Original paper

Evaluation of the periodontal status and systemic diseases in dental patients in Turkey

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Abstract

Background. Periodontal diseases are chronic inflammatory diseases related to many hereditary, environmental, physical, and psychological factors.

Objectives. The aim of the present study was to determine the demographic data, periodontal status and systemic conditions of patients who reported to the Department of Oral and Maxillofacial Radiology, and to evaluate the relationship between the periodontal status and the associated risk factors.

Material and methods. The study included a total of 2,000 patients (974 males and 1,026 females). The anamnesis data on the patients' systemic diseases/conditions and periodontal diagnoses were analyzed statistically.

Results. Upon evaluating the clinical and radiological examination data, the findings were as follows: 9.20% of patients had clinically healthy gingiva; 15.20% had gingivitis on an intact periodontium; 22.75% had gingivitis on a reduced periodontium (in total, 37.95% had gingivitis); 47.20% had mild to moderate periodontitis (stages I and II, grades A and B); and 3.45% had severe periodontitis (stages III and IV, grades B and C) (in total, 50.65% had periodontitis). Additionally, 2.20% of patients were diagnosed with necrotizing periodontal diseases (NPD). Gingival health was significantly poorer in patients with hypertension, diabetes, gastrointestinal system diseases (GID), cardiovascular system diseases (CVD), gynecological disorders, psychiatric disorders, hypothyroidism, rheumatological diseases, osteoporosis, chronic respiratory diseases/asthma, anemia, a history of cancer, and dermatological problems ($p < 0.001$).

Conclusions. Periodontitis is a significant public health concern among the Turkish population, with high incidence rates of mild to moderate periodontitis attributed to risk factors such as age, smoking and various systemic diseases.

Keywords: epidemiology, diabetes, periodontal disease, risk factors, systemic disease

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Highlights

- Periodontitis is highly prevalent in the Turkish population, with over 50% of patients affected, mostly in mild to moderate stages.
- Systemic diseases, such as hypertension, diabetes and hypothyroidism, are significantly associated with poorer gingival health ($p < 0.001$).
- These findings highlight the importance of a multidisciplinary approach in periodontal care, especially for patients with systemic health conditions.

Introduction

Periodontal diseases are chronic inflammatory diseases primarily caused by microbial dental plaque; they are related to various hereditary, environmental, physical, and psychological factors.[1] Host-related factors, such as age, gender, systemic diseases, smoking, and the psychological status, can have a significantly impact on disease progression. Therefore, obtaining a detailed patient history is essential for establishing a treatment plan for a periodontal disease, and identifying modifiable and non-modifiable risk factors.[1–6]

Numerous studies have shown that smoking, a modifiable risk factor, increases the development and progression of periodontal diseases.[7–10] In addition, research indicates improvement in the prognosis of periodontal diseases among patients who quitted smoking.[10,11]

Age and gender are non-modifiable risk factors associated with periodontal diseases. Studies show an increase in the prevalence and severity of periodontal diseases with advancing age.[12,13] Furthermore, periodontal diseases are more prevalent in males than females, which is attributed partly to genetic predisposition and differences in oral hygiene practices among male individuals.[6,14] Educating patients about smoking cessation and oral hygiene is important for improving the prognosis of periodontal diseases.[2,5,7,8]

Recent research confirms that periodontal diseases affect systemic health beyond oral cavity involvement. Studies have shown a link between periodontitis and preterm birth, low birth weight and systemic diseases, such as cardiovascular system diseases (CVD), diabetes, inflammatory joint disorders, and chronic kidney disease.[1,15–19] Moreover, deficiencies in essential vitamins and imbalance in the antioxidant–oxidant level, including conditions such as hyperhomocysteinemia, influence the development and prognosis of periodontitis.[20]

In 2017, the American Academy of Periodontology and the European Federation of Periodontology (AAP-EFP) introduced a new classification. In comparison with the AAP's 1999 classification, this updated version is more comprehensive and includes more detailed clinical diagnostic information. The AAP 1999 classification categorized patients based on the clinical pocket measurements (the level of periodontal attachment loss), distinguishing between localized or generalized periodontitis according to disease involvement, and between aggressive or chronic periodontitis according to disease severity.[21] In contrast, the AAP-EFP 2017 classification categorizes patients by staging (stages I–IV) and grading (grades A–C) according to the clinical attachment level (CAL) or interdental bone loss (IBL) and the number of lost teeth.[22] With the use of the new classification, the current periodontal disease can be addressed in various aspects.[22–25]

There are very few studies analyzing both the systemic and periodontal status, using the new AAP-EFP 2017 classification. Epidemiological studies need to be updated periodically to incorporate new information, including emerging epidemics, advances in medicine and technology, and the use of natural products in traditional medicine and their effects.[26–28] The null hypothesis was that there would be no difference in the distribution of diagnoses made by means of the AAP-EFP 2017 periodontal disease classification in the presence of systemic health or systemic diseases among the Turkish population in 2017–2022.

This retrospective study aimed to assess the periodontal disease and health status, systemic diseases/conditions, and the relationship between the periodontal status and patient risk factors among individuals visiting the Department of Oral and Maxillofacial Radiology at Antalya Bilim University, Turkey, in 2017–2022.

Material and methods

Our study adhered to the principles outlined in the Declaration of Helsinki adopted in 1975 (revised in 2013). The study protocol (No. 2022/08) was approved by the Clinical Research Ethics Committee at Niğde Ömer Halisdemir University, Turkey. This retrospective study analyzed the records of individuals who underwent their

initial dental examination at the Department of Oral and Maxillofacial Radiology at Antalya Bilim University between January 2017 and January 2022. Following their initial assessment, patients requiring periodontal treatment were referred to the periodontology clinic. The researchers retrieved data from the archives of the Faculty of Dentistry, encompassing the records of 3,000 patients, of whom 2,000 met the inclusion criteria.

The inclusion criteria specified patients who visited the clinic between January 2017 and January 2022, with complete demographic data, information about smoking habits, a medical history, and comprehensive clinical periodontal examination data, including the whole periodontal pocket depth (PPD), the gingival index (GI),[29] the plaque index (PI),[29] the number of missing teeth, and tooth mobility. In addition, complete radiological examination data on interdental alveolar bone loss was required. Patients diagnosed under the new periodontal disease classification were eligible for inclusion. The exclusion criteria encompassed individuals with missing data, those unwilling to participate in the study, patients diagnosed under the 1999 periodontal disease classification, and pregnant or lactating women.

Demographic and medical status data

Patient data was extracted from standard patient files, and included demographic details (age, gender), smoking habits, and self-reported systemic diseases or their absence.

Periodontal evaluation

Periodontal disease diagnoses were made by expert periodontologists at the Faculty of Dentistry of Antalya Bilim University in accordance with the following and were recorded on the patient forms. These patient forms were the primary data source for our retrospective study. The diagnoses were categorized according to the AAP-EFP 2017 classification, using clinical and radiological examination data, and the patients were divided into specific diagnostic groups.

Patients with no bleeding on probing (BoP) or BoP ≤ 10%, no signs of inflammation (edema, hyperemia), and no clinical or radiological evidence of CAL or IBL were included in the "gingival health on an intact periodontium" (GH+iP) group. Patients without gingival inflammation, with PPD ≤ 3 mm, but with decreased periodontium due to a previous periodontal disease were included in the "gingival health on a reduced periodontium" (GH+rP) group. These 2 subgroups constituted the "gingival health" group. Patients with gingival inflammation and PPD ≤ 3 mm were included in the "gingivitis on an intact periodontium" (G+iP) group if there was no bone loss and no decrease in the periodontium; if there was a decrease in the periodontium, they were included in the "gingivitis on a reduced periodontium" (G+rP) group. These 2 subgroups together constituted the "gingivitis" group.

Periodontitis was categorized into stages (I–IV) and grades (A–C) based on CAL or IBL and the number of lost teeth. Stages were determined by the severity and complexity of periodontitis as follows:

- stage I: Onset of periodontitis (0–15% IBL);
- stage II: Moderate periodontitis (15–33% IBL);
- stage III: Severe periodontitis (>33% IBL) with possible tooth loss; and
- stage IV: Severe periodontitis (>33% IBL) with potential for a complete loss of dentition.

The mild to moderate periodontitis (MP; chronic periodontitis according to the AAP's 1999 classification) group included patients classified as stages I and II, and grades A and B (IBL: 0–33% and %IBL/age: 0–1).

The severe periodontitis (SP; aggressive periodontitis according to the AAP's 1999 classification) group included patients classified as stages III and IV, and grades B and C (IBL > 33% and %IBL/age > 0.25).[22]

In addition, the "necrotizing periodontal diseases" (NPD) group comprised "necrotizing gingivitis" (NG) and "necrotizing periodontitis" (NP) patients,[30] as per the classification system.

Sample size estimation

Sample size estimation and power analysis were performed using the G*power software, v. 3.1 (https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower), and the one-way analysis of variance (ANOVA) test. The calculations indicated a requirement of at least 228 patients for the 4 main diagnostic groups (gingival health, gingivitis, periodontitis, and NPD) and a minimum of 296 patients for the 8 detailed subgroups (GH+iP, GH+rP, G+iP, G+rP, MP, SP, NG, NP), with 90% power and a significance level (α) of 0.05.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, v. 23.0 (IBM Corp., Armonk, USA). Descriptive statistics for quantitative variables are presented as median (*Me*) (min–max), since the data was not normally distributed. In addition, the mean and standard deviation ($M \pm SD$) values are provided as well. Qualitative data is reported as frequency and percentage (n (%)). Normality was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Group comparisons were done using the non-parametric Kruskal–Wallis test, followed by post hoc pairwise comparisons to identify significant differences. The χ^2 test was used to analyze relationships and ratios with regard to qualitative data. Statistical significance was determined at $p < 0.05$.

Results

In our study, data from 2,000 patients was analyzed. The sample consisted of 974 (48.70%) males and 1,026 (51.30%) females, with a mean age of 42.33 ±14.11 years (40.15 ±11.66 years for males and 38.22 ±10.11 years for females). The mean age across different periodontal health status groups were as follows: 25.93 ±11.33 years for the periodontally healthy individuals; 25.33 ±7.66 years for the gingivitis patients; 46.54 ±13.33 years for the periodontitis patients; and 33.47 ±10.33 years for the patients with NPD. The periodontitis patients were on average significantly older as compared to other groups ($p < 0.001$). In addition, a significant difference in terms of age was found between the healthy and periodontitis groups (post hoc) ($p < 0.05$).

The periodontal status according to gender is shown in Table 1. Among male patients, 72 were periodontally healthy (12 GH+iP, 60 GH+rP), 338 had gingivitis

Table 1. Periodontal status according to gender

Gender	Periodontal status													*p*-value
	gingival health			gingivitis			periodontitis			NPD			total	
	GH+iP	GH+rP	total	G+iP	G+rP	total	MP	SP	total	NG	NP	total		
Male	12 (0.60)[a]	60 (3.00)[a]	72 (3.60)[a]	121 (6.05)	217 (10.85)[a]	338 (16.90)	516 (25.80)	27 (1.35)[a]	543 (27.15)	12 (0.60)[a]	9 (0.45)[a]	21 (1.05)[a]	974 (48.70)	<0.001*
Female	30 (1.50)[a]	82 (4.10)[a]	112 (5.60)[a]	183 (9.15)	238 (11.90)[a]	421 (21.05)	428 (21.40)	42 (2.10)[a]	470 (23.50)	16 (0.80)[a]	7 (0.35)[a]	23 (1.15)[a]	1,026 (51.30)	<0.001*
Total	42 (2.10)	142 (7.10)	184 (9.20)	304 (15.20)	455 (22.75)	759 (37.95)	944 (47.20)	69 (3.45)	1,013 (50.65)	28 (1.40)	16 (0.80)	44 (2.20)	2,000 (100.00)	<0.001*

Data presented as number (percentage) (*n* (%)).
Groups: GH+iP – gingival health on an intact periodontium; GH+rP – gingival health on a reduced periodontium; G+iP – gingivitis on an intact periodontium; G+rP – gingivitis on a reduced periodontium; MP – mild to moderate periodontitis; SP – severe periodontitis; NG – necrotizing gingivitis; NP – necrotizing periodontitis. NPD – necrotizing periodontal diseases; * statistically significant; [a] no statistically significant difference between the groups.

Table 2. Distribution of periodontal diagnoses by patient groups (systemic diseases)

Systemic disease	Periodontal status													*p*-value
	gingival health*			gingivitis*			periodontitis*			NPD*			total	
	GH+iP*	GH+rP*	total	G+iP*	G+rP*	total	MP*	SP*	total	NG*	NP*	total		
None*	26 (1.30)	62 (3.10)	88 (4.40)	163 (8.15)	134 (6.70)	297 (14.85)	125 (6.25)	27 (1.35)	152 (7.60)	8 (0.40)[a]	0 (0.00)[a]	8 (0.40)[a]	545 (27.25)	<0.001*
Hypertension	3 (0.15)[a]	13 (0.65)[a]	16 (0.80)[a,b]	8 (0.40)	47 (2.35)	55 (2.75)[b]	296 (14.80)[c]	5 (0.25)	301 (15.05)[c]	0 (0.00)	0 (0.00)[a]	0 (0.00)	372 (18.60)	<0.001*
Diabetes	5 (0.25)[a]	14 (0.70)[a]	19 (0.95)[a,b]	21 (1.05)	33 (1.65)	54 (2.70)[b]	107 (5.35)[c]	13 (0.65)	120 (6.00)[c]	5 (0.25)[a]	2 (0.10)	7 (0.35)[a]	200 (10.00)	<0.001*
GID	3 (0.15)[a]	10 (0.50)	13 (0.65)	16 (0.80)	56 (2.80)	72 (3.60)	34 (1.70)	3 (0.15)[a]	37 (1.85)	3 (0.15)[a]	2 (0.10)[a]	5 (0.25)	127 (6.35)	<0.001*
CVD	2 (0.10)[a]	3 (0.15)[a]	5 (0.25)	6 (0.30)[a]	34 (1.70)	40 (2.00)	76 (3.80)	4 (0.20)[a]	80 (4.00)	0 (0.00)[a]	0 (0.00)[a]	0 (0.00)	125 (6.25)	<0.001*
Gynecological disorders	0 (0.00)	8 (0.40)	8 (0.40)	19 (0.95)	34 (1.70)	53 (2.65)	30 (1.50)	1 (0.05)	31 (1.55)	2 (0.10)	0 (0.00)	2 (0.10)	94 (4.70)	<0.001*
Psychiatric disorders	2 (0.10)	3 (0.15)	5 (0.25)	20 (1.00)	16 (0.80)	36 (1.80)	28 (1.40)	4 (0.20)	32 (1.60)	7 (0.35)	1 (0.05)	8 (0.40)	81 (4.05)	<0.001*
Hypothyroidism	1 (0.05)	11 (0.55)	12 (0.60)[a]	22 (1.10)	28 (1.40)	50 (2.50)	13 (0.65)[a]	1 (0.05)	14 (0.70)	1 (0.05)	0 (0.00)	1 (0.05)	77 (3.85)	<0.001*
Rheumatological diseases	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.10)	8 (0.40)	10 (0.50)	61 (3.05)	4 (0.20)	65 (3.25)	1 (0.05)	0 (0.00)	1 (0.05)	76 (3.80)	<0.001*
Osteoporosis	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	5 (0.25)	5 (0.25)	50 (2.50)	4 (0.20)	54 (2.70)	0 (0.00)	0 (0.00)	0 (0.00)	59 (2.95)	<0.001*
Chronic respiratory diseases/asthma	0 (0.00)	1 (0.05)	1 (0.05)	6 (0.30)	12 (0.60)	18 (0.90)	26 (1.30)	0 (0.00)	26 (1.30)	1 (0.05)	0 (0.00)	1 (0.05)	46 (2.30)	<0.001*
Anemia	0 (0.00)	6 (0.30)	6 (0.30)	3 (0.15)	15 (0.75)	18 (0.90)	20 (1.00)	0 (0.00)	20 (1.00)	0 (0.00)	0 (0.00)	0 (0.00)	44 (2.20)	<0.001*
History of cancer	0 (0.00)	3 (0.15)	3 (0.15)	4 (0.20)	5 (0.25)	9 (0.45)	10 (0.50)	1 (0.05)	11 (0.55)	0 (0.00)	4 (0.20)	4 (0.20)	27 (1.35)	<0.001*
Dermatological problems	0 (0.00)	3 (0.15)	3 (0.15)	0 (0.00)	5 (0.25)	5 (0.25)	16 (0.80)	0 (0.00)	16 (0.80)	0 (0.00)	0 (0.00)	0 (0.00)	24 (1.20)	<0.001*

Data presented as *n* (%).
GID – gastrointestinal system diseases; CVD – cardiovascular system diseases; * statistically significant difference; [a] no statistically significant differences among the periodontal status groups; [b] no statistically significant differences between the hypertension and diabetes subgroups; [c] statistically significant differences between the hypertension and diabetes subgroups.

(121 G+iP, 217 G+rP), 543 had periodontitis (516 MP, 27 SP), and 21 had NPD (12 NG, 9 NP). Among female patients, 112 were periodontally healthy (30 GH+iP, 82 GH+rP), 421 had gingivitis (183 G+iP, 238 G+rP), 470 had periodontitis (428 MP, 42 SP), and 23 had NPD (16 NG, 7 NP). Gender differences were significant in diagnosing gingivitis and periodontitis ($p < 0.001$), but no significant difference was found between the genders in diagnosing other diseases ($p > 0.05$).

The distribution of periodontal diagnoses by patient groups is shown in Tables 2 and 3. Systemic diseases in the tables are listed from the most to the least common. Of all patients included in the study, 72.75% had a systemic disease. The presence of a systemic disease significantly increased the likelihood of a periodontitis diagnosis ($p < 0.001$).

In the comparison of the hypertension and diabetes patients, a statistically higher percentage of patients with MP was found among the hypertensives than in the diabetes subgroup (14.80% vs. 5.35%, respectively). However, in contrast to the hypertensive patient subgroup, among the diabetes patients, some had NG (0.25%) or NP (0.10%). Except for the MP and NPD diagnoses, no significant differences between the 2 subgroups were found in the distribution of periodontal diagnoses. In the patients with gastrointestinal system diseases (GID), gingivitis prevalence was significantly higher as compared to other periodontal conditions ($p < 0.001$). Among the CVD patients, significant differences between periodontal conditions were found ($p < 0.001$); NPD were absent in the CVD subgroup. The patients with gynecological disorders showed significant differences in periodontal conditions ($p < 0.001$). The patients with psychiatric disorders, hypothyroidism and chronic respiratory diseases/asthma showed significant differences with regard to the gingival health, gingivitis, periodontitis, and NPD groups ($p < 0.001$). Periodontitis was notably higher than other conditions in the rheumatological disease and osteoporosis patient subgroups ($p < 0.001$). The patients with anemia also showed significant differences among the gingival health, gingivitis and periodontitis groups ($p < 0.001$).

In our study, gingival health was significantly poorer in patients with hypertension, diabetes, GID, CVD, gynecological disorders, psychiatric disorders, hypothyroidism, rheumatological diseases, osteoporosis, chronic respiratory diseases/asthma, anemia, a history of cancer, and dermatological disorders (Table 2).

The distribution and number of patients in the mental retardation and disability, kidney disease, hepatitis B, hypotension, human immunodeficiency virus (HIV)-positive, familial Mediterranean fever (FMF), hyperthyroidism, Parkinson's disease, Alzheimer's disease, and hepatitis C subgroups were not suitable for statistical analysis in our study (p-value unavailable) (Table 3).

The distribution of smoking according to diagnoses is shown in Table 4. Of all patients, 662 (33.10%) were smokers. All patients diagnosed with NPD were smokers. Statistically significant differences were found between the clinical gingival health, gingivitis, periodontitis, and NPD (both NG and NP) groups regarding the smoking status ($p < 0.001$). In the gingival health group there were more non-smokers than smokers ($p < 0.001$).

Table 3. Distribution of periodontal diagnoses by patient groups (other systemic diseases)

Systemic disease	Periodontal status												total	*p*-value
	gingival health			gingivitis			periodontitis			NPD				
	GH+iP	GH+rP	total	G+iP	G+rP	total	MP	SP	total	NG	NP	total		
Mental retardation and disability	0 (0.00)	0 (0.00)	0 (0.00)	7 (0.35)	2 (0.10)	9 (0.45)	10 (0.50)	1 (0.05)	11 (0.55)	0 (0.00)	0 (0.00)	0 (0.00)	20 (1.00)	unavailable
Kidney diseases	0 (0.00)	1 (0.05)	1 (0.05)	1 (0.05)	2 (0.10)	3 (0.15)	12 (0.60)	1 (0.05)	13 (0.65)	0 (0.00)	0 (0.00)	0 (0.00)	17 (0.85)	unavailable
Hepatitis B	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.15)	8 (0.40)	11 (0.55)	4 (0.20)	0 (0.00)	4 (0.20)	0 (0.00)	0 (0.00)	0 (0.00)	15 0.75)	unavailable
Hypotension	0 (0.00)	2 (0.10)	2 (0.10)	0 (0.00)	5 (0.25)	5 (0.25)	7 (0.35)	0 (0.00)	7 (0.35)	0 (0.00)	0 (0.00)	0 (0.00)	14 (0.70)	unavailable
HIV-positive	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.05)	1 (0.05)	2 (0.10)	0 (0.00)	2 (0.10)	0 (0.00)	7 (0.35)	7 (0.35)	10 (0.50)	unavailable
FMF	0 (0.00)	1 (0.05)	1 (0.05)	3 (0.15)	2 (0.10)	5 (0.25)	4 (0.20)	0 (0.00)	4 (0.20)	0 (0.00)	0 (0.00)	0 (0.00)	10 (0.50)	unavailable
Hyperthyroidism	0 (0.00)	1 (0.05)	1 (0.05)	0 (0.00)	1 (0.05)	1 (0.05)	5 (0.25)	0 (0.00)	5 (0.25)	0 (0.00)	0 (0.00)	0 (0.00)	7 (0.35)	unavailable
Parkinson's disease	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (0.20)	0 (0.00)	4 (0.20)	0 (0.00)	0 (0.00)	0 (0.00)	4 (0.20)	unavailable
Alzheimer's disease	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.05)	1 (0.05)	3 (0.15)	0 (0.00)	3 (0.15)	0 (0.00)	0 (0.00)	0 (0.00)	4 (0.20)	unavailable
Hepatitis C	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.05)	1 (0.05)	1 (0.05)	0 (0.00)	1 (0.05)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.10)	unavailable

Data presented as *n* (%).
HIV – human immunodeficiency virus; FMF – familial Mediterranean fever.

Table 4. Distribution of periodontal diagnoses according to the smoking status

Smoking status	Periodontal status													*p*-value
	gingival health*			gingivitis*			periodontitis*			NPD			total	
	GH+iP*	GH+rP*	total	G+iP*	G+rP*	total	MP*	SP*	total	NG[a]	NP[a]	total		
Non-smokers	36 (1.80)	95 (4.75)	131 (6.55)	268 (13.40)	360 (18.00)	628 (31.40)	437 (21.85)	60 (3.00)	497 (24.85)	0 (0.00)	0 (0.00)	0 (0.00)	1,256 (62.80)	<0.001*
Current smokers	4 (0.20)	16 (0.80)	20 (1.00)	28 (1.40)	75 (3.75)	103 (5.15)	486 (24.30)	9 (0.45)	495 (24.75)	28 (1.40)	16 (0.80)	44 (2.20)	662 (33.10)	<0.001*
Ex-smokers	2 (0.10)	31 (1.55)	33 (1.65)	8 (0.40)	20 (1.00)	28 (1.40)	21 (1.05)	0 (0.00)	21 (1.05)	0 (0.00)	0 (0.00)	0 (0.00)	82 (4.10)	<0.001*
Total	42 (2.10)	142 (7.10)	184 (9.20)	304 (15.20)	455 (22.75)	759 (37.95)	944 (47.20)	69 (3.45)	1,013 (50.65)	28 (1.40)	16 (0.80)	44 (2.20)	2,000 (100.00)	<0.001*

Data presented as *n* (%).
* statistically significant difference; [a] no statistically significant difference between the groups.

Discussion

Periodontal diseases are chronic infectious diseases caused by periodontopathogenic bacteria. They are prevalent in societies and influenced by various physical and environmental factors.[7,31] Systemic diseases, such as diabetes and CVD, are host-associated risk factors. The literature confirms that the systemic conditions of the host can impact the onset and prognosis of periodontal diseases.[1–4,7,15,16,23] The prevalence of systemic diseases in the population is relatively high, reported between 39.9% and 52.5%.[32] Advancement in technology and medicine have led to increased lifespans for patients with systemic diseases, consequently increasing the demand for periodontal treatment to improve their quality of life (QoL).[5,7,13]

Epidemiological studies should be periodically repeated to take into account the changing living conditions.[26,28,33,34] In 2017, the classification of periodontitis was revised by AAP-EFP. The staging of periodontitis provides information on disease severity, extent and distribution within the dentition, as well as the complexity of management. The grading system provides supplemental information on future disease risk and progression.[22,24,25] This new classification also refers to systemic diseases (particularly diabetes) and the smoking status.[22] Our study utilized this classification to diagnose and evaluate the systemic diseases, smoking habits and periodontal status of Turkish patients with regard to the period between 2017 and 2022. Our study contributes to epidemiological research in the Turkish population by aligning with the current literature and the updated disease classifications.

The percentage of IBL was used to determine the stages of periodontitis in the study patients. The ratio %IBL/age was used to indirectly assess periodontitis progression. The new classification also provides information about disease severity and progression rates in patients diagnosed with periodontitis, indicating whether treatment may require both non-surgical and surgical approaches.[22,24,25] Whereas debridement and subgingival curettage may be sufficient treatment for stages I and II, surgical periodontal treatment is additionally recommended for stages III and IV.[22,24,25] In our study, IBL exceeded 33% in 7% of the periodontitis patients. In 93% of cases, IBL ranged from 0% to 33% and the ratio %IBL/age was <1. This suggests that non-surgical periodontal treatment is generally sufficient for treating periodontitis in this population. Although MP was significantly higher in the patients with systemic diseases as compared to the healthy group, the presence of MP in the systemically healthy group reveals the multifactorial nature of periodontitis.

In order to include periodontally healthy individuals in our study, we scanned the records of patients visiting the Department of Oral and Maxillofacial Radiology, where the initial examinations were conducted. Most studies in the literature on the Turkish population did not include periodontally healthy groups.[28,33,34] The periodontally healthy individuals in our study were referred to the periodontology clinic due to gingival recession, esthetic smile design, gingival operations prior to fixed prostheses, and implant requirements. Patient forms with data from periodontal clinical evaluations were filled by expert periodontologists. In our study, 2.10% of patients were in the GH+iP group, 7.10% in the GH+rP group (totaling 9.20% with healthy gingiva), 15.20% had G+iP, 22.75% had G+rP (totaling 37.95% with gingivitis), 47.20% had MP, 3.45% had SP (totaling 50.65% with periodontitis), 1.40% had NG, and 0.80% had NP (totaling 2.20% with NPD). Similarly, Akpınar et al. found gingivitis in 51.9% of patients and periodontitis in 47.8%.[28] Sezgin et al. reported 50.0% gingivitis patients, 39.8% periodontitis patients and 9.9% G+rP patients in their study.[34] Another study conducted at Adıyaman University, Turkey, reported gingivitis in 19.6% of patients and periodontitis in 79.3%.[33] These proportional discrepancies may be due to differences in the mean patient age, environmental conditions, geographic factors, the years of epidemiological research, and the use of alternate diagnostic classifications.[12,33] Although our study gave similar results to those in previous studies, it provided more comprehensive insights into periodontal disease severity and complexity, using a new classification.

In our study, the mean age of the periodontally healthy individuals was 25.93 ±11.33 years, it was 25.33 ±7.66 years

for the gingivitis patients, 46.54 ±13.33 years for the periodontitis patients, and 33.47 ±10.33 years in patients with NPD. Similar to other studies in the literature, it was observed that the prevalence of periodontal diseases increases with age.[7,12,28,33,34] This is thought to be due to changes in the immune system with aging and the cumulative effects of periodontal disease agents.[7,28]

In our study, MP was observed mainly in male patients, whereas more G+iP cases were diagnosed among female patients, and this difference was statistically significant ($p < 0.001$). There were no significant gender differences in diagnosing other diseases. In the study of Çalışır and Talmaç, similar to ours, the rate of gingivitis was 21.7% in females and 17.5% in males, and the rate of periodontitis was 81.7% in males and 77.0% in females.[33] Although not fully elucidated in the literature, this difference is attributed to periodontitis being more prevalent in males, possibly due to poorer oral hygiene, higher smoking rates and genetic factors.[7,11,14,23,28]

It has been widely demonstrated in studies that smoking is the strongest modifiable risk factor for periodontal diseases after bacterial plaque, and its role in the pathogenesis of periodontal diseases has been investigated extensively. Many studies indicate a reduced treatment response among smokers. In addition, approx. 40% of periodontitis cases are believed to be associated with active smoking.[35] The increased risk of periodontitis in smokers is associated with the negative effects of smoking on the immune system.[7,9,11] In our study, 51.48% of patients diagnosed with MP were smokers, whereas Çalışır and Talmaç reported a rate of 61.2%.[33] In addition, all patients diagnosed with NPD were smokers.

The incidence of NG varies among populations, depending on living conditions, sociocultural factors, the socioeconomic status, and genetic factors.[36–38] Recent data shows that the prevalence of necrotizing ulcerative gingivitis varies widely, from 6.70% in Chilean students aged 12–21 years[38] to 0.11% in the British Armed Forces.[37] In our current study, the rate of NG in the Turkish population was 1.40%. Furthermore, 25.0% (7/28) of NG patients in our study suffered from psychiatric disorders, such as depression.

Although the prevalence of NP varies across populations, it has been reported to range from 0% to 11%.[39] Its incidence increases notably in patients with HIV, immunosuppression and malnutrition.[40] In our study, NP was detected in 16 patients (0.80%). Among these patients, 2 had diabetes, 2 had GID, 1 had a psychiatric disorder, 4 had a history of cancer, and 7 had HIV. The inclusion of a relatively large number of HIV-positive patients in our study may have contributed to the higher incidence of NP.

Studies have shown that periodontitis, a chronic infectious disease, is associated with many systemic diseases and conditions, such as diabetes, CVD, and preterm birth/low birth weight.[1,7,15,16,23,32] In our study, 72.75% of patients had at least one systemic disease, and clinical gingival health was significantly lower in the patients with hypertension, diabetes, GID, CVD, gynecological disorders, psychiatric disorders, hypothyroidism, rheumatological diseases, osteoporosis, chronic respiratory diseases/asthma, anemia, a history of cancer, and dermatological problems.

Respiratory diseases associated with periodontal diseases include chronic obstructive pulmonary disease (COPD), emphysema, pneumonia, bronchitis, and asthma.[41] It was previously believed that the aspiration of periodontopathogenic bacteria into the lungs, along with enzymes present in saliva, facilitated their adhesion and colonization, thereby altering mucosal surfaces.[42] In a study by Yang et al., the risk of pneumonia was lower in periodontally treated patients with MP as compared to the general population.[43] In our study, gingivitis and MP were higher in the patients with respiratory tract disorders as compared to those with clinically healthy gingiva. Our current findings support a potential relationship between respiratory tract diseases and periodontal diseases.

It has been reported that the periodontal status is associated with GID (e.g., gastroesophageal reflux, gastritis, ulcerative colitis). *Helicobacter pylori*, one of the most important bacteria causing GID, can be found in saliva, the dorsum of the tongue and dental plaque, potentially being a risk factor for chronic periodontitis.[44,45] In our study, G+rP and MP were significantly more prevalent in the patients with GID. Vitamin deficiencies, often due to malabsorption, may explain the higher incidence of bone loss observed in these patients as compared to healthy individuals.[20]

Hormonal changes during puberty, the menstrual cycle, pregnancy, or menopause can affect gingival epithelium, connective tissue, microvascular structures, bone mineral density, and inflammatory responses, potentially contributing to periodontal diseases and severe tissue destruction.[46,47] In our study, the gynecology patient group included individuals receiving hormone supplements, such as progesterone and estrogen, for treatment. In these patients, the rates of gingivitis (53/94) and MP (30/94) were significantly higher than in those periodontally healthy (8/94).

Individuals with thyroid dysfunction are reported to be more susceptible to dental caries and periodontal diseases.[48] Although the exact reason for the increased incidence and severity of periodontal diseases in these patients is still unknown, it is hypothesized that decreased serum levels of thyroid hormones may contribute to increased bone loss due to periodontitis by promoting the activity of resorbing cells.[49] In our study, significant differences in the periodontal status were observed in the patients with hypothyroidism.

A higher incidence of periodontitis was found in patients with hypertension and diabetes, which is consistent with the literature. Similarly, an increased prevalence of periodontal diseases is observed in the presence of any

systemic disease. Çalışır and Talmaç detected systemic diseases in 46.0% of patients with gingivitis and 63.0% of patients with periodontitis.[33] The association between hypertension, diabetes, CVD, smoking and periodontal diseases has been well documented for years.[15,50] Although systemic diseases were not considered in the diagnosis under the 1999 classification of periodontal diseases, they were included in the new classification as of 2017. This emphasizes the importance of taking into consideration systemic diseases in diagnosis and encourages physicians to conduct more comprehensive medical interviews. The relationship between systemic and periodontal diseases, and the distribution of periodontal diagnoses are shown in Table 2. The presented differences in disease distribution under the new classification warrant further investigation in future studies.

Limitations

Physicians learn about the presence of systemic diseases from the patient's medical history, which is based on the patient's statement. The presence of undiagnosed systemic diseases, the management of systemic diseases, the specific medications used, and the routes of their administration could all affect the results.

Therefore, the limitations of our study include self-reported medical data, the lack of patient medication records, and no evaluation of the relationship between socioeconomic factors and other confounding variables and periodontal diseases. More comprehensive studies should be carried out using a multidisciplinary approach, involving medical doctors, as well as the analysis of gingival crevicular fluid (GCF) and saliva, and blood tests.

Conclusions

Current patient-oriented epidemiological approaches are important to understanding the status, distribution, risk factors, and treatment of periodontal diseases in the population. In comparison with the 1999 classification, the 2017 classification of periodontal diseases offers more comprehensive information for the diagnosis of periodontal diseases and should be used in current epidemiology studies, as it also aids in determining the treatment modality. Periodontitis is a public health problem in the Turkish population, with high incidence rates of mild to moderate periodontitis due to risk factors such as age, smoking and various systemic diseases. Given these risk factors, a multidisciplinary treatment approach is important. In addition, physicians should be aware of various risk factors that may exacerbate periodontal diseases and, therefore, take a comprehensive medical history. Early diagnosis enables the stabilization of periodontitis with minimal alveolar bone loss and facilitates the management of systemic diseases.

Ethics approval and consent to participate

The study adhered to the principles outlined in the Declaration of Helsinki adopted in 1975 (revised in 2013). The study protocol (No. 2022/08) was approved by the Clinical Research Ethics Committee at Niğde Ömer Halisdemir University, Turkey. Written informed consent was obtained from the patients for the study.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Use of AI and AI-assisted technologies

Not applicable.

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