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Depressive symptoms in relation to periodontal health in a Jordanian sample

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Abstract: *Objectives*: This cross-sectional study examines the relationship of depression symptoms to periodontal diseases and decayed (D), missing (M) and filled teeth (FT) in a sample of the Jordanian population. *Methods*: Subjects escorting dental patients attending two dental hospitals in North Jordan were included. Each subject received full periodontal examination, including probing pocket depth (PPD), clinical attachment level (CAL), gingival index (GI) and plaque index (PI). The numbers of M, D and F teeth were also recorded. The Zung Self-rating Depression Scale was used to determine susceptibility to depression. *Results*: The frequency of high susceptibility to depression among periodontitis-free subjects and those with periodontitis was found to be 48% and 50% respectively. There was no statistically significant association between susceptibility to depression symptoms and periodontal parameters, including PPD, CAL, PI and GI ($P > 0.05$). However, subjects with low susceptibility to depression had significantly more FT than subjects highly susceptible to depression. *Conclusions*: High susceptibility to depression does not play a significant role in the aetiology and severity of periodontitis in the population studied.

Key words: depressive symptoms; DMF index; Jordan; periodontal diseases

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Introduction

Periodontitis is a diverse group of inflammatory diseases affecting the periodontium during all ages. They are manifested as progressive destruction of the periodontal ligament and alveolar bone with pocket formation, gingival recession or both. Periodontitis may compromise function and aesthetics, cause

pain and ultimately lead to loss of teeth. The primary aetiological factor of inflammatory periodontal diseases is bacterial plaque, which consists of several hundreds of different bacterial species colonizing the tooth and adjacent epithelial surfaces. However, bacterial plaque is considered necessary but not sufficient to cause periodontitis (1). Periodontal diseases have multiple risk factors, including a variety of microbial, environmental, behavioural and systemic disease factors, in addition to the individual's genetic makeup (2). Nevertheless, a significant proportion of the variation in disease severity cannot be explained solely by these factors; psychological factors may be of great importance (3).

Although depressive disorders traditionally reside outside the realm of customary dental practice, psychological factors are currently believed to be important risk factors of periodontal diseases (4). In a case–control study investigating the relationship of periodontitis to social factors, a significant association was found between elevated scores of social strain and periodontitis (5). Another cross-sectional study conducted in Hong Kong (6) concluded that chronic job and financial strains, depression, inadequate coping and maladaptive trait dispositions were significant risk indicators of periodontal attachment loss. However, a more comprehensive look at the literature reveals lack of agreement between previous researchers. Peruzzo *et al.* (7) carried out a systematic review, and included 14 articles published between 1990 and 2006, (seven case–control, six cross-sectional and one prospective clinical trial). They found that 57% of the studies demonstrated a positive relationship between psychological factors/stress and periodontal disease, whereas 14% reported a negative relationship and 28% reported a positive relationship for some characteristics and negative for others.

Depression, an often undiagnosed mood disorder, is a syndrome that affects all age groups, in which it is not a normal reaction to life's difficulties. It involves disturbances in emotional, cognitive, behavioural and somatic regulation. A variety of oral conditions have been associated with depression, such as temporo-mandibular joint disorders (8), oral lichen planus (9), burning mouth syndrome (10) and periodontal diseases (5, 11–13). The prevalence of depression among periodontal patients ranges from 6.6% (14) to 13.5% (15). However, there is paucity in studies investigating the association between depression, as a mood disorder and periodontal disease, particularly in Jordan. Therefore, the aim of this study was to examine the relationship between symptoms of depression and periodontal and dental health in a Jordanian sample.

Study population and methodology

Study population

This cross-sectional study included subjects who escorted patients attending the dental teaching clinics of Jordan University of Science and Technology (JUST) and the outpatient dental clinics in Princess Basma Teaching Hospital in Irbid, North Jordan. The study population consisted of 666 participants, whose ages ranged between 15 and 62 years, with a mean age of 31.1 years. Only systemically healthy individuals, i.e. those who did not suffer chronic diseases, apart from periodontitis, were included. Periodontal patients and individuals who had received periodontal treatment within the last 3 months prior to examination were excluded. Individuals with chronic illnesses and syndromes, those on long-term medications, subjects who have received or were receiving any form of immunosuppressive therapy, pregnant women and orthodontic patients were also excluded from the study.

Methods

This study was approved by the Ethical Committee in the Deanship of Scientific Research at JUST. Informed consents were obtained from all participants prior to start of interview and examination; informed consents were obtained from the parents of participants under the age of 18 years. All subjects were interviewed and examined by a single examiner and the following information was recorded on a specially designed questionnaire: age, gender, level of education, occupation, income, oral hygiene habits and frequency of dental visits.

For each subject, full periodontal examination of all present teeth, except third molars, was carried out. Examination was performed on a dental chair and the data were recorded on a special examination form. These data included probing pocket depth (PPD), clinical attachment level (CAL), the gingival index (GI) of Loe and Silness (16) and the plaque index (PI) of Silness and Loe (17). The PPD and CAL values were obtained for each patient by examining the whole circumference of each tooth, i.e. facially and lingually, including the buccal and facial interproximal surfaces. The numbers of missing, decayed and filled teeth (FT) were recorded. Intra-observer reliability was verified in 60 subjects who were randomly chosen for re-examination on two subsequent days.

Depression symptoms were measured using the Zung Self-rating Depression Scale (ZSDS) (18), which was filled out by each subject. The ZSDS (Fig. 1) includes 20 questions each with four specified alternative answers. Each answer is given a

Make check mark (/) in appropriate column	A little of the time	Some of the time	Good part of the time	Most of the time
1. I feel down- hearted	1	2	3	4
2. Morning is when I feel the best	4	3	2	1
3. I have crying spells or feel like it	1	2	3	4
4. I have trouble sleeping at night	1	2	3	4
5. I eat as much as I used to	4	3	2	1
6. I still enjoy sex	4	3	2	1
7. I notice that i am losing weight	1	2	3	4
8. I have trouble with constipation	1	2	3	4
9. My heart beats faster than usual	1	2	3	4
10. I get tired for no reason	1	2	3	4
11. My mind is as clear as it used to be	4	3	2	1
12. I find it easy to do things I used to do	4	3	2	1
13. I am restless and can't keep still	1	2	3	4
14. I feel hopeful about the future	4	3	2	1
15. I am more irritable than usual	1	2	3	4
16. I find easy to make decisions	4	3	2	1
17. I feel that I am useful and needed	4	3	2	1
18. My life is pretty full	4	3	2	1
19. I feel that others would be better off if I were dead	1	2	3	4
20. I still enjoy the things I used to do	4	3	2	1

Fig. 1. A copy of the Zung Self-rating Depression Scale (ZSDS) used in this study.

score ranging from 1 to 4. The sum score of the points ranges from 20 to 80. The severity of depressive symptoms was determined using the cut-off points (≤39, ≥40) as suggested by Zung (18), such that individuals scoring ≤39, were considered as having low susceptibility to depression and those scoring ≥40 were considered to have high susceptibility to depression. Depressed individuals usually score between 50 and 69. A high score of ZSDS was not regarded as a clinical diagnosis of depression but rather as a level of depressive symptoms of potential clinical significance.

Statistical analysis

The statistical package for social sciences (SPSS) software, version 13 (SPSS™ Inc., Chicago, IL, USA) was used for data processing and analysis. Frequency distribution and cross-tabulation were used to describe and analyse the variation in the distribution of the variables. Chi-squared test was used to assess the association between categorized variables and severity of depression symptoms. Mann–Whitney test was used to explore the difference in continuous clinical parameters between individuals who were found to be highly susceptible and those with lower susceptibility to depression. Logistic regression analysis for dichotomized clinical parameters and multivariate general linear models for continuous clinical parameters were used to test the difference between subjects highly susceptible and subjects less susceptible to depression, after adjusting for important variables. Cronbach's alpha was calculated to assess the degree of internal consistency and homogeneity between the items in ZSDS and intra-class correlation coefficients and to measure consistency or agreement of values. Exact agreement was used to measure reliability of periodontal parameters. Significance was set at $P \leq 0.05$.

Results

Participants' characteristics

This study included a total of 666 participants. The age of the subjects ranged between 15- and 62-year old, with a mean of 31.1 years. The highest proportion of subjects (39.8%) was between 20 and 29 years of age and the lowest (4.4%) was in the age group of ≥50 years (Fig. 2). About two-thirds of the subjects (66%) were females, 54% were married, and 48% had received university education.

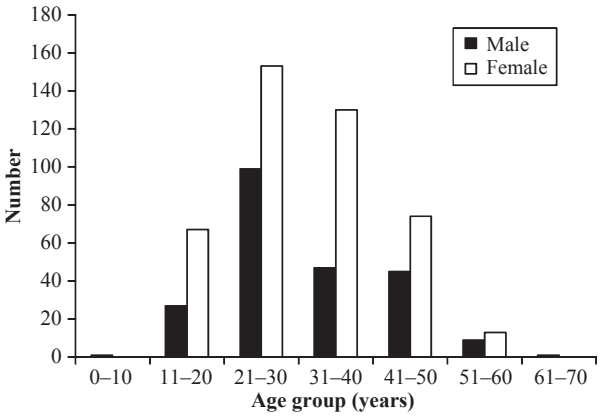

Fig. 2. Age and gender distribution of subjects enrolled in this study.

Intra-examiner reliability

Of the total number of duplicate measurements, the exact agreement was 87% for PPD, 93% for CAL, 96% for PI and 91% for GI.

Clinical parameters and indices in relation to depression symptoms

Among the 666 patients, more than 50%, the majority of which were females, was found to be highly susceptible to depression, with a ZSDS score ≥40. Of the study population, 583 (87.5%) had chronic periodontitis, and 83 (12.5%) were periodontitis-free. The frequency of high susceptibility to depression among healthy subjects and those with periodontitis was found to be 48% and 50% respectively.

Table 1 shows the clinical parameters in relation to susceptibility to depression. There was no statistically significant difference in the average of parameters between those with low susceptibility to depression and those with high susceptibility to depression. However, there was a statistically significant difference in the average of FT ($P < 0.01$). Similar results were obtained when clinical parameters and indices were sub-categorized (Table 2).

Table 1. **Clinical parameters and susceptibility to depression**

Variable	Susceptibility to depression: Low (mean ± SD)	Susceptibility to depression: High (mean ± SD)	*P*-value*
Clinical attachment level	0.74 ± 1.11	0.70 ± 1.18	0.52
Probing pocket depth	2.30 ± 0.82	2.31 ± 0.90	0.79
Plaque index	2.30 ± 0.62	2.22 ± 0.68	0.10
Gingival index	1.65 ± 0.47	1.56 ± 0.48	0.06
Decayed teeth	3.47 ± 3.14	3.51 ± 3.15	0.86
Missing teeth	1.88 ± 3.19	1.89 ± 2.80	0.26
Filled teeth	3.37 ± 3.62	4.09 ± 3.73	<0.01

*Mann–Whitney test.

Multivariate analysis

As shown in Table 3, in the binary logistic regression, CAL (CAL > 1 mm) and PPD (PPD ≥3 mm) were significantly associated with age only. The odds of having average CAL > 1 increased by 11% for each extra year of age, while the odds of having PPD ≥3 mm increased by 7% for each extra year of age. Susceptibility to depression was not significantly associated with these two parameters. In the general linear model, after adjusting for the effect of age, gender, PI and MT, there was no significant difference in the average of CAL between

Table 2. **Sub-categorized clinical parameters and susceptibility to depression**

Parameter		Susceptibility to depression: Low [*n* (%)]	Susceptibility to depression: High [*n* (%)]	*P*-value
Plaque index	≤1	22 (6.63)	14 (4.19)	0.36
	>1–2	142 (42.77)	142 (42.51)	
	>2–3	168 (50.60)	178 (53.29)	
Gingival index	≤1	70 (21.08)	55 (16.47)	0.23
	>1–2	142 (42.77)	142 (42.52)	
	>2–3	120 (36.15)	137 (40.82)	
Periodontal probing depth	<3 mm	280 (84.34)	281 (84.13)	0.11
	>3–5 mm	42 (12.65)	50 (14.97)	
	>5 mm	10 (3.01)	3 (0.90)	
Clinical attachment level	≤1 mm	258 (77.71)	252 (75.44)	0.12
	>1–2 mm	40 (12.05)	39 (11.68)	
	>2–4 mm	21 (6.33)	36 (10.79)	
	>4 mm	13 (3.92)	7 (2.09)	
Decayed teeth	≤2	150 (45.18)	159 (47.60)	0.53
	>2	182 (54.82)	175 (52.40)	
Missing teeth	0	142 (42.77)	163 (48.80)	0.12
	>0	190 (57.29)	171 (51.20)	
Filled teeth	≤2	140 42.17)	187 (55.99)	<0.01**
	>2	192 (57.83)	147 (44.01)	

Table 3. **Multivariate analysis of the factors associated with clinical attachment level (CAL > 1 mm) and probing pocket depth (PPD ≥ 3 mm)**

Variable	PPD: OR (95% CI)	PPD: *P*-value	CAL: OR (95% CI)	CAL: *P*-value
Age	1.07 (1.05–1.09)	<0.01	1.11 (1.09–1.13)	<0.01
Susceptibility to depression (low versus high)	0.87 (0.56–1.34)	0.53	0.71 (0.48–1.05)	0.10

individuals with high and those with low susceptibility to depression ($P = 0.31$).

Discussion

The primary objective of this cross-sectional study was to investigate the relation between depression symptoms and periodontal and dental health among subjects who escorted patients attending dental clinics. This sample was selected for two reasons: the first is because we intended to examine the relationship between periodontal disease and susceptibility to depression without periodontal interference (i.e. periodontal treatment). The second reason is that the study sample is believed to be representative of the population in the north, as it included a heterogeneous group of people in terms of age, gender, residency, education and income.

In this study, a self-rated scale was used to measure depression symptoms in the study population. A self-rated scale has certain benefits over interviewer-rated scales and clinical interviewers. It takes less time, does not require specially trained personnel, is more applicable with a large sample size (19) and puts individuals at ease for answering the scale more accurately and openly. The ZSDS (18) has been primarily designed for screening depressive symptoms among middle-aged populations, but is widely used in clinical studies among different age groups. Its psychometric properties have been tested and found to be acceptable (20). A high score of ZSDS is not used for clinical diagnosis of depression, but rather as an assessment of the level of depressive symptoms of potential clinical significance (21). It has been shown that ZSDS is a valid and sensitive measure of clinical severity in depressed patients. Fountoulakis *et al.* (22) have studied the reliability, validity and psychometric properties of ZSDS and found that for the cut-off of 39/40, ZSDS had a sensitivity of 95% and a specificity of 83.3%.

Clinical depression has been associated with increased extent and severity of periodontal disease, as well as increased rate of periodontal disease progression in longitudinal studies (12, 23). While the mechanism of such an association is poorly understood, it is believed to be through a negative effect of depression on the immune system, coupled with poor behavioural compliance of patients with oral hygiene and treatment recommendations, smoking, changes in diet and bruxism (24).

In this study, the frequency of depressive symptoms among subjects with periodontal diseases was high (50%), although not statistically significant when compared with that of periodontitis-free subjects, as the frequency of depression symptoms was generally high in the whole study population (48%). The frequency of depressive symptoms among periodontitis subjects in this Jordanian population is notably higher, when compared with the results reported for other populations. For example, Elter *et al.* (25) reported a frequency of 12.2% in a US population; Coyne *et al.* (14) reported a frequency of 6.6% in another US population in Michigan, while Simon and von Korff (15) reported a frequency of 13.5% in primary care patients in Washington. This difference may be attributed to differences in the demographic makeup of the populations under study (age, gender, education level and race), leading to different social trends, in addition to differences in economic factors between various populations.

In this study, there was no significant relation between periodontal health, represented by various periodontal parameters, and the severity of depressive symptoms. This may indicate that depressive symptoms had no effect on periodontal health in the population examined. However, these results do not definitively indicate that depression does not affect the initiation and severity of periodontal disease. Rather, they indicate that high ZSDS scores were not associated with increased frequency or severity of periodontitis. Our findings are consistent with the results of Anttila *et al.* (26), who investigated the relationship of depressive symptoms to edentulousness, dental health and dental health behaviour in a Finnish population, using the ZSDS. They found no association between depressive symptoms and dental caries, periodontal status or number of teeth. Our findings are also in agreement with those of Vimpari (20) who found no association between depressive symptoms and periodontal pocketing or dental caries. Castro *et al.* (27), following a recent case–control study in Brazil using four inventories for psychological assessment, also found no significant association between psychosocial factors and periodontal disease.

In contrast, other studies have reported a significant relation between depressive symptoms and periodontal disease. For example, Johannsen *et al.* (28) observed that women with stress-related depression had more plaque accumulation, GI and increased levels of IL-6 and cortisol in gingival cervicular fluid (GCF), compared with normal controls. They suggested that depression might affect immune function, leading to impaired periodontal health. Furthermore, Saletu *et al.* (29) have confirmed the role of depressive mood as a pathogenic factor for periodontitis. The reason for disagreement between these findings and ours appears to be twofold: the different populations studied, and the variance in psychometric scales and inventories used.

As for the dental condition of the study population, a smaller number of FT was significantly associated with high

depressive symptoms, which may be a consequence of infrequent dental attendance. In agreement with this finding, Anttila *et al.* (26) found that dentate women with depressive symptoms had a lower percentage of FT surfaces than non-depressed women. They attributed this to negative attitudes towards dental and oral health, frequent use of sugary products and irregular dental attendance.

In conclusion, this study has not found any significant relation between depression symptoms and periodontal health. However, subjects with low susceptibility to depression had more FT than subjects who were highly susceptible to depression. These findings may indicate that high susceptibility to depression does not play a significant role in the aetiology and severity of periodontitis in this Jordanian population.

Further longitudinal studies are recommended to elucidate the role of psychosocial factors as risk factors of various periodontal diseases. In addition, further studies on the effect of depression symptoms on periodontal disease progression and periodontal treatment outcome among the Jordanian population are recommended.

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