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An overlooked connection: oral health status in patients with chronic diseases

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Abstract

Background Oral and systemic health are closely linked. Chronic diseases like diabetes mellitus, cardiovascular diseases, and hypertension increase the risk of dental caries, periodontal disease and tooth loss. Moreover, poor oral health can worsen the status of systemic diseases. Despite this, oral health is often overlooked in chronic disease management. This study aimed to evaluate the oral health status of patients with chronic diseases (PWCD) compared to healthy controls using DIMF-T and DMF-S indices.

Methods This retrospective study included 205 participants (106 PWCD and 99 healthy controls) attending the Oral Diagnosis & Radiology outpatient clinic at Bahçeşehir University Dental Hospital. Comprehensive intraoral and radiological examinations assessed caries lesions, missing teeth, filled teeth, periodontal disease, denture usage, and the prevalence of apical osteitis, soft tissue lesions, and intraosseous lesions. Oral health status was quantified using DIMF-T and DMF-S indices. Statistical analyses were conducted to identify differences between groups.

Results The study group (PWCD) exhibited significantly higher median values for missing teeth (MT), decayed surfaces (DS), missing surfaces (MS), DIMF-T, and DMF-S indices compared to the control group ($p < 0.001$). Chronic periodontitis was more prevalent in PWCD (76.42%) than in controls (45.45%), while gingivitis was more common in the control group (52.53%, $p < 0.001$). Medication use for systemic diseases was strongly associated with poor oral health outcomes ($p < 0.001$). However, no significant differences were observed between the groups for decayed teeth (DT), hopeless teeth (IT), or filled teeth (FT).

Conclusions PWCD demonstrated worse oral health outcomes compared to healthy controls, highlighting the need for integrated oral and systemic healthcare strategies. Dental professionals should be careful in identifying oral conditions that may signal underlying systemic diseases. Future research should explore the integration of oral health evaluations into routine medical screenings and examine the global practices of oral health management in PWCD.

Keywords Oral health, Chronic diseases, Periodontal disease, Dmf index, Dental caries, Diabetes mellitus

Background

Oral health and systemic health share a profound bidirectional relationship [1, 2]. Chronic diseases, such as diabetes mellitus, cardiovascular disease, and hypertension, can lead to significant oral health challenges, including periodontal disease and tooth loss [1, 3]. Moreover, specific oral conditions can serve as early indicators of systemic diseases, emphasizing the critical importance of oral health to overall health [3, 4].

Research has consistently highlighted the association between oral diseases and systemic conditions. For

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instance, periodontal disease has been linked to diabetes mellitus, metabolic syndrome, cardiovascular diseases, Alzheimer's disease, and adverse pregnancy outcomes. Aging, often accompanied by chronic conditions, further complicates oral disease management [3, 4]. This point warrants emphasis due to the growing demographic of the elderly population, which requires increased attention and tailored care from dental and healthcare professionals [4, 5].

Medications used to treat chronic diseases can contribute to enamel erosion, caries formation, and other oral complications [4, 5]. Despite these interconnections, oral health often remains overlooked in the context of chronic disease management. While previous studies have largely focused on specific aspects such as caries prevalence [6–8], oral manifestations of specific medications and conditions [9–12], or the close relationship between diabetes mellitus and periodontitis [2, 4, 10, 13–16], limited evidence exists on the broader impact of systemic diseases on oral health. Specifically, the influence of these conditions on parameters beyond caries prevalence, missing teeth and filled teeth [17, 18]; such as denture usage, oral mucosal lesions, apical osteitis, and other intraosseous lesions, remained unexplored. This study provides a comprehensive clinical and radiological evaluation, integrating these parameters to offer a holistic understanding of oral health in patients with chronic diseases (PWCD). By addressing these overlooked aspects, this study aims to highlight the connection between oral and systemic health. The hypothesis of this study is that PWCD exhibit poorer oral health outcomes compared to healthy individuals, as measured by DIMF-T and DMF-S indices.

Methods

The aim of this study was to evaluate the oral health status of PWCD compared to a healthy control group, using clinical examinations, radiological assessments, and standardized oral health indices to investigate potential associations and differences.

Ethical approval

This study was conducted in accordance with ethical guidelines and received approval from the Kocaeli Health and Technology University, Non-invasive Clinical Research Ethics Committee (Project No: 2024–118). The study protocol was reviewed and approved by the Institutional Review Board, ensuring compliance with ethical standards. All procedures performed were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. All patient data were anonymized to maintain confidentiality. An informed consent form was obtained from all patients included in this study, granting permission for the use of their data in scientific research.

Patient selection

This study was conducted with the patients of the Oral Diagnosis & Radiology outpatient clinic in the Bahçeşehir University Dental Hospital. The chosen hospital is a tertiary dental healthcare center that serves a diverse patient population, including individuals with various chronic diseases, as well as healthy individuals. This made it an ideal setting for recruiting participants with the systemic and oral health characteristics required for this study. The hospital is equipped with advanced diagnostic tools, including radiographic imaging technologies, and has a dedicated Oral Diagnosis and Radiology outpatient clinic. These resources were essential for the clinical and radiological evaluations performed in the study. For patient selection, a detailed medical history was obtained from all participants, including information on smoking and alcohol consumption and daily medicine usage. Additionally, medical history and records of the patients were reviewed and confirmed through the E-Nabız platform (a comprehensive online system provided by Turkish government that allows Turkish citizens and healthcare professionals to access patients' medical history, including previous diagnoses, blood test results, prescriptions, radiological images, and other relevant information). For the PWCD group, only patients with a diagnosis of chronic disease made at least one year prior to the study were included to ensure chronicity and stability of the condition. This process ensured that the systemic conditions evaluated were not acute or newly diagnosed. The study included a total of 205 participants, divided into two groups: the study group (PWCD) and the control group. The study group consisted of PWCD ($n=106$), including conditions such as hypertension, arrhythmia, hyperlipidemia, chronic thyroiditis, asthma, chronic obstructive pulmonary disease, diabetes mellitus type 2, chronic hepatitis, and chronic kidney disease. A control group of healthy individuals ($n=99$) was also included for comparative analysis.

Clinical and radiological evaluation

All clinical and radiological evaluations were performed by a single Oral and Maxillofacial Radiology specialist with over 9 years of experience. The examiner followed a standardized protocol to ensure uniformity and reliability in data collection. This protocol included defined criteria for assessing clinical parameters and radiological findings.

Comprehensive intraoral and radiological examinations were performed to assess the following parameters:

- Oral Health Assessment Indices

Teeth were assessed under adequate lighting using a mouth mirror. Each tooth was carefully examined for the presence of carious lesions, restorations, and structural integrity. *Decayed teeth:* Teeth with visible carious lesions or those with soft, demineralized enamel or dentin upon probing were recorded as decayed. *Hopeless Teeth (I):* Teeth with severe mobility, extensive caries rendering the tooth unrestorable, or advanced periodontal disease with clinical attachment loss > 6 mm were classified as hopeless. *Missing Teeth (M):* Teeth that were absent due to extraction or other causes (e.g., trauma) were recorded as missing. Third molars were excluded unless they had been replaced with a prosthesis. *Filled Teeth (F):* Teeth with restorations (amalgam, composite, crowns) were recorded as filled. Restorations were inspected for integrity and recurrent decay. *DIMF-T:* The DIMF-T score for each patient was calculated as the total number of decayed, hopeless, missing, and filled teeth.

The DMF-S index was used to evaluate the number of decayed, missing, and filled tooth surfaces. The following steps were applied:

Tooth Surface Examination: Each tooth was divided into five surfaces: buccal, lingual, mesial, distal, and occlusal (for posterior teeth). For anterior teeth, the labial surface was included instead of buccal. All surfaces were inspected for caries, restorations, and missing sections using the same tools as above. *Decayed Surfaces (D):* Surfaces with cavitated carious lesions or soft tissue upon probing were marked as decayed surfaces. Incipient lesions without cavitation were excluded. *Missing Surfaces (M):* For missing teeth, the total number of tooth surfaces for each missing tooth (five) was added to the missing surface count. *Filled Surfaces (F):* Surfaces with restorations, including partial or full crowns, were counted as filled surfaces.

DMF-S: The DMF-S score was calculated as the sum of all decayed, missing, and filled surfaces.

In cases of uncertainty, radiographic imaging was used to confirm the presence of caries or restorations.

These indices were used for a detailed and standardized evaluation of oral health across both the study and control groups. The presence of caries lesions, missing teeth, and filled teeth was evaluated using the DIMF-T and DMF-S index based on the criteria outlined by the World Health Organization (WHO) [19].

- Evaluation of periodontal health status: The periodontal status of participants was classified into four categories: Healthy, Gingivitis, Periodontitis, and Edentulous. Clinical examinations and panoramic radiographs were used for the classification. All assessments followed standardized protocols to ensure consistency and accuracy.

Healthy: Participants were classified as healthy if clinical examinations revealed no signs of gingival inflammation, bleeding on probing (BOP) or periodontal pocket formation. Radiological evaluation confirmed bone loss of ≤ 2 mm relative to the cemento-enamel junction (CEJ).

Gingivitis: Gingivitis was diagnosed based on clinical signs of gingival inflammation, including redness, swelling, and BOP, without evidence of attachment loss or radiographic bone loss. The Gingival Index (GI) was used to evaluate the presence and severity of gingival inflammation. A periodontal probe was gently inserted into the gingival sulcus to assess the following criteria:

a *Visual Examination:* Signs of redness, swelling, and changes in gingival contour and texture were recorded.
b *BOP:* A gentle stroke along the gingival margin was performed with the probe, and bleeding occurrence was noted.
c *Scoring:* Each gingival unit (facial, mesial, distal, and lingual) was scored as: 1 = Mild inflammation with slight color change and no BOP, 2 = Moderate inflammation with redness, swelling, and BOP, 3 = Severe inflammation with marked redness, swelling, ulceration, and spontaneous bleeding. The overall GI score was calculated as the average of all scores per patient.

Periodontitis: Periodontitis classification adhered to the 2018 classification of periodontal diseases as recommended in the clinical practice guideline for the treatment of periodontitis stages I-III. The diagnosis included clinical attachment loss of ≥ 3 mm at two or more non-adjacent teeth, periodontal pocket depth (PD) of ≥ 4 mm, and radiological evidence of alveolar bone loss extending beyond 2 mm from the CEJ [20, 21] using these criteria:

a *PD:* A periodontal probe was used to measure the depth of the periodontal pocket from the gingival margin to the base of the pocket. PD ≥ 4 mm in two or more non-adjacent teeth was considered as a sign of periodontitis.
b *Clinical attachment loss:* This was calculated by measuring the distance from the CEJ to the base of the periodontal pocket. Clinical attachment loss ≥ 3 mm in two or more non-adjacent teeth was used as a diagnostic criteria.
c *Radiographic evaluation:* Panoramic radiographs were examined for alveolar bone loss. Periodontitis was diagnosed if the bone loss extended > 2 mm from the CEJ in two or more non-adjacent teeth.

Edentulous: Individuals were classified as edentulous if all teeth were missing and no residual root fragments or alveolar bone supporting teeth were detected on radiographs.

- Denture usage and type of dentures: Denture usage among participants was classified into four categories: None, Removable, Fixed, and Implant-Supported Prosthesis [22]. Clinical examinations were conducted to evaluate the type and condition of prosthetic devices, while panoramic radiographs were used to confirm the presence and anatomical placement of prostheses.
- Prevalence of apical osteitis: The presence of apical osteitis was assessed through the examination of panoramic radiographs obtained for all study participants. Radiographic evaluations were conducted by an experienced Oral and Maxillofacial Radiology specialist following a standardized protocol. The radiographs were carefully analyzed to identify periapical radiolucencies consistent with periapical rarefying osteitis. Apical osteitis was diagnosed based on radiographic evidence of periapical radiolucencies extending beyond the lamina dura, indicating an inflammatory response in the periapical tissues. The diagnosis criteria followed established endodontic guidelines for periapical status assessment [23, 24].
- Presence of soft tissue lesions and intraosseous lesions: The presence of soft tissue lesions and intraosseous lesions was assessed through clinical examination and panoramic radiography. Diagnoses were classified based on the guidelines provided in the WHO Collaborating Centre for Oral Cancer consensus report and the 5th edition of the WHO Classification of Odontogenic Lesions [25, 26].

Statistical analysis

The data were analyzed using IBM SPSS V23. A priori power analysis was conducted to ensure the sample size was adequate for detecting significant differences between the groups. The analysis assumed equal standard deviations (σ) for both groups and was based on a medium effect size (Cohen's d = 0.5), a significance level (α) of 0.05, and a two-tailed test. The calculated power of the test was 0.911. Additionally, an F-test was performed to confirm the equality of variances assumption between the groups, with no significant difference observed ($p = 0.824$). This analysis confirmed the adequacy of this study's sample size for reliable statistical comparisons. The normality of the distribution was evaluated with the Shapiro–Wilk and Kolmogorov–Smirnov tests to ensure robustness in determining normality. For the comparison of categorical variables between groups, Chi-square test, Yates correction, and Fisher's Exact test were used. The Mann–Whitney U test was applied for the comparison of non-normally distributed data between two groups. For the comparison of non-normally distributed data among three or more groups, the Kruskal–Wallis test was used, and multiple comparisons were analyzed with the Dunn test. Correlations between non-normally distributed variables were examined using Spearman's rho correlation coefficient. Analysis results were presented as mean ± standard deviation for quantitative variables, and as frequency (percentage) for categorical variables. A significance level of $p < 0.050$ was considered statistically significant.

Results

A total of 205 patients were included in the study, comprising 96 males (46.8%) and 109 females (53.2%). The age of the participants ranged from 16 to 84 years, with a mean age of 43.01 years. The participants were divided into two groups: 106 PWCD and 99 healthy controls. In PWCD, 38 patients with cardiovascular diseases, 32 patients with diabetes mellitus, 18 patients with chronic respiratory tract diseases, 11 patients with hypothyroidism, 8 patients with hyperthyroidism, 7 with chronic kidney disease, 5 with chronic hepatitis and 9 with hyperlipidemia were included. In the PWCD group, 60.38% of the participants were female, while 39.62% were male. In the control group, 45.45% of the participants were female, and 54.55% were male (Table 1).

Systemic diseases were significantly associated with periodontal status ($p < 0.001$). Periodontitis was more prevalent in the PWCD (76.42%) compared to the control group (45.45%), while gingivitis was more common in the control group (52.53%). Denture use was significantly higher among the PWCD (57.55%) compared to the control group (35.35%, $p = 0.013$). There was no significant difference between PWCD and control group in terms of dental caries ($p = 0.308$), apical osteitis ($p = 0.166$), soft tissue lesions ($p = 0.355$), or intraosseous lesions ($p = 1.000$) (Table 2).

The DIMF-T index was significantly higher in the PWCD compared to the control group ($p < 0.001$). Although the number of DT was higher in the PWCD, this difference did not reveal a statistical significance ($p = 0.068$). Both groups had comparable numbers of IT ($p = 0.566$) and FT ($p = 0.873$). The number of MT was significantly greater in the PWCD than in the control group $p < 0.001$. Similar to DIMF-T, the DMF-S index was markedly higher in the PWCD compared to the control group ($p < 0.001$). A significant difference was observed in the number of DS ($p = 0.043$) and MS ($p < 0.001$) which were higher in the PWCD, whereas the number of FS

Table 1 Demographic characteristics, addictive behaviors, medication usage, and prevalence of common oral health problems in the control and patients with chronic diseases groups

		PWCD (*n*: 106)	Control Group (*n*: 99)
Age, years (Mean ± SD)		48.95 ± 16.53	36.66 ± 12.93
Female, n (%)		64 (60.38)	45 (45.45)
Smoking, n (%)		36 (33.96)	35 (35.35)
Alcohol, n (%)		22 (20.75)	18 (18.18)
Medication, n (%)		99 (93.40)	0 (0.00)
Gingivitis, n (%)		18 (16.98)	52 (52.53)
Periodontitis, n (%)		81(76.42)	45 (45.45)
Edentulous, n (%)		7 (6.60)	1 (1.01)
Caries, n (%)		97 (91.51)	95 (95.96)
Apikal Osteitis, n (%)		29 (27.36)	36 (36.36)
Intraosseous Lesion, n (%)		3 (2.83)	2 (2.02)
Soft Tissue Lesion, n (%)		1 (0.94)	3 (3.03)
Denture, n (%)		61 (57.55)	35 (35.35)
Systemic Disease	Cardiovascular diseases	38 (29.69)	0 (0.00)
	Diabetes mellitus	32 (25.00)	0 (0.00)
	Chonic respiratory tract diseases	18 (14.06)	0 (0.00)
	Chronic thyroiditis	19 (14.84)	0 (0.00)
	Chronic kidney disease	7 (5.47)	0 (0.00)
	Hepatitis & Hyperlipidemia	14 (10.94)	0 (0.00)

SD Standard deviation, *PWCD* Patients with chronic diseases group

Table 2 The comparison of the common oral health problems in the patients with chronic diseases and control group

		PWCD *n* (%)	Control Group *n* (%)	
Periodontal Condition	Healthy	0 (0.00)	1 (1.01)	**< 0.001**[a]
	Gingivitis	18 (16.98)	52 (52.53)	
	Periodontitis	81 (76.42)	45 (45.45)	
	Edentulous	7 (6.60)	1 (1.01)	
Denture	None	45 (42.45)	64 (64.65)	**0.013**[a]
	Removable	15 (14.15)	7 (7.07)	
	Fixed	31 (29.25)	21 (21.21)	
	Implant-supported Prosthesis	15 (14.15)	7 (7.07)	
Apikal Osteitis	None	77 (72.64)	63 (63.64)	0.166[a]
	Present	29 (27.36)	36 (36.36)	
Soft Tissue Lesion	None	105 (99.06)	96 (96.97)	0.355[c]
	Present	1 (0.94)	3 (3.03)	
Intraosseous Lesion	None	103 (97.17)	97 (97.98)	1.000[c]
	Present	3 (2.83)	2 (2.02)	
Caries	None	9 (8.49)	4 (4.04)	0.308[b]
	Present	97 (91.51)	95 (95.96)	

PWCD Patients with chronic diseases

[a] Pearson's chi square test

[b] Yates correction

[c] Fisher's Exact test

Table 3 The comparison of the parameters of oral health status of the patients with chronic diseases and the control group

	PWCD (Mean ± SD)	Control group (Mean ± SD)	*p*
Age	48.95 ± 16.53	36.66 ± 12.93	**< 0.001**
Decayed Teeth (DT)	3.26 ± 2.98	2.42 ± 2.20	0.068
Hopeless Teeth (IT)	0.26 ± 0.73	0.14 ± 0.38	0.566
Missing Teeth (MT)	8.74 ± 8.54	3.69 ± 5.42	**< 0.001**
Filled Teeth (FT)	4.65 ± 4.20	4.47 ± 4.10	0.873
Decayed Surfaces (DS)	5.50 ± 6.09	3.72 ± 4.10	**0.043**
Missing Surfaces (MS)	40.93 ± 38.93	17.74 ± 25.66	**< 0.001**
Filled Surfaces (FS)	16.49 ± 18.05	13.06 ± 15.81	0.285
DIMF-T	16.92 ± 7.66	10.73 ± 7.09	**< 0.001**
DMF-S	62.92 ± 41.44	34.52 ± 34.68	**< 0.001**

DIMF-T Decayed, hopeless, missing, filling teeth, *DMF-S* Decayed, missing, filling surface, *PWCD* Patients with chronic diseases, *SD* Standard deviation

* Mann Whitney U test, Values with bold indicate statistically significant correlations

Table 4 The comparison of DIMFT and DMFS indices according to gender

	Female Mean ± SD	Male Mean ± SD	*p*
DT	2.69 ± 2.67	3.05 ± 2.65	0,209
IT	0.26 ± 0.73	0.15 ± 0.38	0,685
MT	7.32 ± 8.48	5.14 ± 6.36	0,068
FT	4.94 ± 3.96	4.15 ± 4.31	0,069
DS	4.27 ± 5.16	5.06 ± 5.42	0,107
MS	35.00 ± 39.33	23.75 ± 28.61	**0,045***
FS	15.91 ± 16.01	13.61 ± 18.16	0,078
DIMFT	15.20 ± 8.05	12.48 ± 7.72	**0,017***
DMFS	55.17 ± 42.68	42.43 ± 37.63	**0,024***

SD Standard deviation

* Pearson's chi square test, Values with bold indicate statistically significant correlations

showed no significant difference between the groups ($p = 0.285$) (Table 3).

Significant differences were observed between the groups for MT ($p < 0.001$), DS ($p = 0.004$), and MS ($p < 0.001$), with higher values in the PWCD group. However, no significant differences were noted for DT ($p = 0.068$), IT, FT, and FS ($p > 0.05$) (Table 3). The DIMF-T index was significantly higher in females compared to males ($p = 0.017$). Similarly, the DMF-S index was significantly higher in females than in males ($p = 0.024$) (Table 4). The DIMF-T (PWCD mean: 16.99 ± 7.53; control group: 10.73 ± 7.09) and DMF-S (PWCD mean: 63.05 ± 41.35; control group: 34.52 ± 34.68) indexes were found to be higher in the individuals using medications ($p < 0.001$).

The smoking and alcohol consumption statuses of participants were analyzed to evaluate their potential impact as predisposing factors. The results showed no statistically significant differences between the study and control groups for either smoking ($p = 0.834$) or alcohol consumption ($p = 0.773$). Both smoking and alcohol consumption were similar between groups, reducing the likelihood of bias from these predisposing factors.

Discussion

The findings of the present study support the hypothesis that chronic diseases are linked to poor oral health outcomes. Chronic systemic diseases were significantly associated with periodontal disease, missing teeth, and denture usage, and were correlated with higher mean DIMF-T and DMF-S indices compared to the control group. While the prevalence of tooth decay and the number of decayed teeth were similar between groups, the PWCD group showed higher numbers of decayed and missing surfaces. This suggests that although the occurrence of caries may not differ, the severity of caries is elevated in individuals with chronic diseases. Additionally, no significant differences were observed in the number of teeth or surfaces restored with fillings. This lack of difference, along with the similar prevalence of hopeless teeth, may reflect comparable attitudes toward dental treatments and similar access to dental care between healthy individuals and those with chronic diseases.

Research has highlighted differences between male and female patients in dental caries, with females typically exhibiting higher prevalence and severity. Studies utilizing the DMFT and DMFS indexes have found significantly higher scores in females [6, 7]. Although the precise reasons for these disparity remain unclear, genetic factors, hormones, and changes in saliva have been suggested as contributing factors [6, 8]. In line with this, the present study observed significant differences between male and female patients in oral health conditions, with females showing higher mean values for MS, DIMF-T, and DMF-S indices compared to males. These findings align with the existing literature and further support the potential role of gender-related factors in oral health.

The management of systemic diseases can also influence changes in oral health. The well-established findings from studies showing that many medications—including, but not limited to, antidiabetic, antihypertensive, and antipsychotic drugs—are associated with reduced salivary flow and function [9–12]. In the current study, 93.4% of PWCD were found to be using medications. Patients on daily medication exhibited higher mean DIMF-T and DMF-S scores compared to those not taking medications.

It is essential to understand that oral health plays a pivotal role in systemic well-being. The oral cavity reflects and impacts general health, making it impossible to maintain overall wellness without proper oral care [13]. It has been shown that minimizing oral inflammation caused by periodontal infections also reduce systemic inflammation [27]. Many studies in the literature focused and evaluated the connection between the periodontal health, inflammation and the systemic diseases. Periodontitis has been linked to a range of systemic conditions, including diabetes mellitus, cardiovascular diseases, respiratory infections and kidney diseases [28, 29]. Diabetes mellitus, one of the most common chronic conditions seen in dental practice, has been linked to an increased risk of oral health issues, particularly periodontal disease [14–16, 30]. A recent systematic review indicated with moderate certainty that patients with DM have higher DMF scores [17]. Additionally, a meta-analysis found that children with poor glycemic control are at greater risk for developing caries compared to those with better control and non-diabetic children [31]. These findings highlight the critical need for integrated care approaches, addressing both glycemic control and oral health to reduce the risk of complications in diabetic patients. According to the results of this present study, it was revealed that periodontitis was significantly more prevalent among PWCD compared to healthy controls. The systemic inflammatory burden associated with systemic conditions likely exacerbates periodontal inflammation, contributing to a heightened prevalence of periodontitis in PWCD. By addressing shared risk factors, such as smoking and poor oral hygiene, dental and medical professionals can collaboratively mitigate the overall health risks in patients with chronic diseases [10, 13, 14]

Previous research has consistently shown that various systemic diseases are associated with higher caries experience and elevated DMFT indexes [17, 18, 32, 33]. For instance, patients with Crohn's disease and ulcerative colitis exhibited higher DMFT scores and a greater prevalence of periodontitis compared to healthy controls [18]. Similarly, conditions such as asthma and epilepsy have been linked to increased caries lesions [34]. Further studies have found that diseases like hepatitis, high blood pressure, stroke, liver disease, and diabetes mellitus correlate with elevated caries experience [35]. In a broader study involving patients with various systemic conditions—including cardiovascular disorders, diabetes mellitus with cardiovascular complications, hypertension, renal disease, and gastrointestinal issues—significant associations were found between age, gender, the number of missing teeth, and both DMFT and DMFS scores [36].

These results are colloborated by the current study, which shows that people with systemic disorders had comparable tendencies of higher DMFT scores and increased caries risk. This is consistent with the increasing amount of data indicating that oral health outcomes are significantly influenced by the systemic health. Given that dental health may be a significant predictor of overall health, these findings highlight the necessity of treating patients with chronic illnesses holistically. This emphasizes how important dental professionals are in fostering general health, which may reduce the likelihood of developing a number of systemic diseases.

The connections between oral health, overall well-being, and general health are crucial and deserve attention. Embracing health-promoting practices, such as improving oral health literacy and following oral hygiene guidance, can significantly reduce the prevalence of most oral diseases. Additionally, it is important to recognize that oral diseases have shown to share common risk factors with cardiovascular disease, cancer, chronic respiratory disease, and diabetes mellitus [13]. Integrated oral and systemic health care is essential, particularly for individuals with chronic health conditions. Collecting national data on the prevalence of dental diseases among those with specific chronic conditions could play a pivotal role in promoting healthier behaviors and practices, ultimately improving oral health outcomes. Evidence shows that individuals with rheumatoid arthritis, diabetes mellitus, or liver conditions are twice as likely to require urgent dental treatment compared to those without these conditions. Moreover, even after adjusting for common risk factors, conditions such as arthritis, cardiovascular disease, diabetes mellitus, emphysema, hepatitis C, obesity, and stroke remain significantly associated with dental diseases [37]. Incorporating routine oral health assessments into chronic disease management protocols could enhance care for these vulnerable groups, particularly elderly populations, who are more susceptible to both systemic and oral health issues.

The relationship between oral diseases and systemic conditions is well-established, yet whether this link is casual or causal remains unclear. Inflammation appears to be a shared mechanism, with periodontal disease contributing to systemic inflammation through pro-inflammatory mediators such as C-reactive protein (CRP), TNF-α, and IL-6, potentially exacerbating conditions like diabetes mellitus and cardiovascular diseases. Conversely, systemic diseases impact oral health via immunosuppression and delayed healing. Evidence supports a bidirectional relationship, with periodontal treatment improving glycemic control in patients with diabetes mellitus [38–40].

The limitations of this study should be considered. First, although the overall sample size was sufficient, subgroup analyses (e.g., by specific chronic diseases or

gender) might be underpowered, limiting the robustness of these findings. Second, the study group patients with various chronic diseases together, which might have obscured disease-specific effects on oral health. Further stratified analyses are needed to better understand the impact of specific conditions, such as diabetes mellitus or asthma. The study was conducted at a single dental hospital, which may limit the generalizability of the findings to other populations or healthcare settings. The study did not account for all potential confounding factors, such as socioeconomic status, dietary habits, oral hygiene practices, or access to dental care, which may influence oral health outcomes. In addition, a limitation of this study is that the severity of systemic conditions in the PWCD group was not assessed. While we included patients diagnosed with chronic diseases such as diabetes mellitus, cardiovascular diseases, and chronic respiratory disorders, the study did not evaluate specific markers or classifications to determine the severity of these conditions. This factor limits the ability of the study to explore potential correlations between the severity of systemic diseases and oral health parameters, such as DIMF-T and DMF-S indices or periodontal status. Future research should incorporate detailed assessments of systemic disease severity to provide a more comprehensive understanding of how oral health outcomes may vary based on the progression or control of chronic conditions. For instance, patients with uncontrolled diabetes mellitus, as indicated by elevated HbA1c levels, are reported to have higher risks of periodontitis and increased DMFT indices compared to those with well-controlled diabetes mellitus [38]. Similarly, individuals with advanced cardiovascular disease, such as those with reduced ejection fractions, often exhibit severe periodontal disease and higher rates of tooth loss [41]. Despite this limitation, the study provides robust evidence of worse oral health outcomes in PWCD compared to healthy controls, underscoring the importance of integrated oral and systemic healthcare strategies. Future studies addressing these limitations could provide a more comprehensive understanding of the interplay between systemic health and oral health, thereby contributing to improved interdisciplinary healthcare strategies.

In conclusion, DIMF-T and DMF-S indices had significantly higher values in PWCD. PWCD should visit dental healthcare centers more frequently. Dental professionals should be careful in identifying oral health issues that may signal underlying systemic conditions, while physicians should consider the impact of chronic diseases on oral health. The findings of this study raise critical questions that warrant further exploration to bridge the gap between oral and systemic healthcare. Future research should address various topics such as integrating oral health evaluations into routine medical screenings could facilitate early detection and management of oral conditions, particularly in PWCD. Comparative studies across different healthcare systems could provide insights into effective strategies and best practices for managing oral health in patients with chronic conditions. The role of family dentistry practices may improve oral health status of PWCD. Understanding how family dentistry can collaborate with medical professionals to deliver comprehensive care is vital for enhancing the quality of life for PWCD.

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Authors' contributions
MO: Contributed to conception, design and data acquision, drafted manuscript. EÇ: Contributed to desgin, analysis and interpretation, drafted manuscript. ÇBÖ: Contributed to conception, acquisition and interpretation, drafted manuscript. All authots critically revised the manuscript, gave their final approval and agree to be accountable for all aspects of the work.

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Data availability
The datasets analysed and the supplementary educational material used during the current study are not available. The data of the patients cannot be shared due to confidentiality and privacy concerns. All relevant data necessary to support the findings of this study are included in the manuscript. Additional data are not available for public access to ensure the protection of patient privacy and comply with ethical standards.

Declarations

Ethics approval and consent to participate
This retrospective study was granted ethical approval from the Kocaeli Health and Technology University, Non-invasive Clinical Research Ethics Committee (Project No: 2024–118). An informed consent form was obtained from all patients included in this study, granting permission for the use of their data in scientific research. All patient data were anonymized to maintain confidentiality. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent for publication
Consent forms were present from all participants that include the consent for the publication of the results after data anonymization for scientific purposes. Informed consent to publish these images and findings was obtained from all participants, ensuring compliance with ethical standards. All images and data presented in the manuscript are anonymized to protect the patients' identities.

Competing interests
The authors declare no competing interests.

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