain had the highest impact scores and the lowest impact scores were for functional limitation.[18,19] In the present study, when analysing the different domain scores for CP and AgP, overall AgP did report worse scores in all domains when compared with CP (Figure 1), but the differences were rather small. Physical pain was the only domain that these differences were statistically significant ($P = .007$) between CP and AgP, potentially reflecting faster disease progression and/or different perceptions of pain between the two groups. Furthermore, all differences in OHIP-14 scores between groups in the present study were reduced when adjusted analyses were carried out, showing the potential role of other factors, particularly smoking, BMI and gender, on the association between periodontitis and patients' quality of life.

The methodology of this study helped to improve the validity of the results as it included full-mouth clinical periodontal

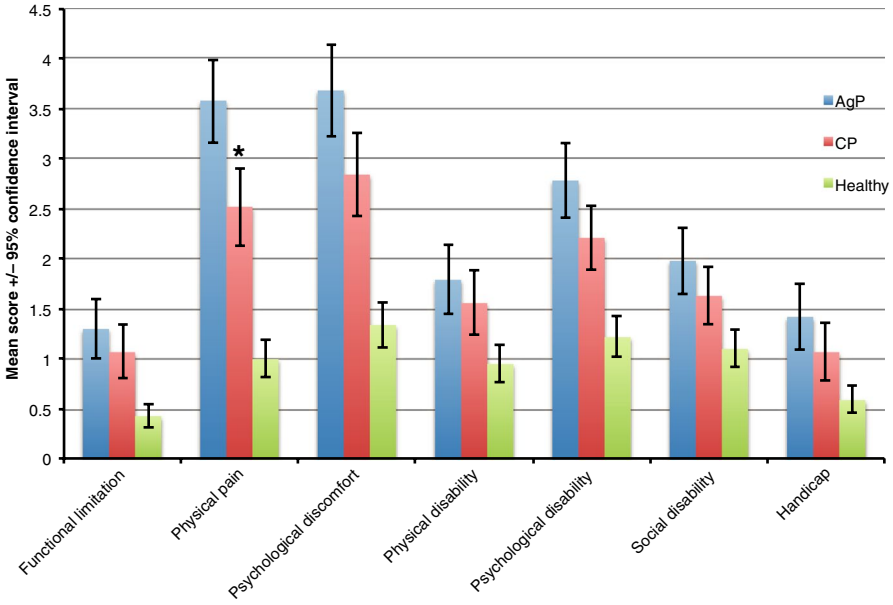

FIGURE 1 Mean values for the different domains of the OHIP-14 questionnaire divided by per-protocol periodontal diagnosis. The 95% confidence intervals are included in the error bars. Comparison between the groups was carried out using ANOVA analysis. Asterisk above a bar defines statistical significance when AgP was compared with CP (P = <0.007). For periodontitis (AgP + CP) vs healthy all results were statistically significant (P = <0.005)

measurements carried out by calibrated examiners, with a periodontal diagnosis assigned by one experienced clinician. Furthermore, only 0.8% of OHIP-14 scores across all domains were not scored by patients, which should have a negligible impact on the results. Calculating the MID in the present study has allowed to put the differences found into context in terms of their clinical relevance, making the results more applicable to clinical practice. Compared to previous literature, the present study had a large sample of participants, including aggressive periodontitis patients, who were compared against a periodontally healthy control group. Llanos et al[20] in a small-scale study included 52 patients (9 LAgP, 33 GAgP and 10 CP) and found that generalized forms of periodontal disease had more significant impact than localized forms. Araújo et al divided subjects with periodontal conditions into different categories, without controls. They found that individuals with periodontal disease (Ag, CP) had higher OHQOL impact scores than those with other conditions (gingival disease, acquired conditions). They reported that patients with more severe forms of periodontal disease such as AgP showed the highest scores when assessed with OHIP-14, but they did not report on significance of differences between the groups.[7] However, with the introduction of the new classification of periodontal disease,[21] aggressive periodontitis and chronic periodontitis are now no longer different diagnoses.

There were limitations in the data collected in this study, as other dental conditions such as dental caries, tooth surface loss, dental trauma and wearing a prosthesis were not accounted for. Furthermore, the OHIP-14 is a generic oral health-related quality of life measure and does not allow for attributing the oral impacts to specific oral conditions. A limitation was that the QOL data were not the primary outcome of this study, with no sample size calculation carried out to power for the OHQOL outcome. When a post hoc calculation was carried out on the data collected, however it showed that the study had more than 90% power to identify a difference in OHIP-14 scores, based on the number of participants included in the study. Furthermore, the Index of Multiple Deprivation used to define SES may not have been sensitive enough for use in individual patients due to variations that can be found in people living in an area, and collecting data such as educational status or household income may have been more appropriate. Unfortunately, it was not possible to re-classify patients retrospectively based on the current classifications of periodontal disease.[21] Therefore, further studies need to clarify potential differences in patient-reported outcomes based on staging and grading.

This study has shown that patients with periodontitis have worse QOL outcomes when compared to periodontally healthy patients, and these differences were large and clinically meaningful. There were oral impacts found for all dimensions of the OHIP-14 when comparing periodontal disease and controls using both the 1999 classification and AAP definitions. Differences were found between AgP and CP, but these moderate and meaningful differences were largely explained through adjustment for confounders. More studies are required to confirm the effects of periodontal treatment on improving QoL. Efforts should be made to prevent, diagnose early and treat periodontitis, in order to improve quality of life of patients. Population-wide strategies should be brought forward to reach out to people affected by periodontitis but who do not have the knowledge or motivation to seek dental care.

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CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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