Clin Oral Invest (2018) 22:1411–1422
https://doi.org/10.1007/s00784-017-2234-8

ORIGINAL ARTICLE

Dental anxiety and oral health-related quality of life in aggressive periodontitis patients

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Received: 7 March 2017 / Accepted: 28 September 2017 / Published online: 11 October 2017

Abstract
Objectives To measure dental anxiety levels and oral health-related qualities of life (OHRQoL) in patients with aggressive periodontitis (AgP) compared to controls and analyze their association with various demographic and clinical parameters.
Methods Sixty consecutive patients with AgP were compared to 80 age- and sex-matched controls with no known history of periodontal disease. Collected data included demographics, smoking habits, numerical rating scale (NRS), Corah's Dental Anxiety Scale (DAS) and Oral Health Impact Profile-14 (OHIP-14), DMFT index (Decayed, Missing and Filled Teeth), Plaque Index (PI), probing depth (PD), bleeding on probing (BOP), and radiographic bone loss.
Results AgP patients exhibited statistically significant higher scores in the DAS total as well as sub-scores, except from DAS 1st question. Compared to the control group, AgP patients exhibited worse OHIP-14 global as well as in all individual OHIP-14 domains scores.

Among both AgP and control patients, the physical pain domain was where the highest impact was recorded, while the lowest impact was recorded in the functional limitation domain.
Conclusions AgP patients were positively associated with higher levels of dental anxiety and worse OHRQoL. Self-perception of dental anxiety and OHRQoL should be regarded as an integral element in routine diagnostic work-up process of periodontal diseases.
Statement of Clinical Relevance Aggressive periodontitis (AgP) patients exhibited higher dental anxiety levels and worse oral health-related quality of life (OHRQoL) compared to controls. Professionals should design strategies that will cope with the dental anxiety associated with the treatment and prevent decreases in OHRQoL.

Keywords Periodontal disease · Aggressive periodontitis · Dental anxiety · Dental fear · Quality of life

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Abbreviations

AgP	Aggressive periodontitis
BOP	Bleeding on probing
CP	Chronic periodontitis
DAS	Dental Anxiety Scale
DMFT	Decay, Missing and Filled Teeth
G-AgP	Generalized aggressive periodontitis
LR	Logistic regression (LR)
NRS	Numerical rating scale
OHIP-14	Oral Health Impact Profile 14
OHRQoL	Oral health-related quality of life
PI	Plaque index
PD	Probing depth
WHO	World Health Organization

Introduction

The term "aggressive periodontitis" (AgP) was first introduced at the International Workshop for Classification of Periodontal Diseases and Conditions [1]. Previously, different clinical patterns of significant loss of alveolar bone and attachment in young adults were known as early-onset or juvenile periodontitis [2]. AgP comprises a group of rare, often severe, rapidly progressive forms of periodontitis generally characterized by an early age of clinical manifestation and a distinct tendency to aggregate in families [3, 4]. The prevalence can be as high as 10% in specific populations, and the World Health Organization estimates that ~ 2% of youth are affected globally [3, 5]. The aggressive nature of AgP can lead to the devastating early loss of teeth in a very young patient population [4].Ethnic and genetic factors have been suggested to play an important role in the development of AgP [3, 6, 7].

Dental plaque and neglect of oral hygiene are generally believed to be the most important risk factors for periodontal disease [8–10]. Stress is another important factor in the etiology and maintenance of many inflammatory diseases including periodontal disease [11–14].

Dental anxiety is an unreasonable apprehension of dental procedures, objects, or the context of dental procedure, usually associated with a significant physiological as well as emotional arousal [15, 16]. Population-based epidemiological surveys demonstrated that 5–20% of adults have dental anxiety, ranging from a mild sensation of apprehension to prominent anxiety and dental phobia [17–19].The most severe presentation, dental phobia, is classified in the DSM 5 (Diagnostic and Statistical Manual of Mental Disorders) as a subtype of specific phobias termed blood-injection-injury (B-I-I) phobia, although accumulating evidence suggests that these conditions may be two distinct entities in terms of etiology and phobic stimuli [20–22]. Dental anxiety is a substantial public health problem, not only due to its prevalence, but also because dental anxiety is associated with a significant psychosocial impact [23–25]. Dental anxiety may lead to a vicious circle as suggested by Berggren [26], in which dental anxiety leads to avoidance of dental treatment which causes a deterioration of dental health, in turn leading to feelings of lower general well-being, vitality, guilt and shame, depression, social isolation, contentment, and a lower quality of life [26].

Higher levels of gingivitis have been reported in dental patients with higher scores on self-reported anxiety [27], while patients with AgP had significantly more depression and loneliness, when compared with patients with chronic periodontitis (CP) and control subjects [28]. Surprisingly, only few studies investigated dental fear among patients with periodontal diseases [29–34], despite the fact that periodontal diseases have been studied extensively since the 1960s. These findings suggest that it may be important for successful treatment of a periodontitis patient to evaluate anxiety levels [14]. High anxiety levels may contribute to initiation and relapse of the illness, maintain adverse life style factors such as smoking, and increase the risk that the patient will neglect his oral hygiene [14].

Multidimensional assessments of oral functioning and well-being, labeled as "oral quality-of-life" (QoL) are increasingly used to provide assessments of health, healthcare needs, and outcomes of care [35]. QoL assessments have an important place in healthcare and in recent years became an accepted end-point in clinical research trials [36]. The effects of illness on QoL can be related to the impairment, disability, and handicap model of diseases [37]. Oral health-related quality of life (OHRQoL) focuses on aspects of human life affected by oral health and dental care [38–40].Oral health status is closely associated with QoL [41] and impaired OHRQoL could originate from poor oral health status [42]. A recent systematic review included 25 studies scientific articles published up to July 2015, demonstrated that periodontal disease was associated with a negative impact on quality of life, with severe periodontitis exerting the most significant impact by compromising aspects related to function and esthetics [43]. Although symptoms of generalized aggressive periodontitis (G-AgP) are highly relevant from the patients' point of view and often have considerable adverse effects on their daily QoL, little is known about this issue, and only two of the studies in the above mentioned systematic review addressed AgP patients [44, 45]. The findings of Eltas and Uslu showed that AgP has a deep impact on patients' OHRQoL, but this study did not include a control group [44]. With regard to the impact of periodontal disease on QoL, functional limitation was found to be one the predominant item, affecting 91.5% of the sample in a study by Araújo et al. [45]. Patients with AgP achieved the highest impact scores [45]. The highest scores on the index were those of patients with a diagnosis of chronic or aggressive periodontitis [45].

To the best of our knowledge, studies evaluating both dental anxiety and OHRQoL and analyzing the associations between these conditions in AgP have not been published in the English language literature. Therefore, in order to shed light on this subject, the aims of the study were to examine whether dental anxiety and oral health-related quality of life differed between persons with AgP and those without that disease. To that end, we measured dental anxiety levels and OHRQoL in patients with AgP compared to controls and analyzed the association with various demographic and clinical parameters associated with disease severity.

Subjects and methods

Study groups

During the period between May 1st, 2013 and May 31st, 2015, consecutive patients with generalized AgP (60 patients) referred to the Department of Periodontology, Oral and Maxillofacial Medical Center, Tel-Hashomer, Israel, were enrolled in the study. This center is situated in the Sheba Medical Center, which is the largest medical center in Israel and one of the larger in the Middle East. Patients were referred from dozens of primary clinics throughout the country for specialist evaluation and management.

The control group consisted of 80 age and sex frequency-matched consecutive individuals attending elective dental screening at the Department of conservative dentistry, Oral and Maxillofacial center, Tel-Hashomer, Israel, with no known history of periodontal disease.

Appropriate sample size was calculated using WINPEPI software [46] and the calculation determined that at least 140 participants, in two groups with 0.75 ratio (80 patients in one group and 60 patients in the second group),were needed to provide 80% statistical power to identify a 4.48-point difference in OHIP-14 global score, with alpha set at 0.05, and an estimated standard deviation (SD) of 9.93 for the group with largest SD and 8.25 for the group with smallest SD, based on our experience analyzing OHIP-14 scores [47].

Inclusion and exclusion criteria

To minimize confounders such as aging and illnesses on dental anxiety and OHRQoL, we examined young to middle-aged individuals without co-morbid psychiatric or physical disabilities.

Inclusion criteria for all groups were age 18–50 years of both sexes with at least 20 remaining teeth.

Exclusion criteria were mental and psychiatric disabilities; presence of drug abuse; a comorbid malignant disease; taking sedative, anxiolytic, or analgesic drug up to week before the survey; pregnancy or lactation; and an acute dental or periodontal condition.

AgP was diagnosed according to the American Academy of Periodontology guidelines [48]. None of the AgP patients had completed a periodontal treatment course during the 6 months before attending the periodontal clinic [49, 50].

Data collection

The study was based on a questionnaire and on clinical examination. The questionnaire consisted of several parts: (1) Demographic details (for details see Table 1), (2) smoking habits, (3) current and maximal numerical rating scale (NRS) for assessment of dental pain, and (4) Corah's Dental Anxiety Scale (DAS) (5) Oral Health Impact Profile 14 (OHIP-14). All questionnaires were filled in during a face-to-face interview at the initial visit before dental treatment and before any medications were prescribed. The questionnaire was conducted on the same day as the clinical examination, and after the clinical examination which established the diagnosis of AgP. Explanations of the diagnosis including risk of tooth loss and therapy option were provided to all patients.

Table 1 Demographic characteristics, smoking habits, and current and maximal numeric rating scale (NRS) scores of patients with aggressive periodontitis compared to controls

Parameter	Variable	Aggressive periodontitis	Control group	*p**
		No. (%) %	No. (%) %	
Sex	Male	45 (75.0)	48 (60.0)	0.056
	Female	15 (25.0)	32 (40.0)	
Country of origin	Africa	16 (26.7)	29 (36.7)	**<0.001**
	Asia	6 (10.0)	6 (7.6)	
	Western	11 (18.3)	35 (44.3)	
	Israel	22 (36.7)	8 (10.1)	
	Others	5 (8.3)	1 (1.3)	
Birth country	Africa	9 (15.0)	3 (3.8)	0.036
	Western	5 (8.3)	14 (17.7)	
	Israel	45 (75.0)	62 (78.5)	
	Others	1 (1.7)	0 (0.0)	
Smoking habits	Yes	19 (31.7)	25 (31.6)	0.998
	No	41 (68.3)	54 (68.4)	

Parameter	Aggressive periodontitis		Control group		P**
	Mean	SD	Mean	SD	
Age	24.7	7.7	27.5	8.8	0.052
Years of schooling	12.3	1.3	13.9	3.3	**<0.001**
Smoking pack years	6.6	6.7	8.1	8.1	0.517
Current NRS	2.1	2.4	1.4	2.2	0.075
Maximal NRS	4.9	3.4	5.1	2.9	0.74

*chi square test**Independent t-test

SD: standard deviation

Smoking habits

Current smoking habits were recorded as (a) current smoking habits: yes/no and (b) history of smoking was calculated in smoking pack years by multiplying the number of packs of cigarettes smoked per day by the number of years the person has smoked.

Periodontal disease evaluation

Clinical examinations were conducted with the aid of light, mouth-mirrors, and a UNC-15 (University of North Carolina, USA) periodontal probe, Hu-Friedy Manufacturing Co., Chicago, IL, USA. Vertical bilateral bitewings for the molar and premolar area combined with parallel periapical radiographs of the maxillary and mandibular incisors were included. Prior to the beginning of the study, a training and calibration session was performed for the examiners to ensure mutual agreement and correct interpretation on the measurements of the indices used in the study.

DMFT Dental caries status assessed was assessed with the DMFT index (Decay, Missing and Filled Teeth) following the World Health Organization (WHO) criteria (out of 28 teeth, i.e., excluding wisdom teeth) (http://www2.paho.org/hq/dmdocuments/2009/OH_st_Esurv.pdf).

Plaque index Oral hygiene was assessed by the Plaque Index (PI) by Loe and Silness [51]. PI was calculated as the percentage of teeth (out of 28 teeth, i.e., excluding wisdom teeth) with visible plaque on any surface of the tooth.

For the other periodontal parameters, clinical examination was performed on the six Ramfjord index teeth (teeth number: 16, 21, 24, 36, 41, 44) as well as for two the rest of the molar teeth: 26 and 46. Ramfjord index teeth have been shown to be representative of the various teeth type [52]. For each tooth, the variables were recorded on six points around the tooth. The following variables were recorded [53, 54]: probing depth (PD), bleeding on probing (BOP), and radiographic bone loss.

Pain evaluation

Patients rated their average dental pain intensity with a 0–10 Numeric Rating Scale (NRS) where 0 represents "no pain" and 10 represents "the worst pain possible," (11 integers including 0) [55, 56]. "Current NRS" representing current pain and "maximal NRS" representing maximal pain in the last month [57] were recorded.

Corah's dental anxiety scale

The survey included the dental anxiety scale (DAS) developed by Corah [15, 16] as a specific instrument to measure dental anxiety, in which patients are asked to rate their fear regarding four dental situations on a 5-point scale. The sum of the scores yields the total score (range from 4 to 20). Higher scores indicate higher levels of dental anxiety. The DAS instrument is the most widely used dental fear scale for adults, with good reported reliability and validity [15, 58–61].

Anxiety levels are categorized as (1) mild anxiety: range from 4 to 8; (2) moderate anxiety: range from 9 to 12; (3) high anxiety: range from 13 to 14; (4) phobia: range from 15 to 20 [62]. In the present study, the validated Hebrew version of DAS was used [63–66].

Phobic stimuli

Since the DAS score fails to capture additional information regarding other specific phobic stimuli, we assessed the fear-provoking nature of other phobic stimuli. Patients were asked to indicate whether each question evokes a fear response (yes or no). The questionnaire included the following phobic stimuli: fear of dental injection, fear of the sound of the dental drill, and fear of having a foreign object in the mouth [20, 67]. Because of the current classification of dental phobia as a B-I-I phobia, we assessed weather dental B-I-I-related situations (i.e., dental injections) are as equally anxiety provoking as non-B-I-I-related situations (i.e., fear of the sound of the dental drill and fear of having a foreign object in the mouth). For this reason, we did not use the modified DAS (MDAS) questionnaire [68],because we were concerned that by using the MDAS, the item about dental injections would blend within the total score, and we would be unable to compare this item with other non-B-I-I-related fears.

Oral health impact profile 14 (OHIP-14)

The validated Hebrew version of the OHIP-14 [41] was used to assess the oral health-related quality of life (OHRQoL) [39, 40]. The OHIP-14 includes seven conceptual domains of OHRQoL, calculated by adding the scores of the two corresponding items including: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. For each OHIP-14 question, subjects were asked how frequently they had experienced the impact in the last 6 months, with values ranging from 0 to 4. Global OHIP-14 scores range from 0 (no adverse impact during previous month) to 56 (all 14 impacts experienced very often during the previous month).

Statistical analysis

Data were tabulated and statistical analyses performed using SPSS software version

21.0 (Chicago, IL, USA). Two-tailed level of statistical significance (α) was set at ≤ 0.05.

Continuous variables are presented as means and standard deviations, and categorical variables are presented as frequencies and percentages.

Differences between groups were examined with a Pearson chi square for categorical variables and an analysis of variance (ANOVA) for numeric variables. Significance tests between DAS and OHIP-14 scores and the independent variables included Chi-square test, ANOVA, and *t* test. Based on the univariate results significant parameters were selected for multivariate linear regression analysis.

Results

One hundred forty participants completed the study: 60 patients with AgP and 80 control subjects.

Table 1 present distribution by age, sex, education, country of origin, birth country, smoking habits, and NRS scores among the two groups. There were no significant differences between the study groups regarding age, sex, and smoking habits, as well as regarding the current and the maximal NRS scores. Israeli country of origin, African country of birth, and less years of schooling were positively associated with AgP patients compared to controls (Table 1).

Periodontal status and caries experience of the study population are presented in Table 2. The AgP group exhibited statistically significant higher mean radiographic bone loss, probing depth, PI, and bleeding score, compared to controls (Table 2). In the AgP group, 52.13% of the teeth had visable plaque, i.e., 14.78 teeth, compared to 27.59% of the teeth with visible plaque, i.e., 7.7 teeth, in the control group.

Patients with AgP exhibited statistically significant more missing (M) teeth, less filled (F) teeth, and lower global DMFT scores compared to controls. No significant differences were found between patients with AgP compared to controls regarding the decay (D) score (Table 2).

Table 3 shows the mean DAS total and sub-scores, DAS categories, self-assessment of dental anxiety, and phobic stimuli as indicated by the study groups. Compared to controls, AgP patients exhibited statistically significant higher scores in the DAS total as well as sub-scores, except from DAS 1st question. Moreover, there were statistically significant differences in the distribution of DAS categories between the AgP group and the control group (Table 3). The AgP group exhibited significantly higher percentage of patients with high anxiety compared to the control group (Table 3).

Furthermore, compared to controls, AgP patients were statistically significantly more likely to fear of the dental drill noise and of foreign objects in the mouth (Table 3). No significant differences were observed between the groups regarding fear of dental injections and self-assessed dental anxiety. The highest rated fear was fear of dental injection among both AgP and control groups.

The associations of DAS total as well as sub-scores with demographic parameters, smoking habits, NRS scores, periodontal status parameters, and DMFT scores among the entire study population (N = 139 patients) were analyzed and presented in Table 4. Younger age, less years of schooling, higher current and maximal NRS scores, and worse scores in all periodontal indexes as well as lower filled teeth (F) and lower DMFT scores were positively associated with higher DAS total scores (Table 4).No significant association was found between DAS total and sub-scores regarding the following parameters: sex, country of origin, birth country, smoking habits, and decayed and missing teeth.

Multivariate linear regression analysis of parameters reaching significantly significant association with the mean DAS total score revealed that significant risk factors for higher DAS total scores are being a patient in the AgP group (p = 0.017, B = − 1.277, S.E. = 0.530, β = − 0.2086, 95% confidence interval (CI)-2.409–0.017), higher current NRS scores (p = 0.004, B = 0.352, S.E. = 0.119, β = 0.276, 95% confidence interval: 0.115–0.588), maximal NRS scores (p = 0.015, B = 0.211, S.E. = 0.086, β = 0.218, 95% CI: 0.041–0.380), and higher PI scores (p = 0.006, B = 0.020, S.E. = 0.007, β = 0.228, 95% CI: 0.006–0.035 80).

The OHIP-14 global and domain scores of the AgP group compared to the control group are presented in Table 5. Compared to controls, AgP patients exhibited worse scores in the OHIP-14 global as well as in all individual OHIP-14 domains scores. Among both AgP and control patients, the physical pain domain was where the highest impact was recorded, while the lowest impact was recorded in the functional limitation domain (Table 5).

The associations of OHIP-14 global and domain scores with demographic and clinical parameters among the whole study population are presented in Table 6.

Less schooling years, smoking habits, higher current and maximal NRS scores, worse periodontal scores in all indexes, and more missing teeth were positively associated with higher (i.e., worse) OHIP-14 global scores. No significant association was found between OHIP-14 global and domain scores regarding the following parameters: age, sex, country of origin, birth country, decayed and filled teeth, and the DMFT score (Table 6).

Multivariate linear regression analysis of parameters reaching significant association with the mean OHIP global scores revealed that significant risk factors for higher OHIP global scores are being a patient in the AgP group (p = 0.008, B = − 4.039, S.E. = 1.489, β = − 0.233, 95% confidence interval − 6.985 to − 1.094), higher current NRS scores (p = 0.041, B = 0.681, S.E. = 0.329, β = 0.187, 95% CI 0.029–1.333), maximal NRS scores (p = 0.029, B = 0.5 11, S.E. = 0.231, β = 0.187, 95% CI: 0.053–0. 968), and higher PI scores (p = 0.001, B = 0.066, S.E. = 0.020, β = 0.264, 95% CI: 0.027–0.106).

Worse mean DAS total score was positively associated with the physical pain, psychological discomfort, and psychological disability OHIP-14 domain scores as well as with the

Table 2 Periodontal status and caries experience of patients with aggressive periodontitis compared to controls

Parameter	Variable	Aggressive periodontitis		Control group		p* value
		No. (%) %		No. (%) %		
Radiographic bone loss categories	0.0–3.0 mm	9 (15.0)		78 (100)		**<0.001**
	3.01–5.0 mm	21 (35.0)		0 (0)		
	5.01–8.0 mm	23 (38.3)		0 (0)		
	8.01–11.0 mm	7 (11.7)		0 (0)		
	11.01 mm <	0 (0)		0 (0)		
Parameter		Aggressive periodontitis		Control group		*p***
		Mean	SD	Mean	SD	
Radiographic bone loss		5.26	2.00	1.29	0.77	*<0.001*
Probing depth		5.30	1.64	2.60	0.71	*<0.001*
PI		52.13	41.89	27.59	22.56	*<0.001*
Bleeding score		60.65	31.35	20.39	16.10	*<0.001*
D		0.83	1.55	0.99	1.48	0.555
M		1.20	2.42	0.32	0.74	*0.008*
F		4.03	4.12	6.82	5.68	*0.002*
DMFT		5.58	5.19	8.10	6.12	*0.012*

P value in bold means a significant *p* value ($p < 0.05$)

SD standard deviation, *D* decay teeth, *M* missing teeth, *F* filled teeth, *PI* plaque index

*chi-square test, **Independent *t* test

mean OHIP-14 global score (Table 7). A significant positive association of DAS third and fourth questions was found with the mean OHIP-14 global score (Table 7).

Discussion

To the best of our knowledge, this is the first study in the English literature that measures and compares OHRQoL and dental anxiety in patients with AgP compared to controls in terms of severity, self-assessment, and response to dental phobic stimuli. The present study addressed many important confounding factors such as demographics, pain scores, caries experience, and various periodontal parameters.

AgP patients were age and sex matched for their corresponding controls. They also matched their corresponding control group for smoking habits and both current and maximal NRS scores. However, Israeli country of origin, African country of birth and less years of schooling were positively associated with AgP patients compared to controls. Since patients were matched for age, lower education among patients with AgP could not be attributed to age differences. The association can be explained by the fact that lower education could result in decreased socioeconomic status and reduces access to information and oral health services [50, 69, 70].

Compared to controls, the AgP group exhibited worse periodontal indices, including radiographic bone loss, probing depth, PI, and bleeding scores. The association between AgP and PI seems controversial in the literature: although Baer [71] suggested that "juvenile periodontitis" is not associated with significant amounts of plaque and calculus; this was not confirmed in the present study, as well as in other studies, who also reported higher PI among AgP patients compared to controls [72–75].

Compared to controls, AgP patients exhibited statistically significant higher scores in the DAS total as well as most subscores and higher percentage of patients with high anxiety, and they were more likely to fear of the dental drill noise and of foreign objects in the mouth. Johannsen et al. (2005) reported in their study of markers of periodontal disease that higher levels of self-reported every day anxiety were associated with deep pockets in smokers, and with gingival inflammation in non-smoking subjects without deep pockets [14]. Their findings that anxious subjects had significantly higher GI than non-anxious subjects, after controlling for smoking, is in line with the current results as well as resemble the finding of Kurer et al. who reported higher levels of gingival inflammation in general dental patients with more anxiety [27]. However, in the group of periodontally healthy non-smokers, a higher degree of gingival inflammation was found in the anxious than in the non-anxious subjects. Whether the

Table 3 Mean Dental anxiety scale (DAS) total and sub-scores, DAS categories,self-assessment of dental anxiety and phobic stimuli as indicated by patients with aggressive periodontitis and controls

Phobic stimuli	Variable	Aggressive periodontitis		Control group		*p** value
		No. (%) %		No. (%) %		
Self-assessed dental anxiety	Yes	24 (40.0)		28 (35.4)		0.582
	No	36 (60.0)		51 (64.6)		
Dental injections	Yes	27 (45.0)		22 (29.3)		0.060
	No	33 (55.0)		53 (70.7)		
Dental drill noise	Yes	13 (21.7)		6 (8.1)		*0.025*
	No	47 (78.3)		68 (91.9)		
Foreign object in the mouth	Yes	14 (23.3)		7 (9.5)		*0.028*
	No	46 (76.7)		67 (90.5)		
DAS categories	Mild anxiety	20 (33.3)		41 (51.9)		*<0.001*
	Moderate anxiety	20 (33.3)		32 (40.5)		
	High anxiety	18 (30.0)		3 (3.8)		
	Phobia	2 (3.3)		3 (3.8)		
Parameter		Aggressive periodontitis		Control group		*p***
		Mean	SD	Mean	SD	
DAS 1st question		2.9	1.1	2.6	0.9	0.070
DAS 2nd question		2.27	0.9	1.8	0.7	*0.001*
DAS 3rd question		2.5	0.9	2.1	0.8	*0.002*
DAS 4th question		2.4	0.9	1.8	0.8	*<0.001*
Total DAS score		10.2	3.1	8.3	2.7	*<0.001*

p value in italics means a significant *p* value ($p < 0.05$)

SD standard deviation

*chi square test **Independent *t* test, *p* value in italics means a significant *p* value ($p < 0.05$)

association between anxiety and gingival inflammation is because of impairment of the immune system or a tendency to neglect oral hygiene among those who are anxious could not be determined should be further studied [14] .It is possible that

Table 4 Associations of demographic and clinical parameters with DAS total and DAS categories among patients with aggressive periodontitis and controls

	Variable	Total DAS score	DAS categories
Demographic parameters	Age	*0.006*	0.055
	Years of schooling	*0.043*	0.217
Pain	Current NRS	*<0.001*	*<0.001*
scores	Maximal NRS	*0.001*	0.077
Periodontal	Bleeding score	*<0.001*	*0.003*
parameters	PI	*0.006*	0.080
	Radiographic bone loss	*0.003*	*0.007*
	Radiographic bone loss categorial	*0.003*	*0.013*
	Probing depth	*0.001*	*0.001*
Caries experience	D	0.218	0.583
	M	0.933	0.718
	F	*0.003*	*0.003*
	DMFT	*0.009*	*0.007*

D decay teeth, *M* missing teeth, *F* filled teeth, *PI* plaque index

^*P* values are presented in the table

*ANOVA, ** chi-square, ***Pearson correlation

Table 5 Mean oral health impact profile (OHIP-14) global and domain scores among aggressive periodontitis patients compared to controls

OHIP-14	Source	N	Mean	SD	*p*
OHIP-14 global score	Aggressive	60	13.75	9.99	*< 0.001*
	Control	79	7.05	5.91	
Functional limitation (OHIP-1 + 2)	Aggressive	60	0.46	0.74	*0.006*
	Control	79	0.17	0.46	
Physical pain (OHIP-3 + 4)	Aggressive	60	1.54	1.02	*0.001*
	Control	79	1.03	0.75	
Psychological discomfort (OHIP-5 + 6)	Aggressive	60	1.27	0.94	*0.001*
	Control	79	0.74	0.88	
Physical disability (OHIP-7 + 8)	Aggressive	60	0.75	0.83	*0.006*
	Control	79	0.42	0.55	
Psychological disability (OHIP-9 + 10)	Aggressive	60	1.24	0.97	*< 0.001*
	Control	79	0.51	0.60	
Social disability (OHIP-11 + 12)	Aggressive	60	0.76	0.98	*0.003*
	Control	79	0.36	0.55	
Handicap (OHIP-13 + 14)	Aggressive	60	0.83	1.027	*< 0.001*
	Control	79	0.26	0.52	

*Independent *t* test, *p* value in italics means a significant *p* value ($p < 0.05$)

the delay associated with dental fear exacerbates the disease. In support, worse periodontal indices were associated with higher DAS scores in the present study. Moreover, there could be influences of anxiety and periodontitis in specific subgroups included in the present study: younger humans with limited knowledge about the disease. Indeed age and education, but not sex, were associated with total DAS score (see Table 4).

AgP patients exhibited worse OHIP-14 global scores as well as worse scores in all individual OHIP-14 domains. In fact, periodontal disease consequences, such as redness, bleeding on brushing, gingival recession, persistent halitosis, pain, tooth mobility, and tooth loss, may compromise mastication, speech, swallowing, and smile esthetics, and consequently negatively affect self-esteem and quality of life. [50, 76].

Worse periodontal scores in all indexes were positively associated with higher OHIP-14 global scores and most domain scores. This is in line with other studies demonstrating that patients with severe periodontitis had significantly higher OHIP-14 values, and worse functional limitation, physical pain, physical incapacity, and psychological incapacity domain scores, than did those with mild/moderate periodontitis [50]. The association to psychological domains was also demonstrated by others, for example, fewer teeth at the beginning of the treatment were related to higher scores of depressive symptoms, even when controlling for several covariates [77]. Patients with higher attachment avoidance attended periodontal treatment later when diagnosed with chronic periodontitis and earlier with AgP [78].

Table 6 Associations of demographic and clinical parameters with OHIP-14 global and domain scores among patients with aggressive periodontitis and controls

	Functional limitation (OHIP-1 + 2)	Physical pain (OHIP − 3 + 4)	Psychological discomfort(OHIP-5 + 6)	Physical disability(OHIP-7 + 8)	Psychological disability(OHIP-9 + 10)	Social disability (OHIP-11 + 12)	Handicap (OHIP-13 + 14)	OHIP-14 global score
Years of schooling	0.072	0.206	0.106	0.013	0.053	0.095	1.099	*0.025*
Smoking habits	0.043	0.217	0.328	0.063	0.136	0.084	0.123	*0.033*
Current NRS	< 0.001	0.001	0.008	0.002	0.075	0.031	0.118	*< 0.001*
Maximal NRS	0.005	0.008	0.009	0.007	0.064	0.341	0.017	*0.003*
Bleeding score	< 0.001	< 0.001	0.026	0.001	< 0.001	0.002	0.002	*< 0.001*
Probing depth	< 0.001	< 0.001	0.001	0.005	< 0.001	< 0.001	< 0.001	*< 0.001*
Radiographic bone loss	< 0.001	< 0.001	< 0.001	0.011	< 0.001	0.003	< 0.001	*< 0.001*
Radiographic bone loss categories	< 0.001	< 0.001	0.004	0.007	< 0.001	0.010	< 0.001	*< 0.001*
PI	0.001	0.001	0.002	0.071	< 0.001	0.001	0.001	*< 0.001*
D	0.866	0.916	0.545	0.985	0.991	0.492	0.741	0.955
M	< 0.001	0.044	0.016	0.004	0.005	0.008	0.001	*< 0.001*
F	0.845	0.653	0.474	0.081	0.181	0.148	0.734	0.268
DMFT	0.933	0.811	0.956	0.326	0.630	0.638	0.559	0.796

D decay teeth, *M* missing teeth, *F* filled teeth, *PI* plaque index

*Pearson correlation **ANOVA

Table 7 Associations of DAS categories, DAS total and sub-scores with OHIP-14 global and domain scores among aggressive periodontitis patients and controls

	Functional limitation (OHIP-1 + 2)	Physical pain (OHIP-3 + 4)	Psychological discomfort (OHIP-5 + 6)	Physical disability (OHIP-7 + 8)	Psychological disability (OHIP-9 + 10)	Social disability (OHIP-11 + 12)	Handicap (OHIP-13 + 14)	OHIP-14 global score
DAS total score	0.502	*0.020*	*0.043*	0.293	*0.047*	0.089	0.465	*0.039*
DAS 1st question	0.561	0.118	0.534	0.933	0.504	0.547	0.593	0.462
DAS-2nd question	0.747	0.089	0.056	0.358	*0.020*	0.166	0.307	0.057
DAS-3rd Question	0.328	*0.015*	0.052	0.371	*0.020*	0.069	0.322	*0.026*
DAS-4th question	0.112	0.051	0.021	0.086	0.161	0.063	0.941	*0.041*

*Pearson correlation, **ANOVA

OHRQoL assessments may play an important role in clinical practice in terms of identifying needs, selecting therapies and monitoring patients' progress [44]. A greater understanding of the consequences of periodontal disease and the effects of therapy are important on many fronts: in understanding and embracing patients' perceptions of the impact of their oral health on their lives, in planning periodontal care that addresses patients' needs and key concerns, in evaluating outcomes from periodontal treatment from the patients' perspective, and in drawing attention to the importance of periodontal care in society [79].

Due to the speed of tissue loss in AgP if left untreated, irreversible tissue damage can occur in the bone and soft tissue surrounding the teeth, leading to tooth mobility and, ultimately, to the loss of teeth. In the present study as well as in previous reports [44], it was found that missing teeth affected comfort and physical aspects more than they affected physiological and social aspects. Although there is low evidence of anxiety in the periodontal literature, the results of the present study can be compared to results with older/other ones from studies investigated chronic as well as aggressive periodontitis. The association of missing teeth with OHRQoL in AgP could be due to the fact that decreased number of teeth was associated with greater discomfort during chewing and as a result impaired OHRQoL, as was also confirmed in other studies [45, 50, 76, 80, 81]. For example, the Korea national health and nutrition examination survey demonstrated that dental pain and tooth loss had a considerable impact of HRQoL [82]. Moreover, fewer teeth at the beginning of the treatment were related to higher scores of depressive symptoms, even when controlling for several covariates [77].

The main strengths of the present study are the large sample size (139 patients) in particular for aggressive periodontitis, which is a relatively rare disease. We used a strict protocol utilizing standardized internationally accepted DAS and OHIP-14 questionnaires and NRS scores which allow comparison with other socioeconomic or ethnic groups.

Limitations of this study include the possibility of selection bias of this convenience cohort and may limit the generalizability of our results. However, patients were referred from multiple clinics serving different populations. The case-control study design means that we cannot assume causality, and therefore this paper only suggests associations between the variables. Patients were not surveyed regarding regular dental check-ups and preventive care patterns. However, data regarding caries experience can be drawn from the D, M, F indices. Data regarding preventive care patterns such as dental hygiene can be drawn from the PI and bleeding score indices.

(Table 2). Clearly, additional, similar studies in other settings would be helpful in addressing this issue as well as population based epidemiological surveys.

Conclusions

In conclusion, compared to controls, AgP patients were positively associated with higher levels of dental anxiety and worse OHRQoL.

Self-perception of dental anxiety and OHRQoL should be an integral part of the routine diagnostic work-up procedure. It is essential, from a public health perspective to establish communication between health professionals from the dental and

behavioral fields, in order to implement a multidisciplinary team approach to treat dental anxiety, involving behavioral and psychological interventions. Integration of self-perception and periodontal treatment should lead professionals to design health strategies that will cope with the dental anxiety associated with the treatment and prevent decreases in OHRQoL.

Author Contributions Each of the contributors provided substantive intellectual contribution to one or more of the activities related to this manuscript as follows:

Liran Levin: made substantial contributions to the study's conception and design, interpretation of data, revised and approved the manuscript**.**

Avraham Zini: analysis and interpretation of data and approved the manuscript.

Jonathan Levine: data collection of the aggressive periodontitis group and approved the manuscript.

Maor Weiss: data collection of the aggressive periodontitis group and approved the manuscript.

Ron Lev: revised and approved the manuscript.

Avihay Hai: data collection of the control group and approved the manuscript.

Daniella Chebath-Taub: data collection of the control group and approved the manuscript.

Galit Almoznino: principal investigator, made substantial contributions to the study's conception and design, acquisition of data, and analysis and interpretation of data; drafted the submitted the article and provided final approval of the version to be published.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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