

# Involvement of psychosocial factors in the association of obesity with periodontitis

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**Abstract:** The present case-control study of 79 subjects (19-69 yr) was designed to assess the relationship of several psychological determinants to periodontal disease and obesity. Periodontal clinical examinations were performed, and the subjects were asked to complete a set of questionnaires measuring Type A personality, anxiety, depression, dental anxiety, hopelessness, emotional intelligence, stress, self-esteem, optimism and satisfaction with life. In a bivariate analysis, overweight individuals presented higher levels of smoking exposure, anxiety and depression and lower levels of optimism and satisfaction with life. They were mainly females, with a higher number of sites and teeth with probing depth (PD) >6 mm and clinical attachment level (CAL) >5 mm. Patients with a mean PD exceeding 3 mm and a bleeding on probing index of >25% presented higher values of dental anxiety and lower levels of self-esteem. Multiple linear regression analyses revealed that dental anxiety was positively associated with the number of teeth with a PD of >6 mm and with reasons for visiting a dentist, while satisfaction with life was associated with flossing frequency. We conclude that there is an association between several psychological determinants, periodontitis, and body mass index. (*J Oral Sci* 52, 115-124, 2010)

Keywords: periodontal disease; psychology; obesity.

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## Introduction

The global obesity epidemic has been described by the World Health Organization (1) as one of the most blatantly visible, yet most neglected, public health problems that threatens to overwhelm both developing and developed countries (2). Obesity is a growing problem in Europe, currently affecting between 10% and 20% of the population (3). Understanding the various factors that have contributed to this trend and understanding why obesity is so difficult to treat has become an increasingly important health issue.

Various cross-sectional and case-control studies have found a strong association between obesity and periodontal disease (4-16). It has also been revealed that metabolic syndrome increases the risk of periodontitis, suggesting that people exhibiting several components of metabolic syndrome should be encouraged to undergo regular periodontal examination (7,13,14,17-19).

A few reports have proposed several mechanisms by which obesity can directly affect periodontal tissue. Obesity affects host immunity (19), and the relationship between adipose tissue and the immune system is believed to be related to the secretion of numerous adipokines, including leptin, whose amount is correlated with fat mass (20). It has been demonstrated that human leptin is present within healthy and marginally inflamed gingiva, and decreases in concentration with increased probing depth (21). Recent studies have indicated that adipose tissue, especially visceral adipose tissue, is an important organ that secretes several bioactive substances known as adipocytokines, which include tumor necrosis factor- $\alpha$ , which may enhance periodontal degradation (7).

The aim of this study was to investigate the relationship of psychological factors to obesity and periodontal disease.

## Materials and Methods

### Subjects

This study population comprised 79 patients consecutively selected from attendees at a private dental practice. Patients enrolled in this study had to satisfy the following criteria: 1) age 19-69 years; 2) a non-contributory medical history; 3) absence of current analgesic therapy; 4) no antibiotic treatment within the preceding 6 months or use of anti-inflammatory drugs on a regular basis; 5) no former periodontal treatment in the previous 2 years; 6) not pregnant or lactating. A total of 100 subjects were approached. Of these, 2 did not consent to participate and 19 were excluded because of incompatibility with the selection criteria. The recruitment period lasted for 9 months.

### Procedures

During the appointment, the first author first explained the details of the research project to participants individually. Patients who agreed to participate were asked to provide signed informed consent. Subjects were then asked to complete a questionnaire including the following sections: (i) demographic and socioeconomic details; (ii) medical history – including symptoms and diagnosed systemic diseases; (iii) dental habits and dental care utilization; and (iv) history of cigarette smoking and exposure to occupational hazards.

In verbal interviews, all patients were informed in detail about the disease and its consequences. The causes of the disease and its potential systemic background as well as the purpose, course and procedure of the investigation, were also explained. Thereafter the patients were free to decide whether they wished to participate in the study. Upon entry, they signed a declaration of informed consent. The subjects were over 18 years old, and the questionnaires were anonymous. The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 1983.

All participants were checked by the investigating dentist (who was also a qualified clinical psychologist) before the clinical examination to confirm that they had no relevant medical history or conditions requiring prophylactic antibiotic cover, and had no positive history of psychiatric episode. Periodontal examination was then carried out. When clinical examinations had been completed, a brief verbal report of dental status was given to the subject, including indications for treatment, in accordance with standard professional ethical requirements.

The subjects were then given a set of self-administered psychological questionnaires. The instructions were explained, and the interviewer stood by to clarify any queries. Upon completion of the psychological

questionnaires, the participants were invited to offer comments on what they had experienced through the course of the study procedures, including the periodontal clinical examination and questionnaire survey.

### Periodontal examination

Clinical examination included recording the number of standing teeth; measurement of the following parameters for each tooth: calculus (CI), visible or detectable through tactile sense using a periodontal probe, bleeding on probing (BOP), followed by recession (REC) and probing depth (PD). Features excluded from the examination were impacted teeth, retained roots, grossly broken-down teeth or teeth that were difficult to examine because of site inaccessibility or difficulty in determining the cement-enamel junction (CEJ) on clinical examination. REC was measured from the CEJ to the gingival margin, while CAL was calculated by summation of PD and REC. PD and REC measurements were made at six sites (Disto-Buccal, Mid-Buccal, Mesio-Buccal, Disto-Lingual, Mid-Lingual, Mesio-Lingual) of the tooth using a #15 University of North Carolina probe (CP15 Medesy, Italy). Full-mouth plaque and calculus scores (PI and CI) were recorded as the percentage of total surfaces (four aspects per tooth) revealing the presence of plaque and calculus (22). Bleeding on probing was assessed dichotomously with a manual probe. Full mouth bleeding score was recorded as the percentage of total surfaces (six aspects per tooth) that revealed the presence of bleeding upon probing.

### Psychological instruments

#### *The Type A Self-Rating Inventory (TASRI)*

The TASRI is a 28-item scale for evaluation of Type A behavior (23). The response format of the scale is a simple checklist involving a 7-point Likert scale. Type B items must be converted by subtracting each response from 8. The total Type A score is obtained by adding 21 Type A items to the 7 transformed Type B items.

#### *The Hospital Anxiety and Depression Scale (HADS)*

The HADS is a brief scale containing seven anxiety and seven depression items, respectively. Participants are asked to reply to a series of statements by circling the appropriate response scored on a scale of 0-3. Subscale scores of >8 are generally taken to indicate that the respondent is probably anxious or depressed (24). The HADS has been widely used as an anxiety and depression screening measure and has previously been used in dental research (25).

### *The Modified Corah Dental Anxiety Scale (MDAS)*

The MDAS asks respondents to indicate their emotional reaction to a dental visit, when in the waiting room, and during drilling, scaling and injection of local anesthetic. The MDAS uses a simple rating scale with 5 possible responses to each question. The responses range from 'not anxious' (scoring 1) to 'extremely anxious' (scoring 5). The reliability of the English language version of the MDAS is good (internal consistency = 0.89; test-retest = 0.82) (26,27).

### *The Hopelessness Scale*

Hopelessness, defined as negative expectancies about oneself and the future, was measured by two items used in the Kupio Heart Disease Study (28-30). These items were "I feel that it is impossible to reach the goals I would like to strive for" and "The future seems to me to be hopeless, and I can't believe that things are changing for the better". Responses were on a 5-point Likert scale (0, absolutely agree; 1, somewhat agree; 2, cannot say; 3, somewhat disagree; or 4, absolutely disagree). Items were reverse-scored and summed to create a hopelessness score, with a range of 0 to 8.

### *The Emotional Intelligence (EI) Scale*

The EI scale (31) comprises thirty-three items, three of which are reverse-scored, measured on a 5-point Likert scale from 1 to 5. The possible range of scores is 33 to 165.

### *The Perceived Stress Scale (PSS-10)*

Perceived stress was measured using the PSS-10 (32), which was designed to measure the "degree to which situations in one's life are appraised as stressful." It comprises ten items, four of which are reverse-scored, measured on a 5-point Likert scale from 0 to 4. The possible range of scores is 0 to 40.

### *The Rosenberg Self-Esteem Scale (SES)*

To assess global self-esteem, we administered the Rosenberg Self-Esteem Scale, which is a self-administered instrument (33). Respondents rate their level of agreement with each of 10 statements, such as "I feel that I am a person of worth, at least on an equal basis with others" and "I wish I could have more respect for myself." Possible scores range from zero (low self-esteem) to 10 (high self-esteem). Rosenberg reported a reproducibility coefficient of 0.92 for this scale (34).

### *The Life Orientation Test (LOT)*

Optimism was measured by using the LOT (35), which

is an eight-item self-report measure (plus four filler items) assessing generalized expectancies for positive versus negative outcomes. Respondents were asked to indicate their degree of agreement with statements such as "In uncertain times, I usually expect the best," and "I hardly ever expect things to go my way," using a 5-point response scale ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). Of the 8 scored items, 4 are worded in a positive direction and 4 in a negative direction. After reversing the scoring for the negatively worded items, item scores were totaled to yield an overall optimism score, with high scores representing greater optimism. In our sample, scores ranged from 4 to 24.

### *The Satisfaction with Life Scale (SWLS)*

The SWLS is a five-item scale designed to measure a person's global judgment of satisfaction with their life. Respondents are asked to give scores based on their own experiences and values using a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Diener et al. (36) report that the SWLS is a valid and reliable measure of satisfaction with life ( $\alpha=0.87$ ) and has 2-month test-retest stability ( $\alpha=0.82$ ).

The scales were translated into Romanian by two bilingual psychologists using back translation methods. In the present study, the means, standard deviations, Cronbach's alpha and interscale correlations are presented in Table 1.

### **Other variables**

Smoking exposure of any individual was expressed in terms of 1) consumption, i.e., the number of cigarettes consumed per day, 2) duration, i.e., the number of years of smoking, and 3) life-time exposure, i.e., the accumulated exposure over time, in terms of the product of daily consumption and years of duration ("cigarette-years") (37). Only individuals in whom an unambiguous diagnosis of smoking could be ascertained were included in the study. The smoking history was collected by means of a standardized questionnaire.

Blood pressure was measured using a standard mercury sphygmomanometer in each arm in seated subjects. Mean readings from both arms were used for systolic and diastolic blood pressure. Body mass index was calculated from measured weight and height. BMI was calculated as the body weight/height<sup>2</sup> (kg/m<sup>2</sup>). The measured BMI was categorized using the World Health Organization classification (1): normal weight equated to BMI < 25 kg/m<sup>2</sup> and overweight  $\geq 25$  kg/m<sup>2</sup>.

## Data analysis

Descriptive statistics and statistical analyses were performed by computer using a statistical software package (SPSS 13.0, Inc., Chicago, USA). The internal consistency of the psychological scales was examined using Cronbach's  $\alpha$ . Descriptive statistics were used on all variables. Differences between groups were identified by Student's *t*-test and chi-squared test. Multiple linear regression analyses were performed utilizing age, sex, smoking, body mass index, Type A personality, anxiety, depression, dental anxiety, hopelessness, emotional intelligence, stress, self-esteem, optimism, satisfaction with life, periodontal probing depth, clinical attachment level, calculus index, plaque index, bleeding on probing index and number of remaining teeth as independent variables in the study group. All reported *P* values are two-tailed; differences at *P* < 0.05 were considered statistically significant.

## Results

Table 1 shows the results of evaluation of the validity of the various psychological instruments used in the present study. The Cronbach's alpha value ranged from 0.66 to 0.89 for the individual scales and subscales, and the item-scale correlation coefficients ranged from 0.13 to 0.69.

Tables 2 and 3 display the distribution of the selected characteristics of the adults included in this analysis by age, gender, psychological determinants, periodontal health status, oral health behavior and BMI. Overweight individuals presented higher levels of smoking exposure, anxiety and depression and lower levels of optimism and

satisfaction with life. They were mainly females with a history of hypertension and a higher number of sites and teeth with a PD of >6 mm, REC of >1 mm and CAL of >5 mm (Table 2). When the patients were stratified according to periodontal status, it was revealed that those with a mean PD >3 mm and a bleeding on probing index of >25% presented higher values of dental anxiety, and lower levels of self-esteem (Table 3).

Multiple linear regression analyses were performed to examine the independent determinants of oral health-related behavior. Statistical analysis showed that collinearity was not significant between variables. It was revealed that age and dental anxiety were positively associated with the number of teeth with a PD of >6 mm and with reasons for visiting a dentist, while satisfaction with life was associated with flossing frequency. It was also revealed that emotional intelligence was a determinant of the number of remaining teeth (Table 4).

## Discussion

The present study clarified the association between several psychological determinants, periodontitis and BMI. There is growing evidence in the recent literature to suggest that metabolic syndrome may be triggered and/or exacerbated by adverse social factors (38) and certain psychological pathologies (39), traits and behaviors (40). Several studies have found a social gradient in both work stress and metabolic syndrome (41-43), suggesting that the social gradient in metabolic syndrome and heart disease may be partly explainable by greater exposure to work stress

Table 1 Means, standard deviations, Cronbach's Alpha and interscale correlations (*n* = 79)

	Type A personality (TASRI)	Anxiety (HADS)	Depression (HADS)	Dental anxiety (MDAS)	Hopelessness	Emotional intelligence (EI)	Stress (PSS-10)	Self-esteem (SES)	Optimism (LOT)	Satisfaction with life (SWLS)
Type A personality (TASRI)	1									
Anxiety (HADS)	-0.236*	1								
Depression (HADS)	-0.392**	0.371**	1							
Dental anxiety (MDAS)	-0.204	0.139	0.057	1						
Hopelessness	-0.505**	0.441**	0.488**	0.182	1					
Emotional intelligence (EI)	0.175	-0.221*	-0.340**	-0.091	-0.236*	1				
Stress (PSS-10)	-0.283*	0.511**	0.489**	0.188	0.433**	-0.405**	1			
Self-esteem (SES)	0.404**	-0.513**	-0.541**	-0.082	-0.619**	0.269*	-0.553**	1		
Optimism (LOT)	0.374**	-0.502**	-0.594**	-0.157	-0.558**	0.389**	-0.576**	0.591**	1	
Satisfaction with life (SWLS)	0.289**	-0.454**	-0.495**	-0.115	-0.549**	0.335**	-0.487**	0.522**	0.691**	1
Mean	113.43	6.74	5.96	9.51	1.99	127.41	15.50	21.38	16.41	23.06
Standard Deviations	12.41	2.87	3.33	3.37	2.12	16.06	5.88	4.35	4.13	6.51
Cronbach's alpha	0.700	0.669	0.732	0.850	0.768	0.899	0.877	0.826	0.781	0.883
No. of items in questionnaire	28	7	7	5	2	33	10	10	10	5

\**P* < 0.05; \*\**P* < 0.01

Table 2 Bivariate association between Body Mass Index and study variables

Characteristics <sup>a</sup>	Total Participants ( <i>n</i> = 77*)	Normal BMI < 25 kg/m <sup>2</sup> ( <i>n</i> = 40)	Overweight BMI ≥ 25 kg/m <sup>2</sup> ( <i>n</i> = 37)	Crude odds ratio (95% CI) <sup>c</sup>	<i>P</i> value
	Mean ± SD <sup>b</sup>	Mean ± SD	Mean ± SD		
Age (yrs)	41.19 ± 12.10	39.69 ± 10.50	42.41 ± 13.55		0.332 <sup>e</sup>
Smoking exposure (cigarette-years)	83.93 ± 154.15	44.77 ± 91.34	130.81 ± 195.17		<b>0.014<sup>e</sup></b>
Mean PD (mm)	2.55 ± 0.74	2.51 ± 0.78	2.60 ± 0.71		0.616 <sup>e</sup>
Mean CAL (mm)	3.11 ± 1.23	3.07 ± 1.42	3.18 ± 1.04		0.695 <sup>e</sup>
Mean no. of sites with PD < 3mm	115.05 ± 34.35	117.95 ± 34.36	110.67 ± 34.92		0.360 <sup>e</sup>
Mean no. of sites with PD = 4-5mm	24.41 ± 16.93	21.52 ± 15.36	28.13 ± 18.28		0.089 <sup>e</sup>
Mean no. of sites with PD < 6mm	5.82 ± 12.13	5.42 ± 14.32	6.32 ± 9.81		0.751 <sup>e</sup>
Mean no. of sites with REC > 1mm	28.84 ± 34.44	26.94 ± 36.76	31.16 ± 33.15		0.602 <sup>e</sup>
Mean no. of sites with CAL > 5mm	25.07 ± 30.13	22.85 ± 31.69	28.02 ± 29.32		0.460 <sup>e</sup>
Total Remaining teeth	24.21 ± 3.92	24.15 ± 4.27	24.18 ± 3.64		0.966 <sup>e</sup>
Plaque Index	66.89 ± 26.05	63.83 ± 21.18	70.72 ± 30.87		0.267 <sup>e</sup>
Calculus Index	29.16 ± 28.12	26.36 ± 17.28	31.69 ± 36.89		0.425 <sup>e</sup>
Bleeding on Probing Index	27.27 ± 18.95	27.78 ± 18.97	27.35 ± 19.50		0.922 <sup>e</sup>
Type A personality (TASRI)	113.43 ± 12.41	114.53 ± 13.47	112.64 ± 11.41		0.511 <sup>e</sup>
Anxiety (HADS)	6.74 ± 2.87	6.03 ± 2.92	7.33 ± 2.68		<b>0.047<sup>e</sup></b>
Depression (HADS)	5.96 ± 3.33	4.93 ± 3.32	6.75 ± 2.87		<b>0.012<sup>e</sup></b>
Dental anxiety (MDAS)	9.51 ± 3.37	9.15 ± 3.29	10.08 ± 3.42		0.229 <sup>e</sup>
Hopelessness	1.99 ± 2.12	1.67 ± 1.98	2.10 ± 2.06		0.347 <sup>e</sup>
Emotional intelligence (EI)	127.41 ± 16.06	129.72 ± 17.00	125.45 ± 13.23		0.225 <sup>e</sup>
Stress (PSS-10)	15.50 ± 5.88	14.28 ± 5.78	16.45 ± 5.69		0.102 <sup>e</sup>
Self-esteem (SES)	21.38 ± 4.35	22.42 ± 3.75	20.71 ± 4.44		0.071 <sup>e</sup>
Optimism (LOT)	16.41 ± 4.13	17.85 ± 3.95	15.13 ± 3.69		<b>0.003<sup>e</sup></b>
Satisfaction with life (SWLS)	23.06 ± 6.51	24.70 ± 6.80	21.49 ± 5.77		<b>0.029<sup>e</sup></b>
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
Females	48 (60.8)	32 (76.2)	16 (43.2)	5.25 (1.91-14.44)	<b>0.002<sup>d</sup></b>
Married	46 (58.2)	24 (57.1)	22 (59.5)	1.02 (0.41-2.54)	0.961 <sup>d</sup>
Lower educational level	17 (21.5)	9 (21.4)	8 (21.6)	1.05 (0.35-3.09)	0.926 <sup>d</sup>
Medical history of hypertension	13 (16.5)	3 (7.1)	10 (27)	0.21 (0.05-0.87)	<b>0.047<sup>d</sup></b>
Daily toothbrushing frequency: twice a day or more	60 (89.7)	36 (90)	32 (96.5)	0.12 (0.62-2.04)	<b>0.813<sup>d</sup></b>
Flossing frequency: never	46 (58.2)	22 (52.4)	24 (64.9)	0.66 (0.26-1.66)	0.516 <sup>d</sup>
Mouthrinse frequency: never	28 (35.4)	15 (35.7)	13 (35.1)	1.10 (0.43-2.81)	0.829 <sup>d</sup>
Last dental visit: less than 6 months ago	37 (48.1)	21 (53.8)	16 (43.2)	1.24 (0.49-3.10)	0.815 <sup>d</sup>
Reason for the dental visit: when treatment is needed or when pain	50 (63.3)	24 (57.2)	26 (70.3)	0.63 (0.24-1.63)	0.481 <sup>d</sup>
Sites with PD < 3mm	9089 (79.18)	4718 (81.40)	4095 (76.25)	7.81 (7.31-8.51)	<b>0.0001<sup>d</sup></b>
Sites with PD = 4-5mm	1929 (16.80)	861 (14.85)	1041 (19.38)	1.74 (1.58-1.92)	<b>0.0001<sup>d</sup></b>
Sites with PD > 6mm	460 (4.00)	217 (3.74)	234 (4.35)	1.87 (1.55-2.25)	<b>0.0001<sup>d</sup></b>
Sites with REC > 1mm	2250 (19.60)	1051 (18.13)	1153 (21.47)	1.98 (1.81-2.17)	<b>0.0001<sup>d</sup></b>
Sites with CAL > 5mm	1981 (17.25)	914 (15.76)	1037 (19.31)	1.88 (1.71-2.07)	<b>0.0001<sup>d</sup></b>
Teeth with PD < 3mm	922 (48.19)	483 (50)	407 (45.47)	1.19 (0.99-1.43)	0.056 <sup>d</sup>
Teeth with PD = 4-5mm	736 (38.47)	371 (38.40)	350 (39.10)	0.97 (0.80-1.17)	0.793 <sup>d</sup>
Teeth with PD > 6mm	246 (12.85)	103 (10.66)	138 (15.41)	0.65 (0.49-0.86)	<b>0.003<sup>d</sup></b>
Teeth with REC > 1mm	598 (31.25)	316 (32.71)	261 (29.16)	1.81 (0.96-1.43)	0.108 <sup>d</sup>

<sup>a</sup> Abbreviations: probing depth (PD), recession (REC), clinical attachment loss (CAL).

<sup>b</sup> SD, standard deviation.

<sup>c</sup> CI, confidence interval.

<sup>d</sup> Chi-squared test.

<sup>e</sup> Student's *t*-test.

\* Two patients were excluded from this analysis because no data related to their height and weight was obtained

among less advantaged social groups. Metabolic syndrome and obesity have also been linked to several other psychological factors: body dissatisfaction, self-esteem, depression (44-46), stress (47-49), and positive and negative affect (50-51). In line with previous reports, our study revealed that, in comparison with controls, overweight participants had significantly higher values of depression (6.75 ± 2.87 vs. 4.93 ± 3.32, *P* < 0.05) and anxiety (7.33

± 2.68 vs. 6.03 ± 2.92, *P* < 0.05), and lower levels of optimism (15.13 ± 3.69 vs. 17.85 ± 3.95, *P* < 0.01) and satisfaction with life (21.49 ± 5.77 vs. 24.70 ± 6.80, *P* < 0.05). With regard to periodontal status, overweight participants had significantly fewer sites with a PD of <3 mm, a higher number of sites with a PD of >6 mm, and a higher number of sites with more than 1 mm of recession and a clinical attachment level of >5 mm (*P* = 0.0001).

Table 3 Bivariate association between periodontal evaluation and study variables

Characteristics <sup>a</sup>	PD			CAL			BOP		
	Controls PDm < 3mm (n = 62)	Cases PDm > 3mm (n = 17)	P value <sup>c</sup>	Controls CALm < 5mm (n = 47)	Cases CALm > 5mm (n = 29)	P value <sup>c</sup>	Controls BOP < 25% (n = 40)	Cases BOP > 25% (n = 39)	P value <sup>c</sup>
	Mean ± SD <sup>b</sup>	Mean ± SD		Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Age (yrs)	39.81 ± 12.03	46.00 ± 11.40	0.85	36.76 ± 10.98	48.37 ± 10.37	<b>0.000</b>	36.92 ± 11.90	45.70 ± 10.72	<b>0.001</b>
Plaque Index	62.37 ± 19.65	84.96 ± 39.01	<b>0.002</b>	61.04 ± 19.88	76.70 ± 32.05	<b>0.011</b>	61.28 ± 21.64	72.64 ± 29.09	0.058
Calculus Index	22.64 ± 14.57	53.61 ± 48.09	<b>0.000</b>	21.55 ± 13.49	41.49 ± 39.56	<b>0.002</b>	22.36 ± 14.76	35.96 ± 35.92	<b>0.034</b>
Bleeding on Probing Index	24.29 ± 17.12	38.15 ± 21.75	<b>0.007</b>	20.85 ± 14.92	37.75 ± 20.35	<b>0.000</b>	21.24 ± 17.15	33.45 ± 18.91	<b>0.004</b>
Type A personality (TASRI)	113.74 ± 12.15	112.32 ± 13.68	0.68	114.19 ± 12.56	112.20 ± 12.28	0.492	114.57 ± 13.08	112.27 ± 11.75	0.413
Anxiety (HADS)	6.51 ± 2.95	7.58 ± 2.50	0.17	6.24 ± 2.89	7.56 ± 2.69	<b>0.046</b>	6.14 ± 2.63	7.35 ± 3.02	0.061
Depression (HADS)	5.71 ± 3.39	6.88 ± 3.03	0.20	5.91 ± 3.39	6.04 ± 3.30	0.870	5.39 ± 3.30	6.54 ± 3.31	0.127
Dental anxiety (MDAS)	9.06 ± 3.41	11.17 ± 2.69	<b>0.02</b>	9.00 ± 3.49	10.36 ± 3.03	0.080	8.40 ± 3.05	10.66 ± 3.32	<b>0.002</b>
Hopelessness	1.99 ± 2.18	2.00 ± 1.96	0.99	1.97 ± 2.15	2.03 ± 2.12	0.909	1.64 ± 1.89	2.35 ± 2.31	0.137
Emotional intelligence (EI)	127.29 ± 16.57	127.85 ± 14.50	0.90	127.54 ± 17.24	127.20 ± 14.20	0.927	128.29 ± 16.50	126.51 ± 15.76	0.626
Stress (PSS-10)	14.96 ± 6.04	17.47 ± 4.91	0.12	15.00 ± 6.42	16.31 ± 4.86	0.338	14.92 ± 5.77	16.09 ± 6.00	0.383
Self-esteem (SES)	21.58 ± 4.17	20.64 ± 5.02	0.43	21.60 ± 4.27	20.90 ± 4.51	0.451	22.46 ± 3.94	20.27 ± 4.51	<b>0.024</b>
Optimism (LOT)	16.76 ± 4.13	15.16 ± 4.00	0.16	16.94 ± 3.83	15.56 ± 4.51	0.150	17.23 ± 3.68	15.58 ± 4.43	0.076
Satisfaction with life (SWLS)	23.24 ± 6.75	22.41 ± 5.70	0.64	23.56 ± 6.72	22.26 ± 6.19	0.393	24.21 ± 6.17	21.89 ± 6.72	0.114

<sup>a</sup> Abbreviations: probing depth (PD), clinical attachment loss (CAL), Bleeding on Probing Index (BOP)

<sup>b</sup> SD, standard deviation.

<sup>c</sup> Student's *t*-test.

Table 4 Multiple linear regression analyses between study variables

Variables	Periodontal Health Status										Oral health Behaviors				
	Body Mass index (kg/m <sup>2</sup> )	Total remaining teeth	Plaque Index	Calculus Index	Bleeding on probing Index	Mean PD (mm)	Mean CAL (mm)	No. of sites with PD > 6mm	Mean no. of sites with CAL > 5mm	No. of teeth with PD > 6mm	Daily toothbrushing frequency	Flossing frequency	Mouthrinse frequency	Last dental visit	Reason for the dental visit
Gender	<b>-0.321*</b>	0.112	-0.074	0.069	0.105	-0.070	0.242	-0.112	-0.162	-0.136	-0.190	0.016	0.039	0.157	-0.036
Age (yrs)	0.089	<b>-0.639***</b>	0.138	0.085	0.245	<b>0.496***</b>	<b>0.252*</b>	<b>0.456***</b>	<b>0.255*</b>	0.115	<b>-0.290**</b>	0.122	<b>-0.313*</b>	-0.044	
Type A personality (TASRI)	0.089	0.108	0.179	-0.002	-0.018	-0.161	-0.167	-0.030	-0.039	0.074	-0.141	0.052	0.090	0.018	0.098
Anxiety (HADS)	0.062	0.131	0.065	0.005	-0.137	0.011	0.080	-0.038	0.104	-0.029	0.062	0.085	0.272	-0.001	0.069
Depression (HADS)	0.124	-0.052	-0.103	0.019	-0.026	-0.133	-0.049	0.135	0.094	0.087	-0.272	-0.143	-0.206	-0.183	-0.178
Dental anxiety (MDAS)	0.068	-0.075	0.153	0.135	0.187	0.207	0.201	0.189	0.215	<b>0.253*</b>	-0.180	-0.190	-0.053	-0.137	<b>-0.351**</b>
Hopelessness	0.043	0.108	0.131	0.161	0.017	-0.103	-0.220	0.054	-0.173	0.029	-0.134	0.242	-0.087	0.293	0.177
Emotional intelligence (EI)	0.082	<b>-0.233*</b>	0.193	0.167	-0.019	0.026	0.050	0.137	0.081	0.167	-0.111	-0.169	-0.076	0.061	-0.117
Stress (PSS-10)	-0.048	-0.149	0.131	-0.017	-0.163	0.174	0.134	0.131	0.003	0.201	0.095	-0.096	-0.180	0.103	0.181
Self-esteem (SES)	-0.033	0.037	-0.103	-0.143	-0.214	0.030	-0.022	0.063	-0.149	0.036	0.075	0.009	-0.097	0.157	-0.010
Optimism (LOT)	-0.224	-0.142	0.011	0.226	-0.173	0.039	0.123	-0.038	0.085	-0.113	0.186	0.213	-0.190	-0.087	0.146
Satisfaction with life (SWLS)	0.117	0.066	0.083	0.037	0.140	0.062	0.035	0.241	0.159	0.241	-0.192	<b>-0.386*</b>	0.117	0.073	0.047
R <sup>2</sup>	0.201	0.467	0.138	0.125	0.166	0.151	0.325	0.166	0.292	0.212	0.151	0.255	0.141	0.163	0.184
F	1.297	4.594	0.787	0.713	1.044	0.937	2.528	1.046	2.169	1.411	0.936	1.770	.834	1.009	1.180
P	0.243	<b>&lt;0.0001</b>	0.661	0.733	0.422	0.517	<b>0.009</b>	0.420	<b>0.024</b>	0.185	0.518	0.073	0.616	0.452	0.317

<sup>a</sup> Abbreviations: probing depth (PD), clinical attachment loss (CAL), Bleeding on Probing Index (BOP)

<sup>b</sup> SD, standard deviation.

\**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001

These results are similar with those reported by Saito et al. (4), who demonstrated that individuals in the highest quartile for BMI had a significantly higher odds ratio (OR) for being in the highest quintile for mean probing pocket depth (OR = 4.3; 95% confidence interval: 2.1-8.9; *P* < 0.001). Linden et al. (2) investigated whether there was an association between obesity and periodontitis in a homogeneous group of 60-70-year-old Western European men, and showed that obesity was associated with a higher percentage of sites with a probing depth of >5 mm (4.8 vs. 3.4, *P* = 0.01) and low-threshold periodontitis (OR = 1.77, *P* = 0.004), after adjustment for confounders. Low-threshold periodontitis was identified by the presence of at least two teeth with non-contiguous inter-proximal sites

with an attachment loss of ≥ 6 mm and with at least one pocket ≥ 5 mm deep.

Although periodontal disease is mainly affected by behavior determined by social and psychological factors, periodontists have not seriously considered psychosocial pathways in its etiology, diagnosis, and treatment. However, a sound understanding of the psychosocial pathways of behavior strongly linked to periodontal disease, and how psychological factors affect the response of periodontal tissues to pathogens, is essential for diagnosis and improving the effectiveness of interventions (52). Various studies have provided evidence of an association between depression and periodontal health (53-58). It has also been shown that clinical depression may also have a negative

effect on periodontal treatment outcome (59). Several authors have focused on the effect of anxiety on the etiology of periodontal disease (60-64). The present study revealed significantly higher levels of dental anxiety in patients with a mean probing depth of >3 mm ( $P = 0.02$ ), and in whom more than 25% of sites bled on probing ( $P = 0.002$ ). Moreover, multiple regression analysis showed that dental anxiety was an important determinant of the number of teeth with a PD of >6 mm ( $P < 0.05$ ). These results conflict with a report that in a sample of 5364 adults aged 18-91 years, periodontitis and gingivitis were not associated with dental fear, despite the fact that higher dental fear was significantly associated with a higher number of missing teeth (65).

Emotional intelligence is a psychological construct considered to be a measure of coping skills. An association between emotional intelligence domains (emotional awareness, competencies, values and beliefs) and short-term changes in plaque and bleeding was revealed, suggesting that initial responses to standardized periodontal treatment may be partly related to emotional intelligence (66). In a sample of first-year students, emotional intelligence levels were related to self-reported oral health status, dental visit frequency, and reasons for visiting a dentist (67). Multiple regression analysis in the present study revealed that the level of emotional intelligence was a determinant of the total number of remaining teeth.

There was also an association between satisfaction with life and oral health behavior (flossing frequency). This agrees with observations by Ylöstalo et al. (68), Honkala et al. (69,70) and Dumitrescu et al. (71), who showed that oral health status and behavior are associated with life satisfaction, optimism, and happiness.

There is growing evidence in the recent literature that obesity and periodontitis may be triggered and/or exacerbated by adverse social factors and certain psychological pathologies, traits and behaviors. Dental practitioners should therefore give consideration to the fact that overweight patients who present with impaired periodontal status may also be experiencing anxiety, depression, and impaired satisfaction with life.

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